



Q4 2019 Investor Conference

Feb 12th, 2020

Embedded wisely, Embedded widely

ememory

A hand is shown placing a coin on top of a stack of several other coins. To the left, another stack of coins has a small green plant with three leaves growing out of it. The background is a soft, out-of-focus green and yellow bokeh.

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A hand is shown dropping a coin into a stack of coins. To the left, another stack of coins has a small green plant with two leaves growing out of it. The background is a soft, out-of-focus green and yellow bokeh.

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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.

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A hand is shown dropping a coin into a stack of coins. A small green plant with three leaves is growing out of the stack. The background is a warm, golden-yellow color. The image is framed by a white, brush-stroke-like border on the right side.

Review of Operations

Q4 2019 Financial Results

The EPS of Q4 2019 was 1.74 NTD, ROE was 30.2%.

(thousands of NT dollars)

	Q4 2019 (Unaudited)	Q3 2019	Q4 2018	Change (QoQ)	Change (YoY)
Revenue	361,896	336,587	406,752	7.5%	-11.0%
Gross Margin	100%	100%	100%	-	-
Operating Expenses	202,386	197,399	222,532	2.5%	-9.1%
Operating Income	159,510	139,188	184,220	14.6%	-13.4%
Operating Margin	44.1%	41.4%	45.3%	2.7ppts	-1.2ppts
Net Income	129,653	120,170	163,611	7.9%	-20.8%
Net Margin	35.8%	35.7%	40.2%	0.1ppts	-4.4ppts
EPS (Unit: NTD)	1.74	1.62	2.20	7.4%	-20.9%
ROE	30.2%	29.1%	34.5%	1.1ppts	-4.3ppts

FY 2019 Financial Results

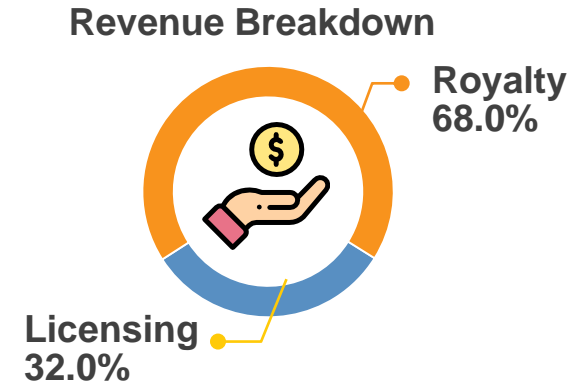
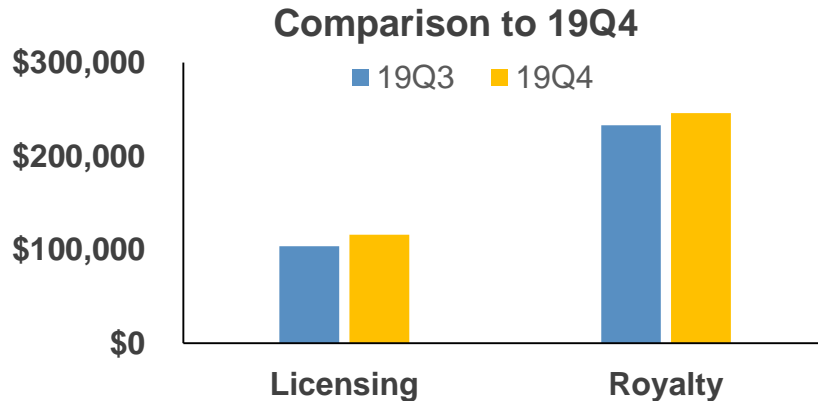
The EPS of 2019 was 7.30 NTD, ROE was 31.6%.

(thousands of NT dollars)

	FY 2019 (Unaudited)	FY 2018	Change (YoY)
Revenue	1,410,085	1,476,516	-4.5%
Gross Margin	100%	100%	-
Operating Expenses	788,762	803,781	-1.9%
Operating Income	621,323	672,735	-7.6%
Operating Margin	44.1%	45.6%	-1.5ppts
Net Income	542,072	613,106	-11.6%
Net Margin	38.4%	41.5%	-3.1ppts
EPS (Unit: NTD)	7.30	8.13	-10.2%
ROE	31.6%	32.3%	-0.7ppts

Revenue in Different Stream

Revenue up 7.5% QoQ but down 11.0% YoY.



Revenue

NT\$ Thousands	Q4 2019	Q3 2019	Q4 2018	QoQ	YoY	FY 2019	FY 2018	YoY
Licensing	115,944	103,689	124,726	11.8%	-7.0%	430,263	449,806	-4.3%
Royalty	245,952	232,898	282,026	5.6%	-12.8%	979,822	1,026,710	-4.6%
Total	361,896	336,587	406,752	7.5%	-11.0%	1,410,085	1,476,516	-4.5%

Q4 Revenue by Technology

The royalty of NeoFuse has a growth of 49% QoQ.

- ✓ The licensing revenue of NeoFuse increased 36.9% QoQ and 9.4% YoY. Its royalty revenue increased 49% QoQ and 15.8% YoY.
- ✓ The royalty revenue of NeoBit decreased 6.8% QoQ and 20.7% YoY. Its licensing revenue decreased 12.1% QoQ but increased 7.8% YoY.
- ✓ The licensing revenue of MTP (NeoEE+NeoMTP) decreased 27.7% QoQ and 56.8% YoY, because of less license case; while its royalty revenue increased 28.4% QoQ but decreased 17.6% YoY.

Technology	Q4 2019								
	Total Revenue			Licensing Revenue			Royalty Revenue		
	% of Q4 Revenue	Change (QoQ)	Change (YoY)	% of Q4 Licensing	Change (QoQ)	Change (YoY)	% of Q4 Royalty	Change (QoQ)	Change (YoY)
NeoBit	54.7%	-7.7%	-17.2%	27.5%	-12.1%	7.8%	67.6%	-6.8%	-20.7%
NeoFuse	37.5%	42.9%	12.6%	56.7%	36.9%	9.4%	28.4%	49.0%	15.8%
NeoPUF	1.0%	100.0%	34.8%	3.0%	100.0%	34.8%	0.0%	0.0%	0.0%
NeoEE	5.4%	7.4%	-26.8%	11.3%	11.6%	-17.6%	2.6%	-0.2%	-40.2%
NeoMTP	1.2%	-50.9%	-75.5%	0.8%	-88.6%	-94.7%	1.4%	179.0%	183.4%
PUFrt	0.2%	100.0%	100.0%	0.7%	100.0%	100.0%	0.0%	0.0%	0.0%

2019 Revenue by Technology

The royalty of NeoFuse has a growth of 50.7% YoY.

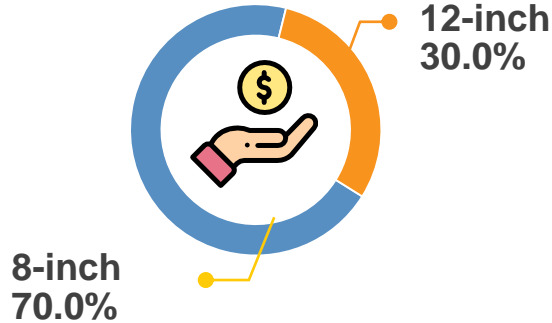
- ✓ The licensing revenue of NeoFuse increased 26.4% YoY. Its royalty revenue increased 50.7% YoY.
- ✓ The royalty revenue of NeoBit decreased 10% YoY. Its licensing revenue decreased 14.8% YoY.
- ✓ The licensing revenue of MTP (NeoEE+NeoMTP) decreased 44.8% and royalty decreased 43.3% YoY. The focus of MTP is in the collaboration with leading automotive manufacturers, and developing MRAM, ReRAM and AI memory.

Technology	2019					
	Total Revenue		Licensing Revenue		Royalty Revenue	
	% of Revenue	Change (YoY)	% of Licensing	Change (YoY)	% of Royalty	Change (YoY)
NeoBit	60.6%	-10.6%	26.9%	-14.8%	75.4%	-10.0%
NeoFuse	31.4%	36.2%	56.8%	26.4%	20.3%	50.7%
NeoPUF	0.3%	58.8%	1.0%	58.8%	0.0%	0.0%
NeoEE	5.8%	-33.7%	11.5%	-12.1%	3.3%	-51.9%
NeoMTP	1.8%	-63.3%	3.6%	-74.9%	1.0%	44.7%
PUFrt	0.1%	100.0%	0.2%	100.0%	0.0%	0.0%

Royalty Revenue by Wafer Size

12-inch wafer contributed to 30.0%.

Q4 Royalty Breakdown



- ✓ Royalty for 12-inch wafers contributed 30% of royalty, decreased by 4.2% sequentially and 20% YoY.
- ✓ The sequential decline is due to DDI customers inventory adjustment.

Royalty

Wafer Size	Q4 2019			FY 2019	
	% of Q4	Change (QoQ)	Change (YoY)	% of 2019	Change (YoY)
8-Inch	70.0%	10.4%	-9.3%	69.3%	-1.5%
12-Inch	30.0%	-4.2%	-20.0%	30.7%	-10.9%



Future Outlook

eMemory Embedded Everywhere

eMemory's IP seeks to penetrate across all the applications.

Core Tech



✓ **Product Applications:**

eMemory's IP are already applied into different scenarios, which includes PMIC, LCD driver, Sensors, RFID, OLED Driver, Connectivity IC, DTV, STB, SSD Controller, Bluetooth, TDDI, MCU, Fingerprint Sensor, Smart Meters, Surveillance, DRAM, embedded Flash and FPGA.

✓ **Future Target**

1. NeoFuse used in CIS and ISP
2. NeoPUF-based IP in Soc, processor, IoT related chip and embedded flash platform



✓ **The Future in Security Chip IP:**

The rapid growth in AIoT and 5G drive the demand for hardware security. OTP and PUF are indispensable for root of trust in hardware security.

✓ **PUF-based Security Solutions:**

To satisfy the market needs, eMemory developed a new series of PUF-based security solution, including PUFrt, PUFiot, PUFse and PUFflash.

Security

Our Perspectives

eMemory continue to create value for the industry and our shareholders.

Licensing & Royalty



- ✓ Licensing:
 - NeoFuse and NeoPUF will continue to grow due to increasing advanced technology platforms and more comprehensive PUF related IP portfolios.
- ✓ Royalty:
 - Royalty from DDI will increase due to higher penetration rate of OLED DDI by existing customers and new customers.
 - PMIC's royalty will grow as content increase in 5G and higher ASP is migrating into advance process node.
 - New applications ie. Multimedia, DTV, STB, surveillance, ISP, and DRAM will continue to grow our royalty in the coming years.

New Application & Technology Development



- ✓ For new applications:
 - NeoPUF was designed into leading customers for IoT application. PUFrt (NeoPUF-based root of trust) was adopted by customers for AI applications.
- ✓ For new development:
 - Developed 6nm and 5nm plus (N5P) technology with leading foundry partners.
 - Developed PUF into embedded flash platform. PUF-based IoT security solution, security elements and hardware security module IPs are under development.
 - Build PUF-based hardware security open IP platform, by integrating OTP, PUF, security-functioned IPs, and encryption algorithm IPs to provide total security solutions for AIoT and 5G applications.



Q&A



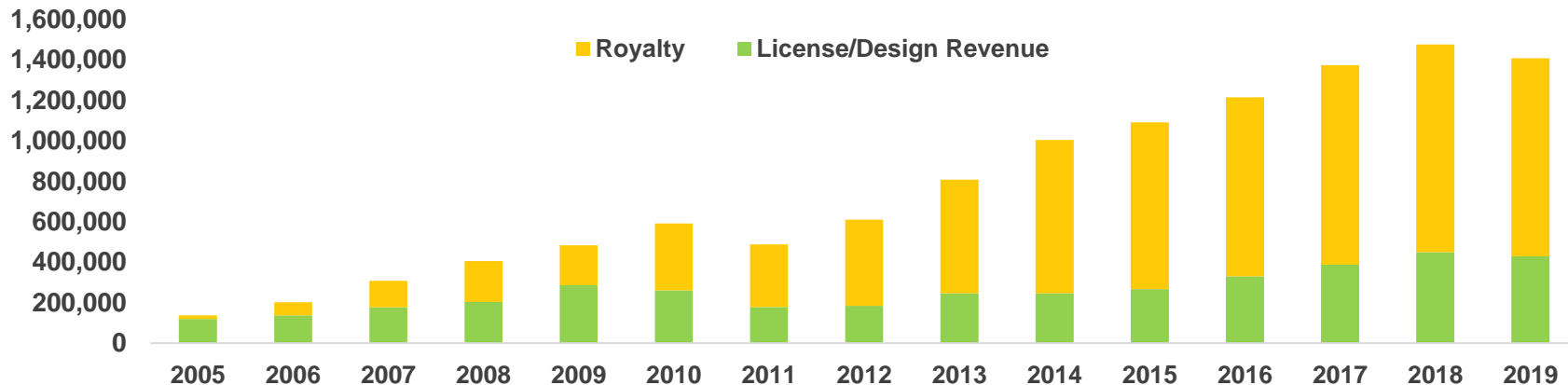
Appendix

Company Overview

eMemory is the global leader of embedded non-volatile memory IP.

Revenue Trend

(Unit: NT\$ 1,000)



**Founded
In 2000**

Based in Hsinchu, Taiwan.
IPO in 2011

**600+
Patents Issued**

256 pending patents. 267
employees with 70% R&D
personnel

**Best IP Partner
With TSMC**

TSMC Best IP Partner Award
since 2010.

Worldwide Customers

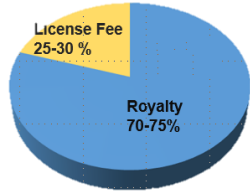
Our IP solutions are adopted by leading foundries, IDMs and fables worldwide.

	Foundry	IDM	Fabless
Taiwan	4	1	282
China	7	0	688
Korea	4	0	83
Japan	4	7	59
North America	1	1	278
Europe	2	1	137
Others	1	0	60



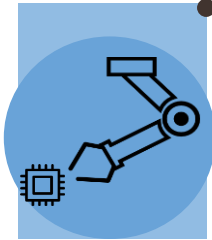
Business Model

Recurring royalty is the backbone of our business.



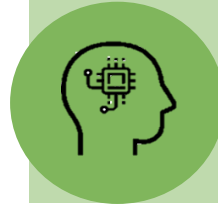
- ✓ 70-75% revenue are from royalty based on wafer production
- ✓ More adoption = more volume shipment
- ✓ More advanced node wafers = higher ASP per wafer

Revenue Breakdown



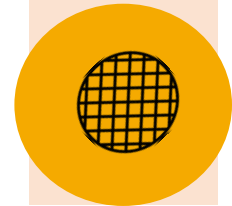
License Fee
Foundries Process
Development

2-3 years



Design License Fee
Fabless Product
Development

2-3 years



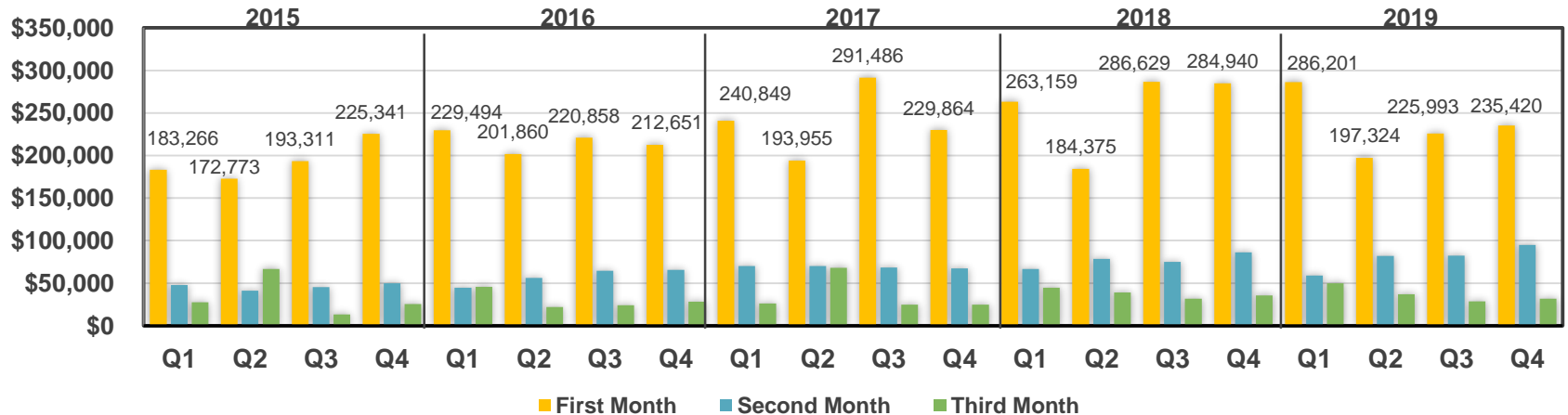
Royalty
Wafer Mass Production

Quarterly Revenue Pattern

eMemory's revenue are mostly received in the first month of the quarter.

- ✓ 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.
- ✓ Two foundries pay royalty semiannually, reported in Jan and July Revenue.

Thousands of NT dollars



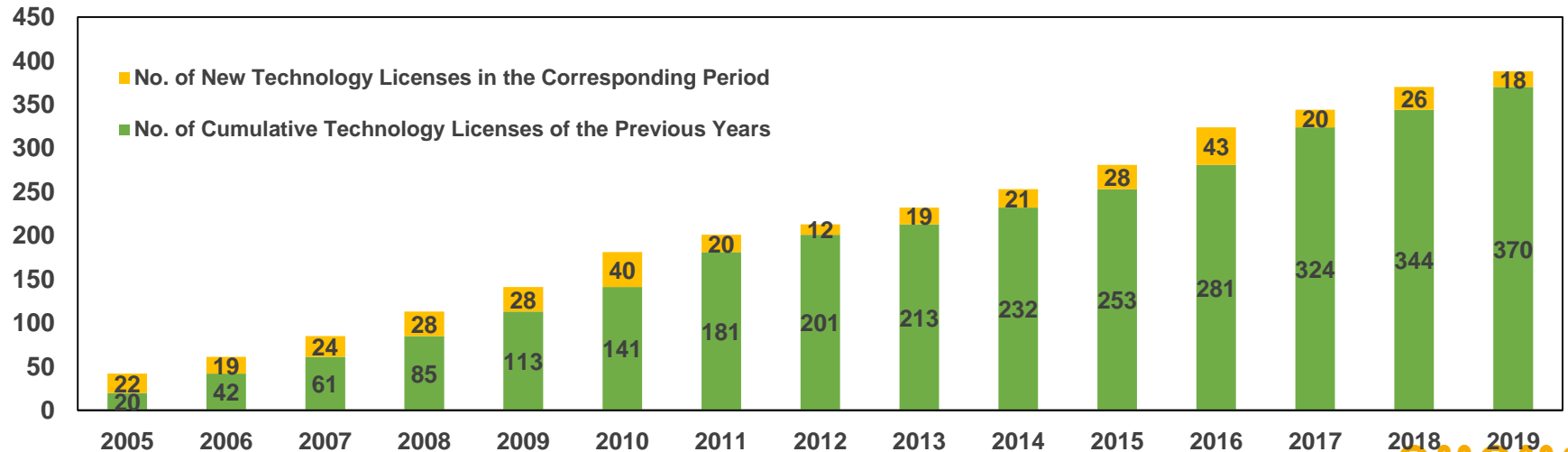
Technology Licenses

Cumulative technology licenses.

Number of Licenses

Year	2016	2017	2018	2019
License	43	20	26	18

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 Technology Under Development

Products in different process nodes.

- ✓ New technologies being developed for 95 platforms by Q4 2019.
- ✓ 7 licensing contracts were signed.

	5/6nm	7/10nm	12/16nm	28nm	40nm	55/65nm	80/90nm	0.11~ 0.13um	0.15~ 0.18um	>0.25um
NeoBit	-	-	-	-	-	1	2	9	10	2
NeoFuse	2	1	3	10	4	7	4	2	1	-
NeoPUF	1	-	-	4	3	1	-	-	-	-
NeoEE	-	-	-	-	-	-	2	3	7	-
NeoMTP	-	-	-	-	-	2	2	5	7	-

Note: As of Dec 31st, 2019

Technology Development

Developments by process nodes.

12" Fabs	Production	Development	IP Type		Process Type
5/6nm	0	3	OTP, PUF	FF	
7/10nm	2	1	OTP, PUF	FF, FF+	
12/16nm	3	3	OTP	FF, FF+	
28nm	23	14	OTP, PUF	LP/ULP/ULL, HPC/HPC+, HV-OLED, DRAM, SOI	
40nm	12	7	OTP, PUF, MTP	LP/ULP, E-Flash, HV-DDI/OLED	
55/65nm	23	11	OTP, PUF, MTP	LP/ULP, E-Flash, HV-DDI/OLED, DRAM, CIS, BCD, PM	
80/90nm	16	9	OTP, MTP	HV-DDI/OLED, LP, Generic, BCD	
0.13/0.11um	13	7	OTP, MTP	HV-DDI, BCD, Generic	
0.18um	1	2	OTP	BCD, Generic	
Total	93	57			

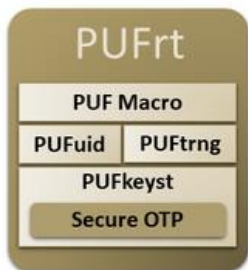
8" Fabs	Development	IP Type		Process Type
90nm	1	OTP	HV-DDI, LL, BCD	
0.13/0.11um	12	OTP, MTP, PUF	HV/HV-MR, BCD, LP/LL, CIS, Green, Flash, SOI, Generic	
0.18/0.16/0.152um	23	OTP, MTP	HV/HV-MR, BCD, LP/LL, CIS, Green, Generic	
0.25um	2	OTP	BCD	
0.35um	0	OTP	UHV	
Total	38			

Note: As of Dec 31st, 2019

PUF-based Hardware Security IP

NeoPUF provide the foundation for developing eMemory's security function IPs.

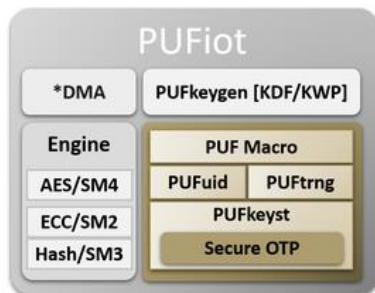
Standard Solution: PUFrt



Feature Highlights:

- ✓ Fast & low-power tRNG
- ✓ Reliable chip ID
- ✓ Advanced OTP read / write protection

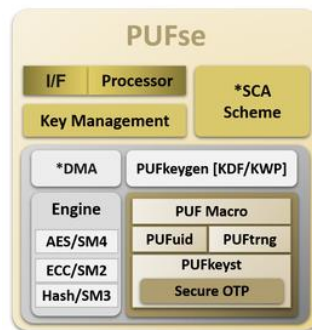
Premium Solution: PUFiot



Feature Highlights:

- ✓ PUFrt integrated
- ✓ OSCCA compliance
- ✓ KDF / KWP NIST compliance
- ✓ BUS & DMA support

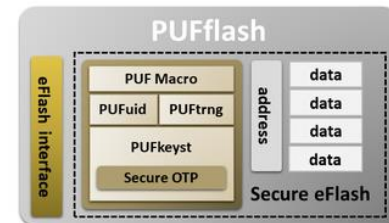
High-End Solution: PUFse



Feature Highlights:

- ✓ PUFiot integrated
- ✓ OTA support
- ✓ Secure boot
- ✓ Side channel attack resistant

Secure Embedded: PUFflash



Feature Highlights:

- ✓ Secure data storage
- ✓ No performance side-effect
- ✓ No extra integration burden

AIoT Demand is Growing

AIoT: AI embedded in IoT.

- ✓ AIoT, The Technological Revolution
 - ❖ Golden Era of IoT
 - ❖ Connected IoT devices are up to 26 billion in 2020 according to Gartner report

- ✓ AIoT Hardware Attack Surface
 - ❖ Data at Rest
 - Trained Model (Data poisoning on machine learning)
 - Parameters/Scenario Information
 - ❖ Data Integrity and IoT Authentication
 - Data Communication Network between Client and Server
 - Big Data and Information Integrity
 - ❖ Data During Transmission
 - PCIe Interface Offers High Throughput with AES-GCM Algorithm

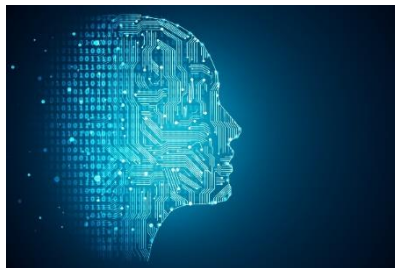
Wide Range Applications of PUF-based Security Solutions

IoT



With the growth of the IoT, PUF-based security can provide low power security functions to protect users' privacy.

Artificial Intelligence



AI applications include training and inference. Both are expensive and valuable intellectual property to protect by PUF-based security.

Automotive



In smart cars, PUF-based security can provide a robust root of trust to protect drivers from the malicious attacks.

Fintech



PUF-based inborn secret unique ID provide the trustworthy devices for fintech services, e.g. blockchain, transaction, etc.

IoT Security

IoT security has been considered by developed countries.

✓ In UK, Legislating for Security in Consumer IoT

<https://www.copperhorse.co.uk/legislating-for-security-in-consumer-iot/>

✓ In USA, California IoT security law

<https://www.helpnetsecurity.com/2019/11/20/california-iot-security-law/>

✓ In Japan, Building safeguards for reliable and affordable Internet of Things (IoT) environments

<https://www.ipa.go.jp/english/sec/iot/index.html>

PUF & PUF-based Security Solutions

PUF is random, robust & unique.

What is PUF?

- ✓ A physical unclonable function (PUF) is a physically-defined "**fingerprint**" that serves as a unique identity for a semiconductor device.
- ✓ PUFs depend on the uniqueness of the random physical factors introduced during manufacturing. These factors are unpredictable and uncontrollable.

The Feature of PUF



Random

PUFs depend on random physical factors introduced during manufacturing.



Robust

PUF's stability and reliable can be the ideal root of trust inside the chip.

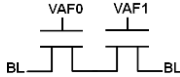
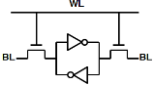


Unique

PUFs depend on the uniqueness of their physical microstructure.

NeoPUF vs SRAM PUF

NeoPUF is the ideal PUF.

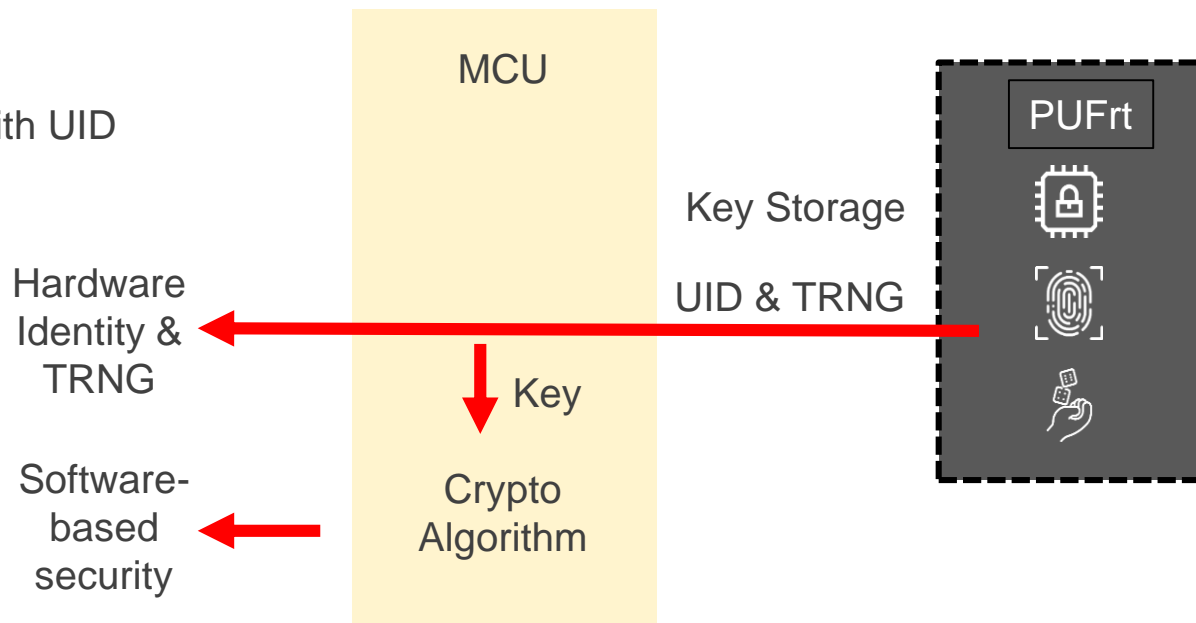
	Ideal PUF	NeoPUF	SRAM PUF
Unit Cell			
Inter- Hamming Distance	50%	50%	47%
Hamming Weight	0.5	0.5	0.62
Bit Error Rate	0%	0%	5.5% w/o ECC
Correction Methods & Area Impact	None	None	128kbit BCH-ECC 42k gates 256kbit BCH-ECC 56k gates
ECC Helper Data in NVM	None	None	>> 2kb , rely on repair info
SRAM Source	None	None	> 2kb
Operation Temperature	Any Temp	-40~125 °C	< 85°C
BCH Execution Code in NVM	None	None	>> 2kb
Powerful CPU	No need	No need	Yes , for performing BCH-ECC

PUFsecurity IP – PUFrt

PUFrt (PUF-based Root of Trust).

PUFrt Key Features:

- ✓ Secure Storage
- ✓ Fast TRNG
- ✓ In-born secret with UID access

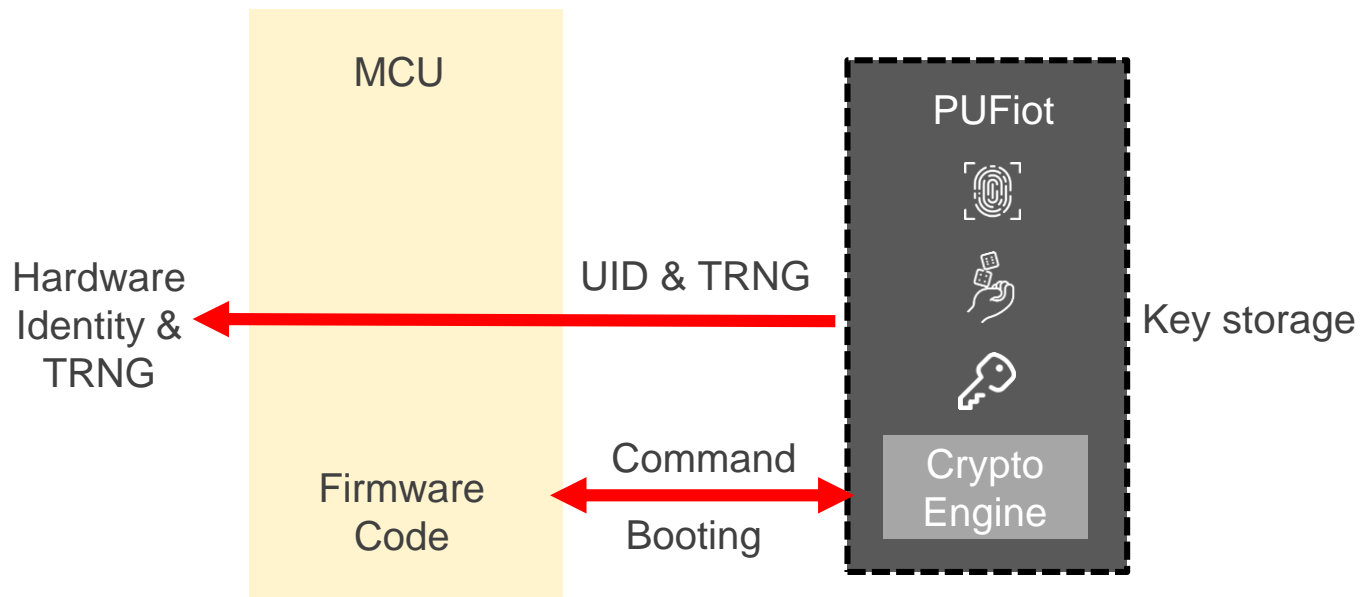


PUFsecurity IP – PUFiot

PUFiot (PUF-based Engine for IoT).

PUFiot Key Features:

- ✓ Suitable for IoT/AIoT application
- ✓ PUFrt inside
- ✓ Support DMA/KEK/KDF
- ✓ Support Bus Interface
- ✓ Support Firmware
- ✓ Support Standard Algorithms

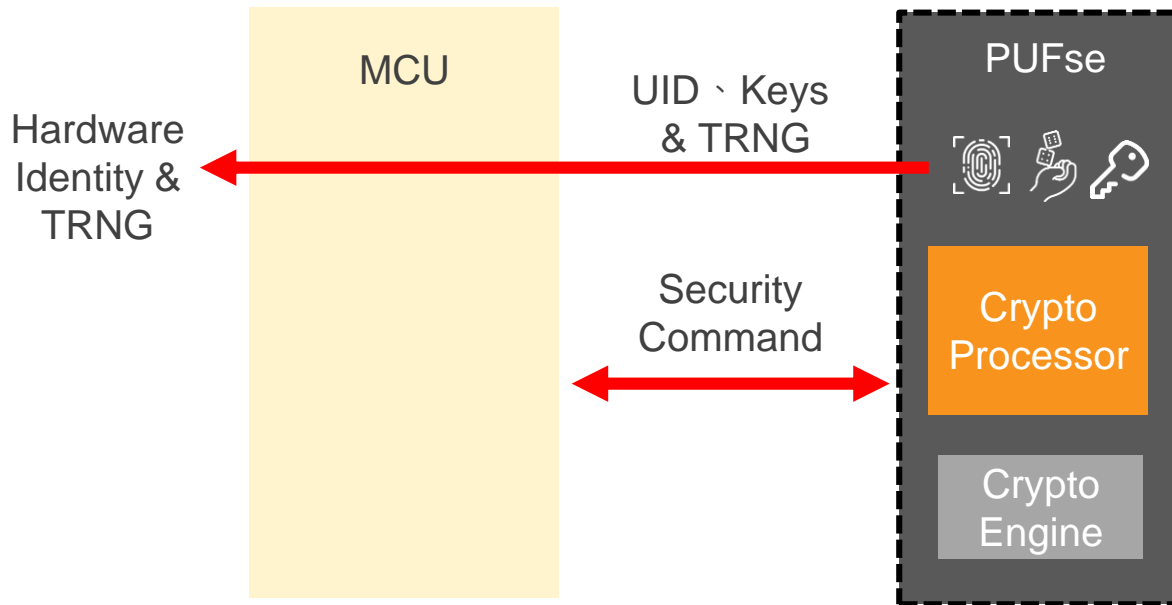


PUFsecurity IP – PUFse

PUFse (PUF-based Secure Element).

PUFse Key Features:

- ✓ Suitable for High-level Security
- ✓ PUFiot inside
- ✓ Support Key Management
- ✓ Support Software API & Driver
- ✓ Support Secure Boot

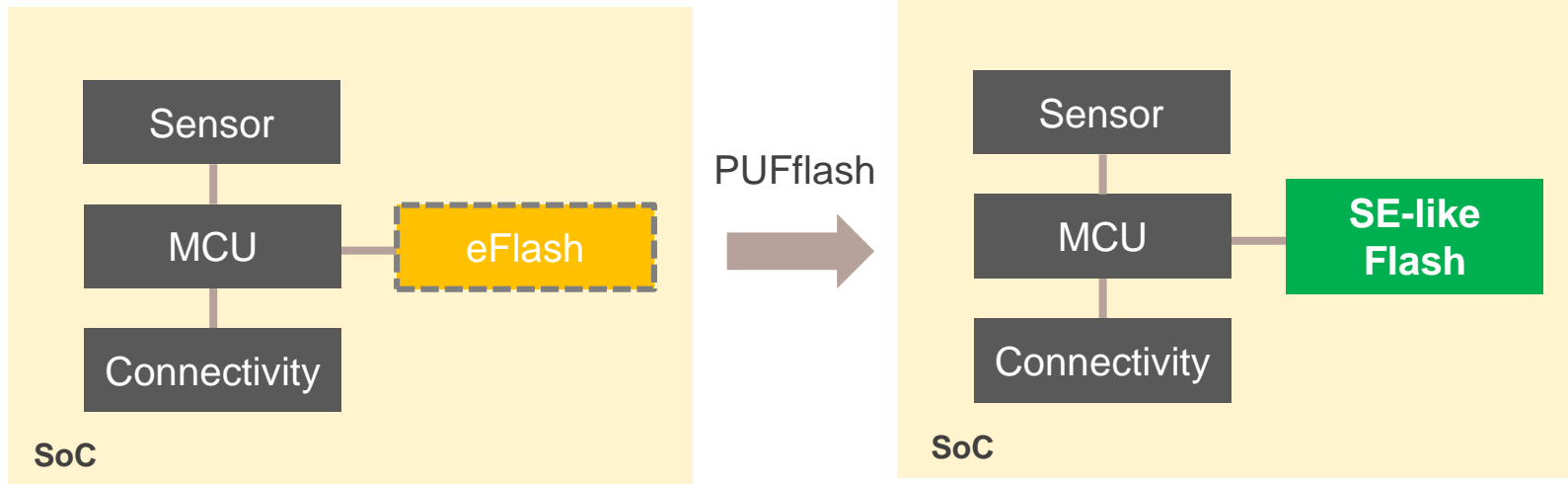


PUFsecurity IP – PUFflash

PUFflash (Secured Embedded Flash).

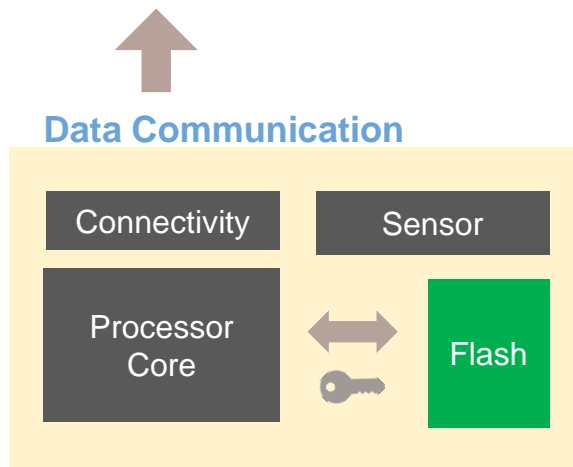
eFlash combines with PUFflash:

- ✓ Converting eFlash (pure storage) into Security-Element (SE) like security IP.
- ✓ Enhancing product security, what customer needs is only replacing eFlash by SE-like Flash

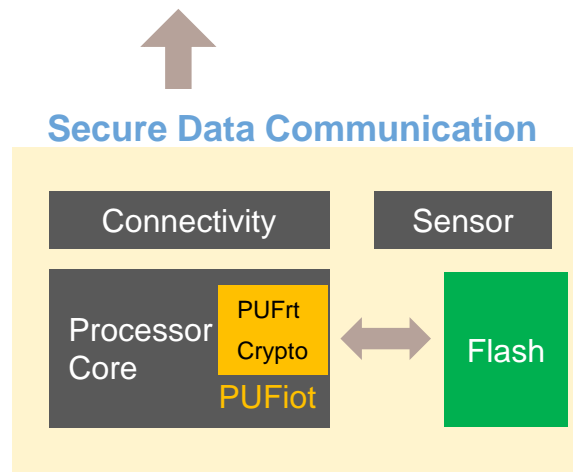


PUF-based Solution for AIoT

Edge Protection with Inborn Feature.



- ✓ Authentication and encryption by software- based cryptography
- ✓ Additional processor load and power consumption
- ✓ Potential key exposure

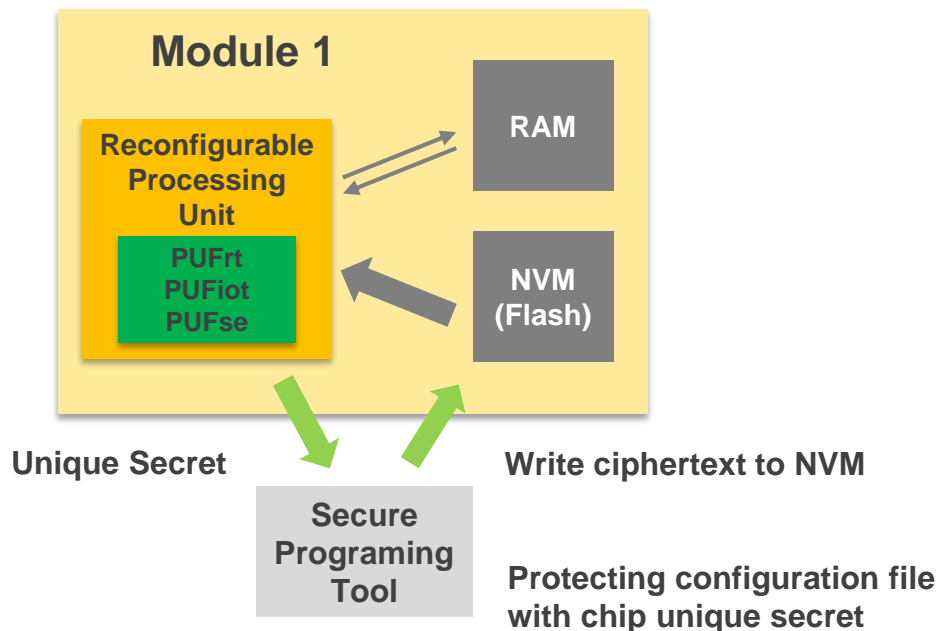


- ✓ PUF based hardware root of trust for protecting chip unique secret and know-how
- ✓ Unload processor computing
- ✓ High-efficient crypto operation without key exposure

PUF-based Solution for AIoT

Business Protection via Identified Module.

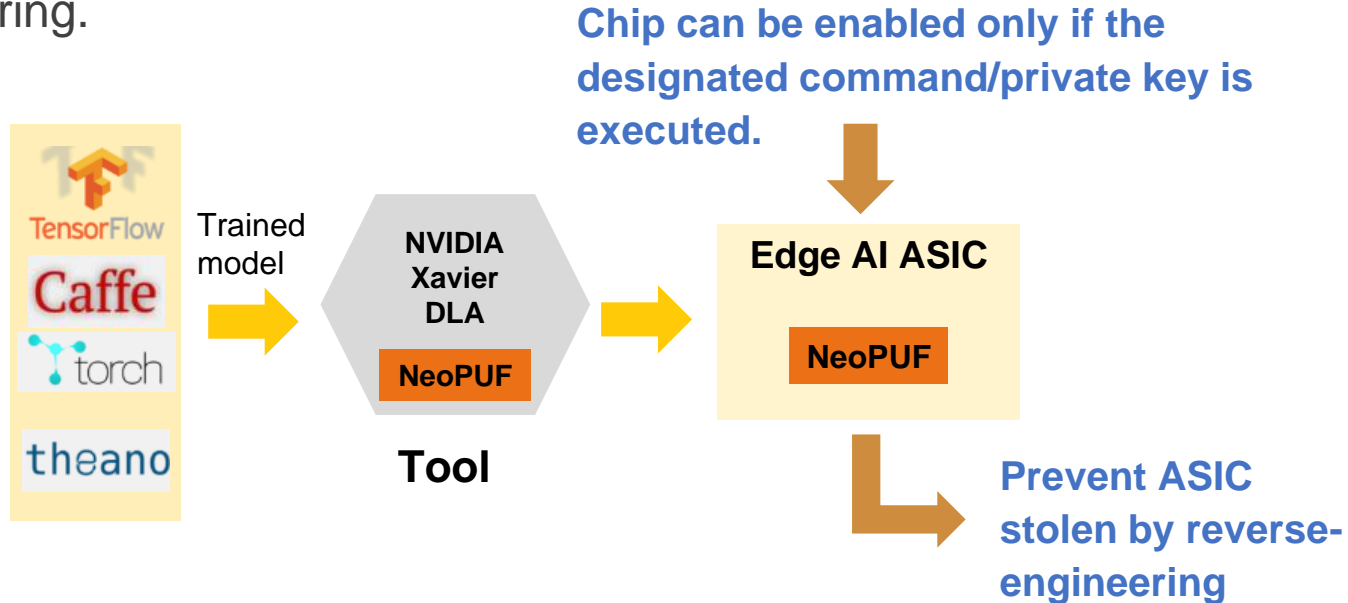
- ✓ Product know-how and biz are protected by inborn unique secret & identity from PUFrt



PUF-based Solution for AIoT

Protecting AIoT System from Counterfeits.

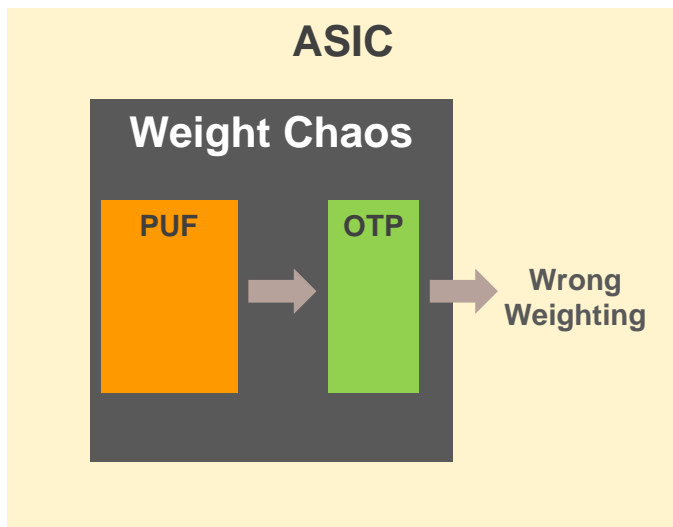
- ✓ Anti-Counterfeits with NeoPUF to prevent ASIC stolen by reverse-engineering.



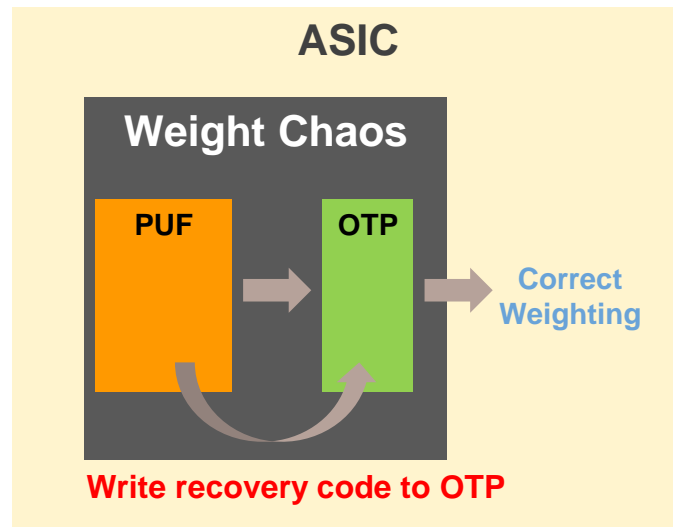
PUF-based Solution for AIoT

Simply Protect ASIC by using PUF.

- ✓ Weight Chaos with intrinsic recovery code from NeoPUF to protect ASIC
Design → Cloned ASIC chip cannot clone recovery code from NeoPUF



Before Enable

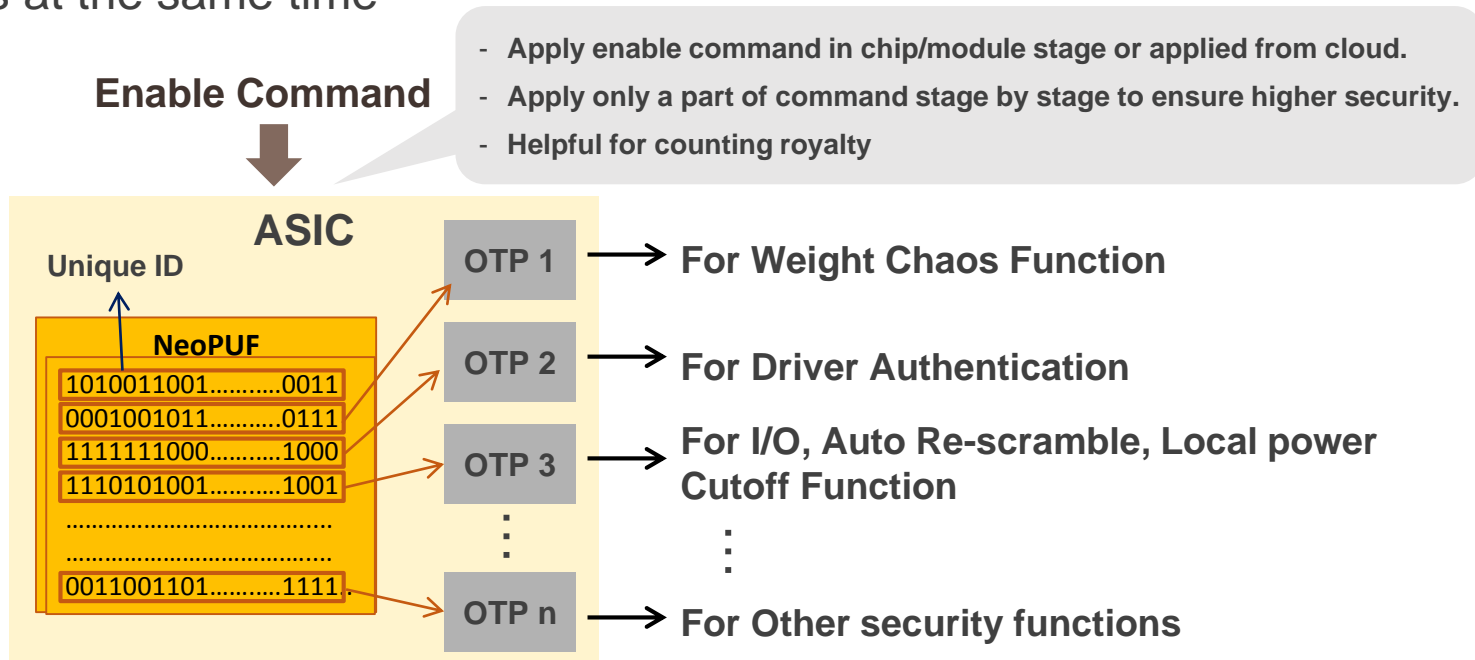


Enable

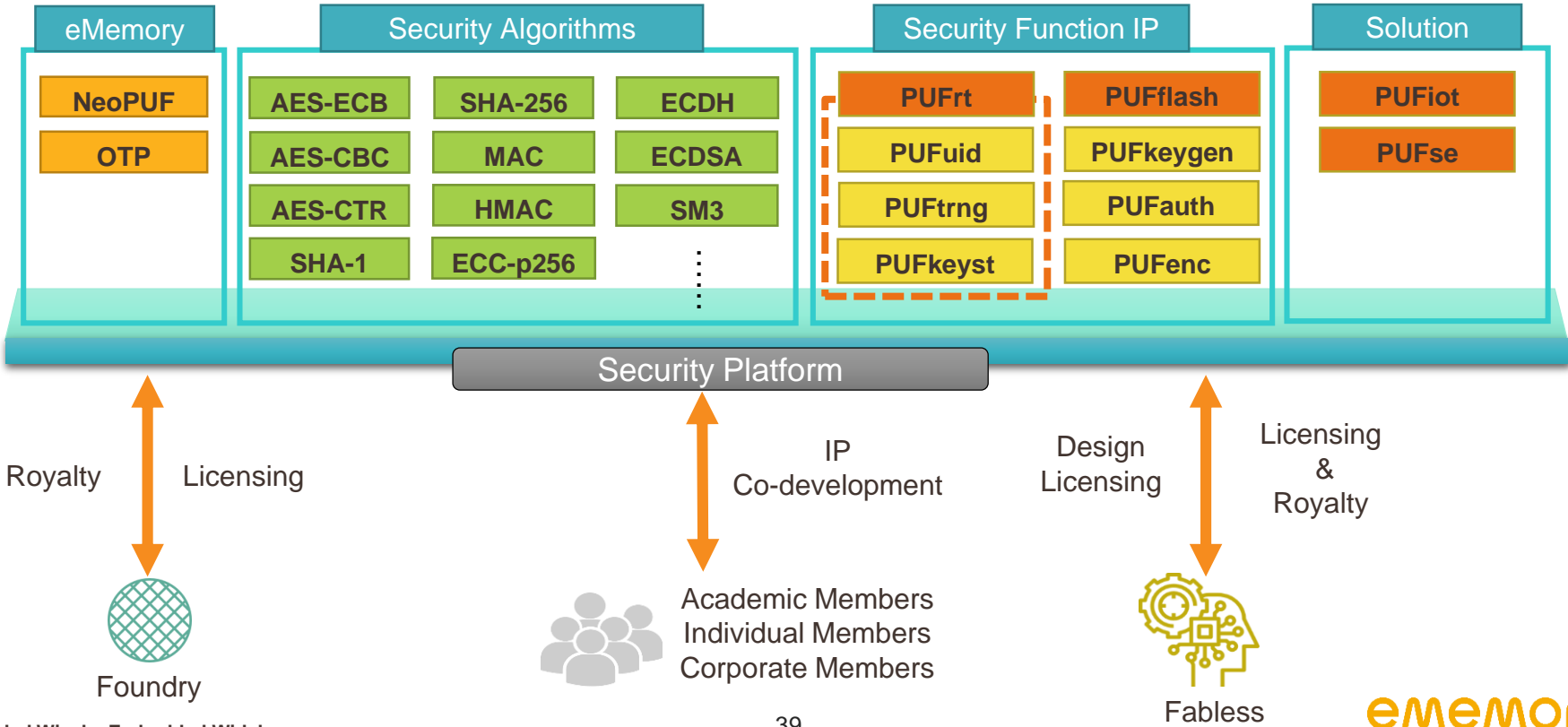
PUF-based Solution for AIoT

Building Higher Security Layers for Sensitive Data in AIoT system.

- ✓ With the big entropy pool, user can build in several kinds of security functions at the same time



Open Platform & Business Model



A hand is shown dropping a coin into a stack of coins. A small green plant with three leaves is growing out of the stack. The background is a warm, golden-yellow color. The image is framed by a white, brush-stroke-like border.

THANKS

Embedded wisely, Embedded widely