

# 物聯網時代 靜態記憶體新價值與挑戰

林仕庭 | Steam Lin

*Technology Manager at Winbond*

**winbond**

A Global Supplier of  
Advanced Memory Solutions



## 林仕庭 | Steam Lin

A Technology Manager works at Flash Memory Technical Marketing & Application Division for Winbond. Holds Master degree in Electronics Engineering from National Central University. Join Winbond in 2010, works with most of the Winbond Flash memory product development, promotion and customer technical support.

林仕庭技術經理為中央大學電機工程學系碩士。於2010年加入華邦，擔任FAE與AE工程師。參與絕大部分華邦快閃記憶體產品的開發驗證，並負責客戶對於華邦快閃記憶軟硬體技術支援工作。

1. 新的挑戰: 物聯網產品中的靜態記憶體
2. 效能與價格: SPI Stack, 多種挑戰, 一個答案
3. 靜態記憶體新價值: Security Memory

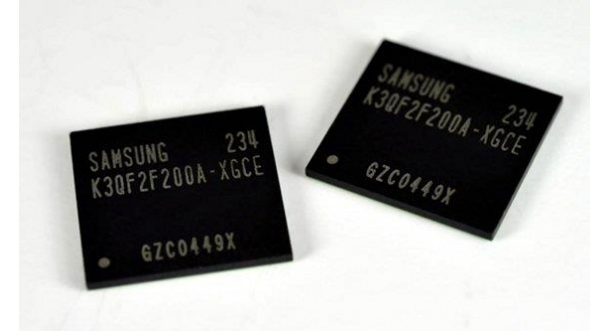
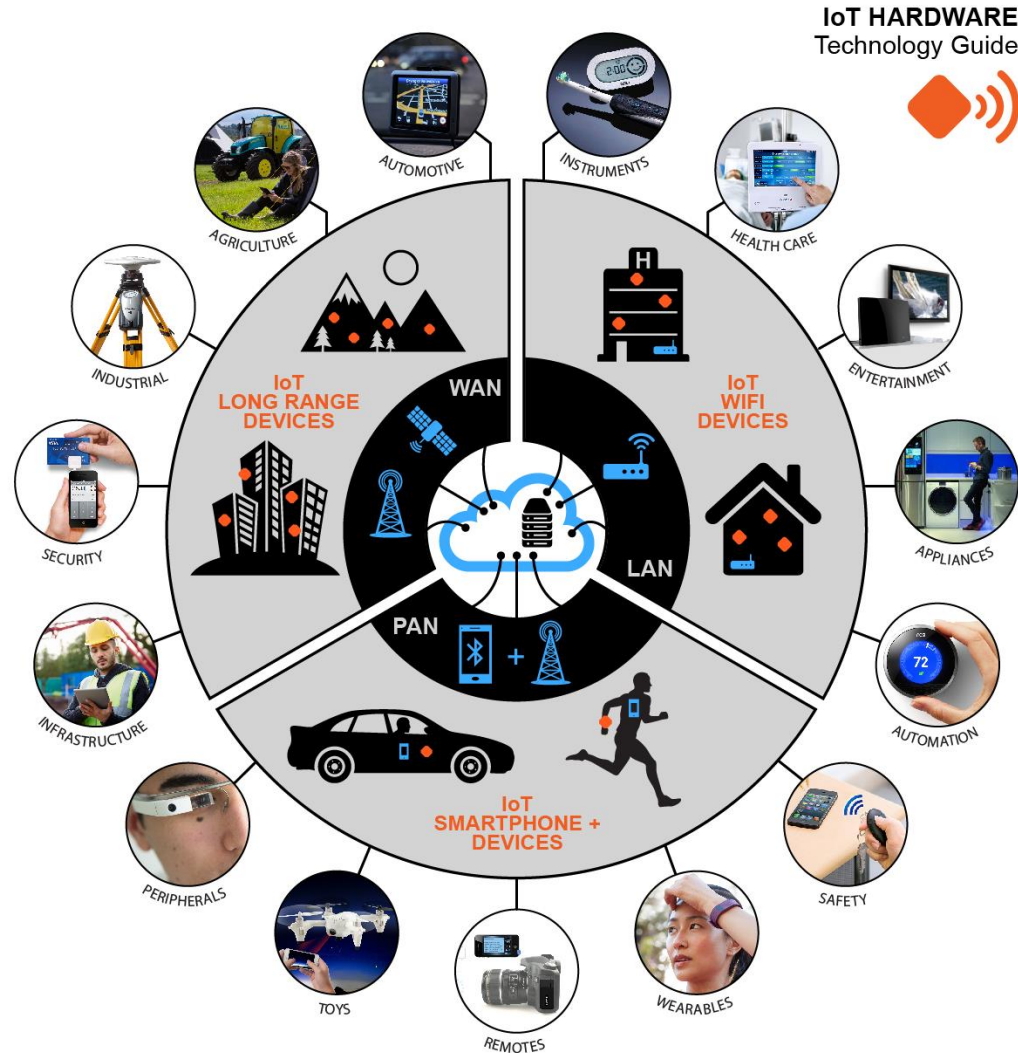
# We are in the IoT World





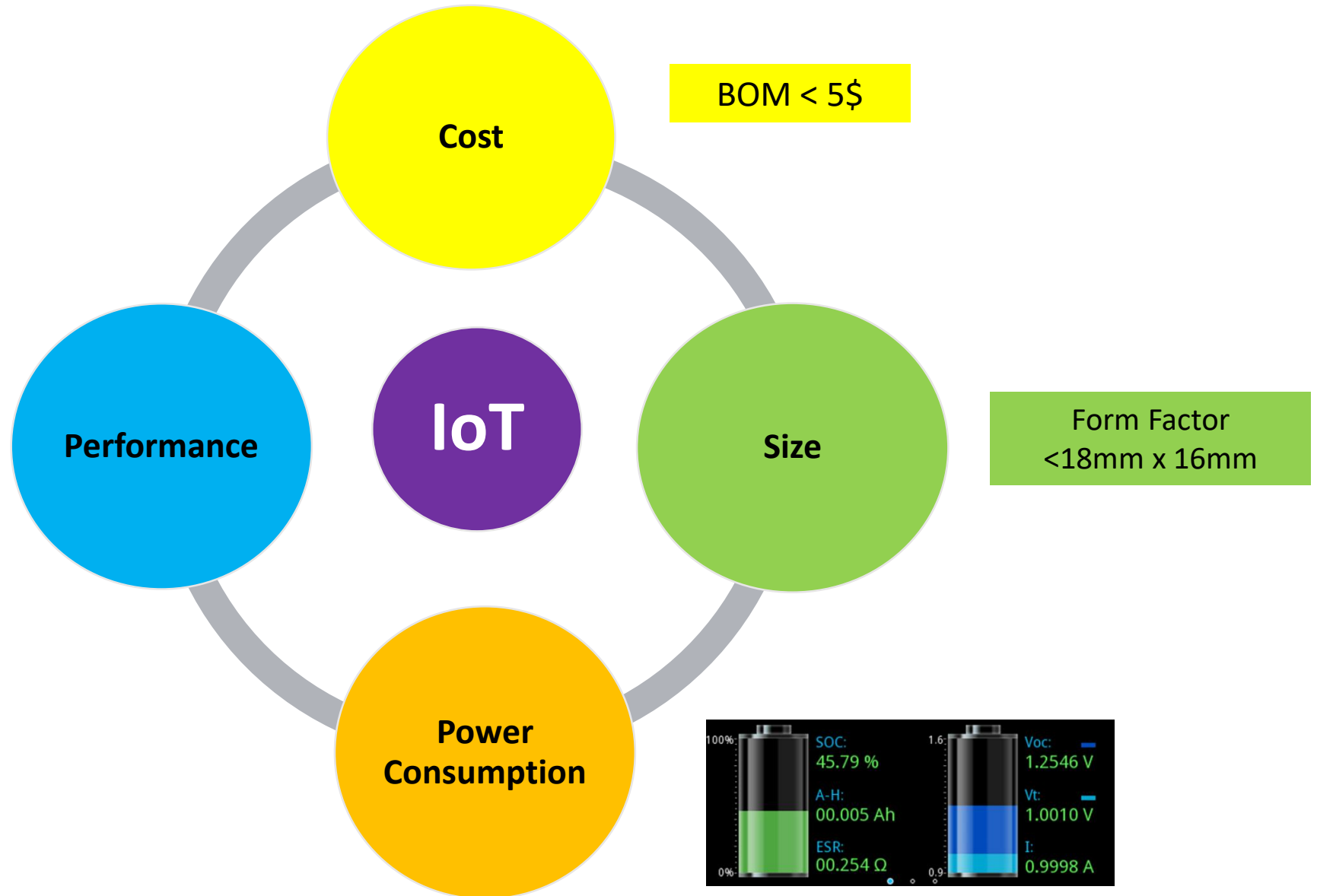
# Must for IoT Application: Memory

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# Memory Key Factors of IoT Device

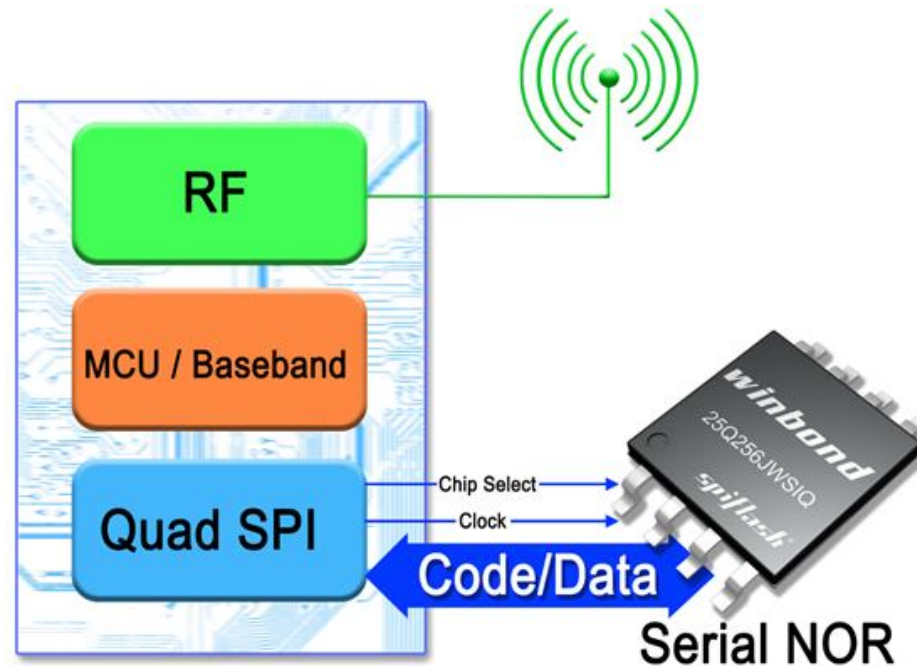
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# Types of IOT Memory

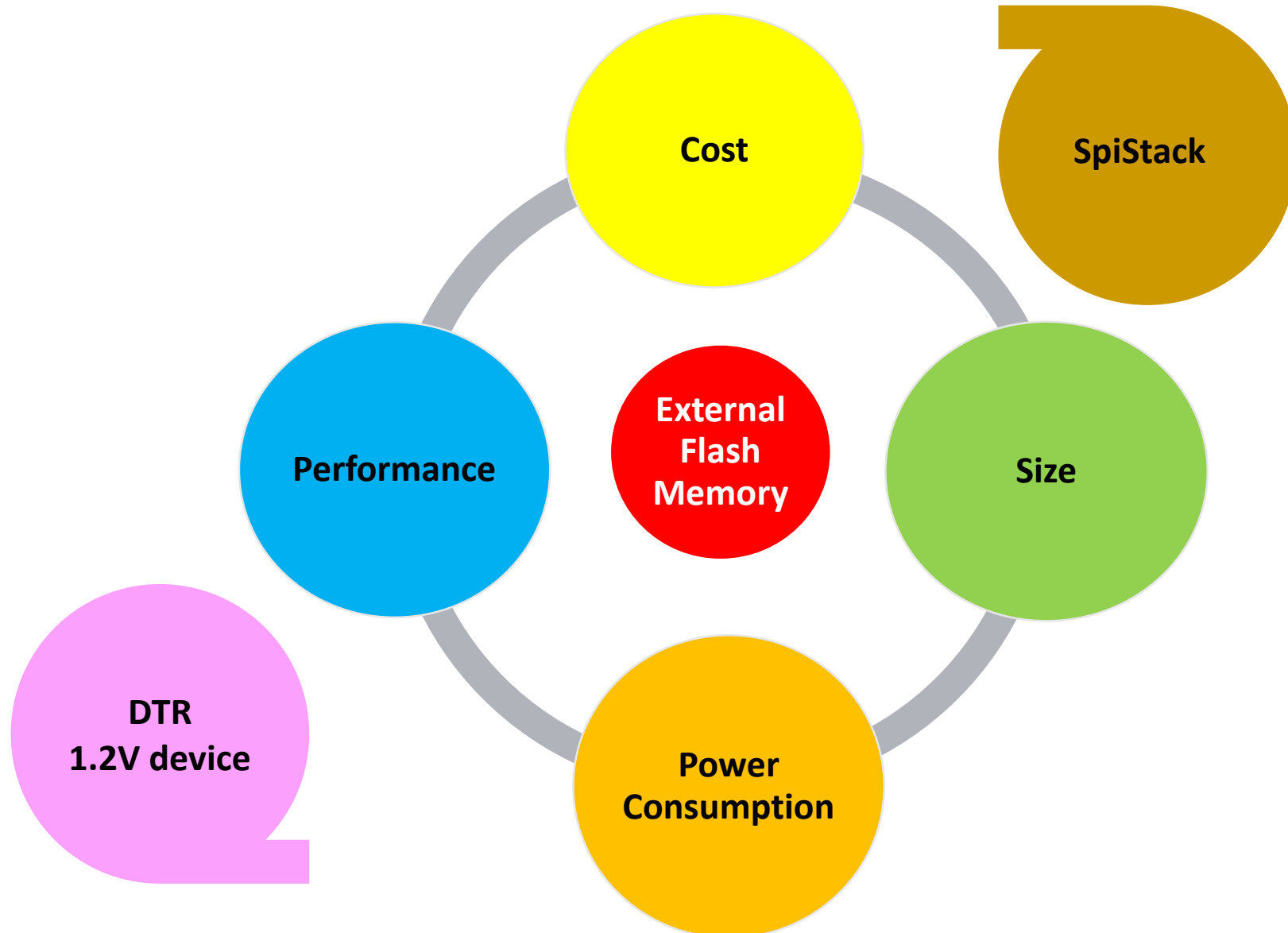
- External Flash Memory:
- Embedded Flash Memory:
- Multichip Package Memory:
- Multi Media Cards:

Inexpensive, reliable and flexible



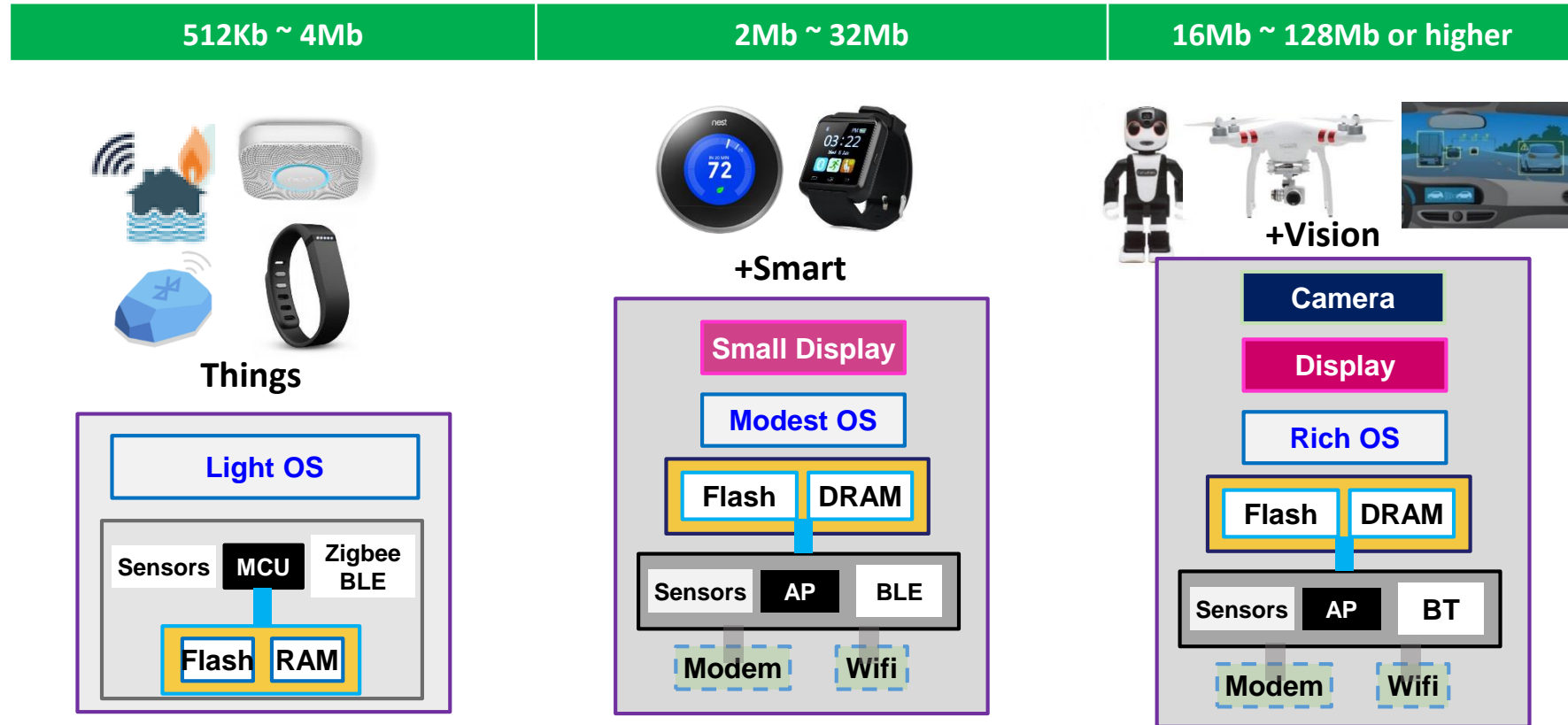
# Challenge for Flash of IOT Device

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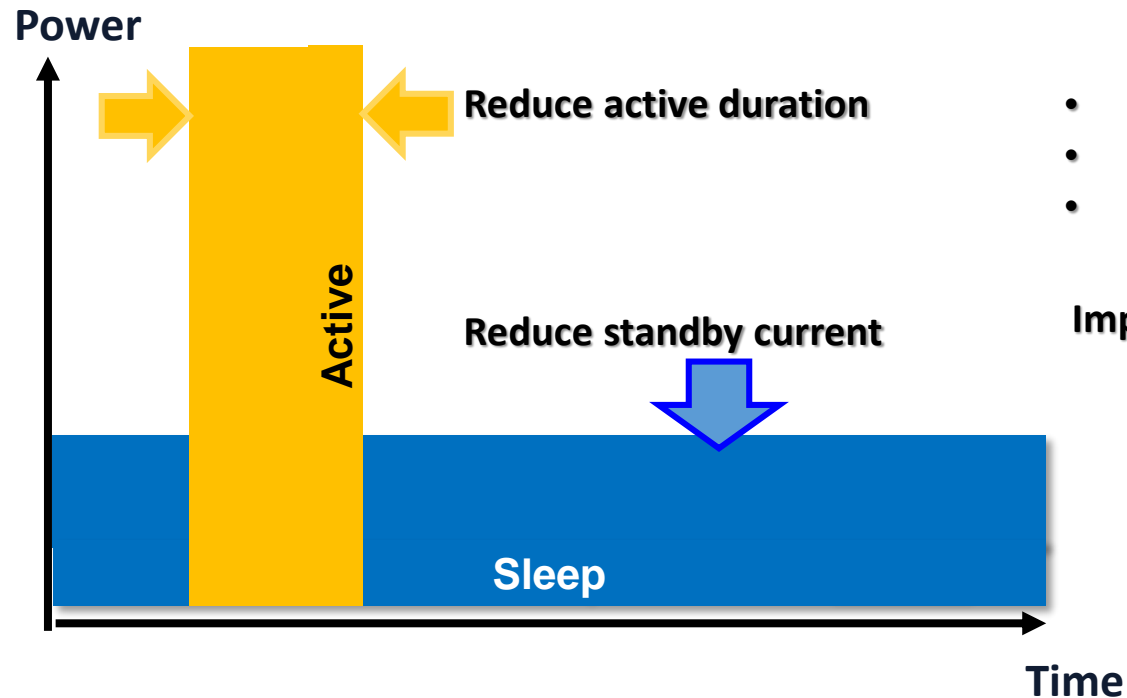
# Common Edge Node Devices



Battery Operated → needs lower power consumption

# Strategy to Minimize Power Consumption

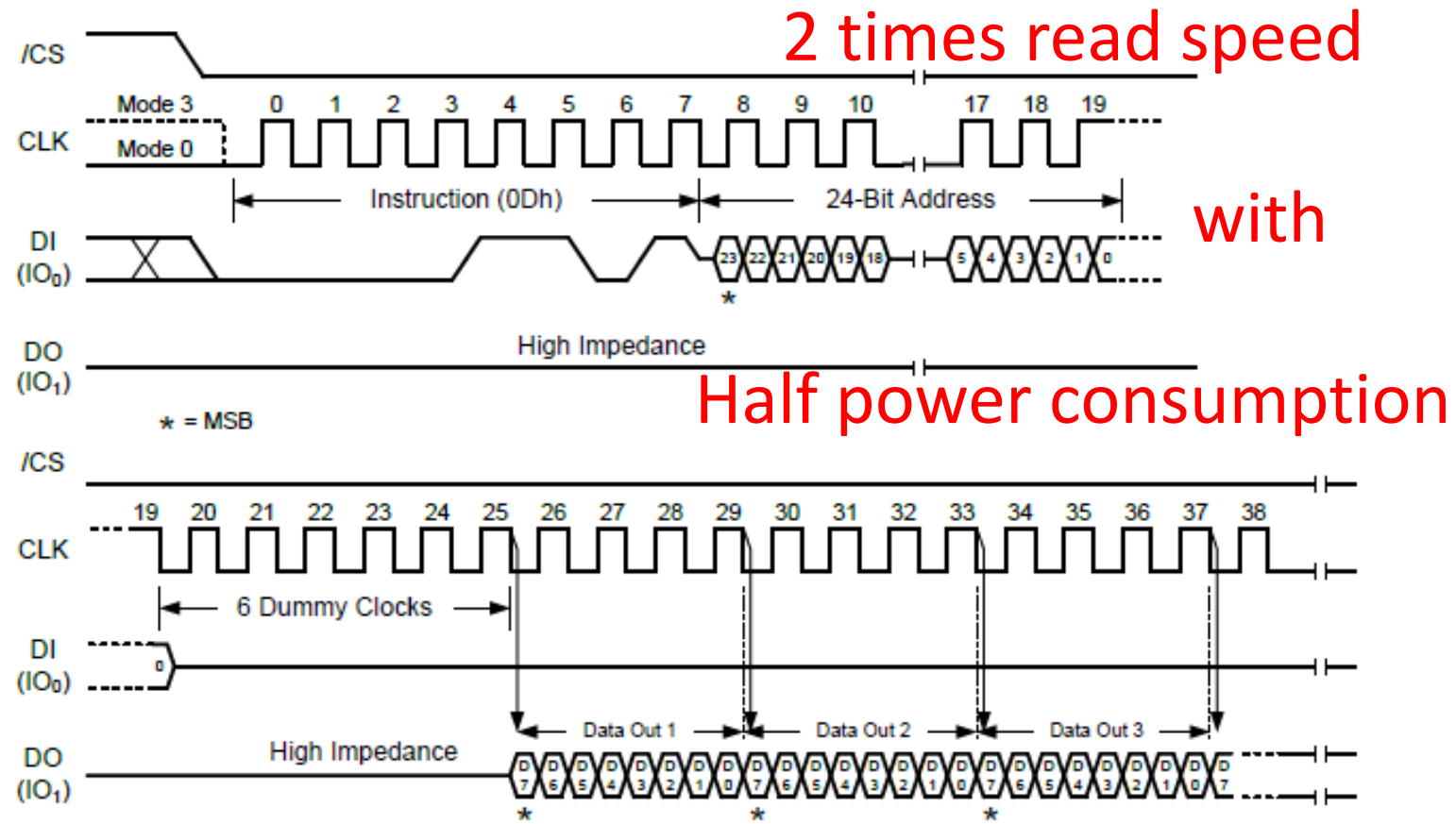
- The energy consumption includes active mode and sleep mode.
- Edge node device is not always in active mode.
- Lower the operation voltage



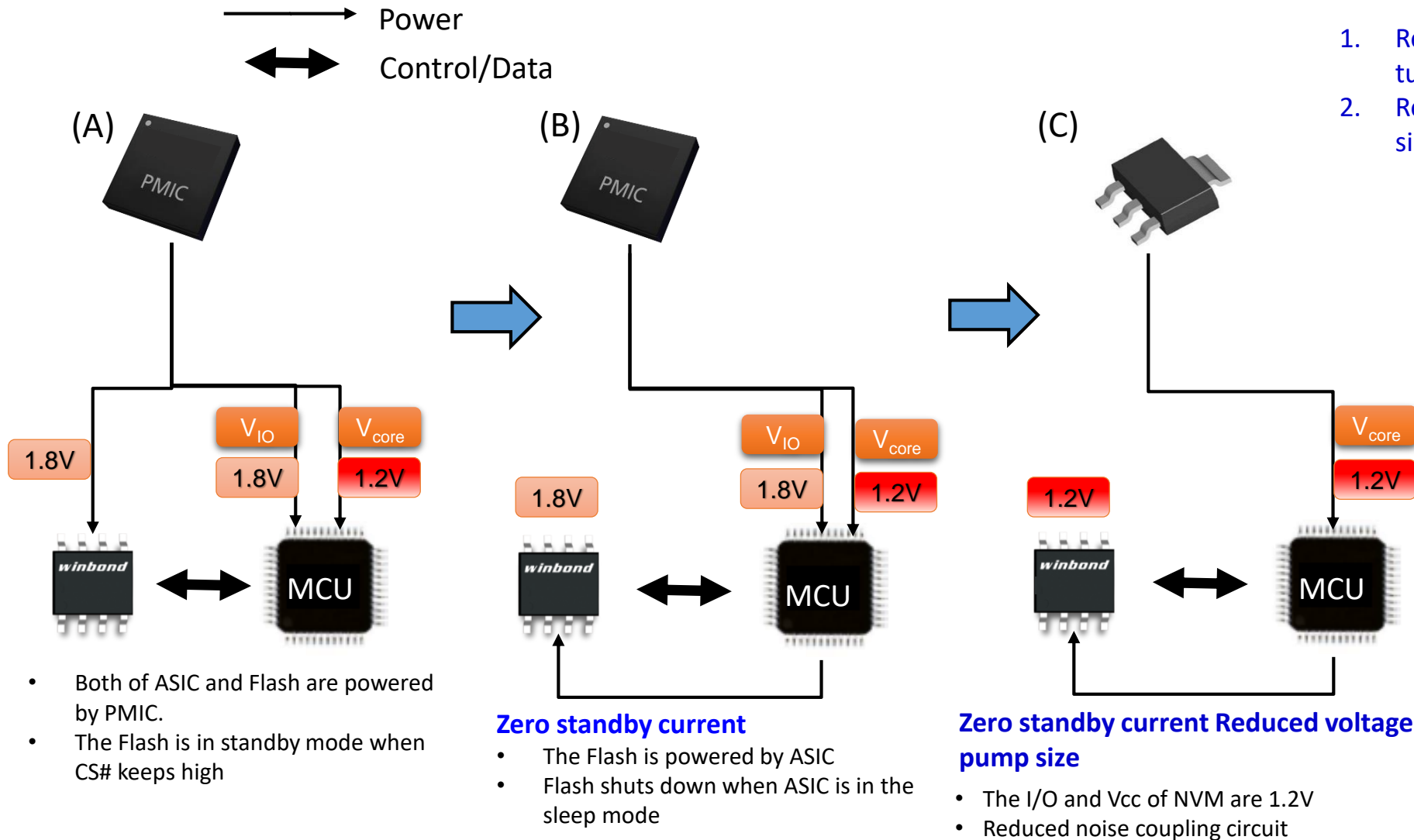
- **Multi-tasks**
- **Higher clock rate**
- **Access Flash in high speed**

Improve each component

# DTR Dual Transfer Rate

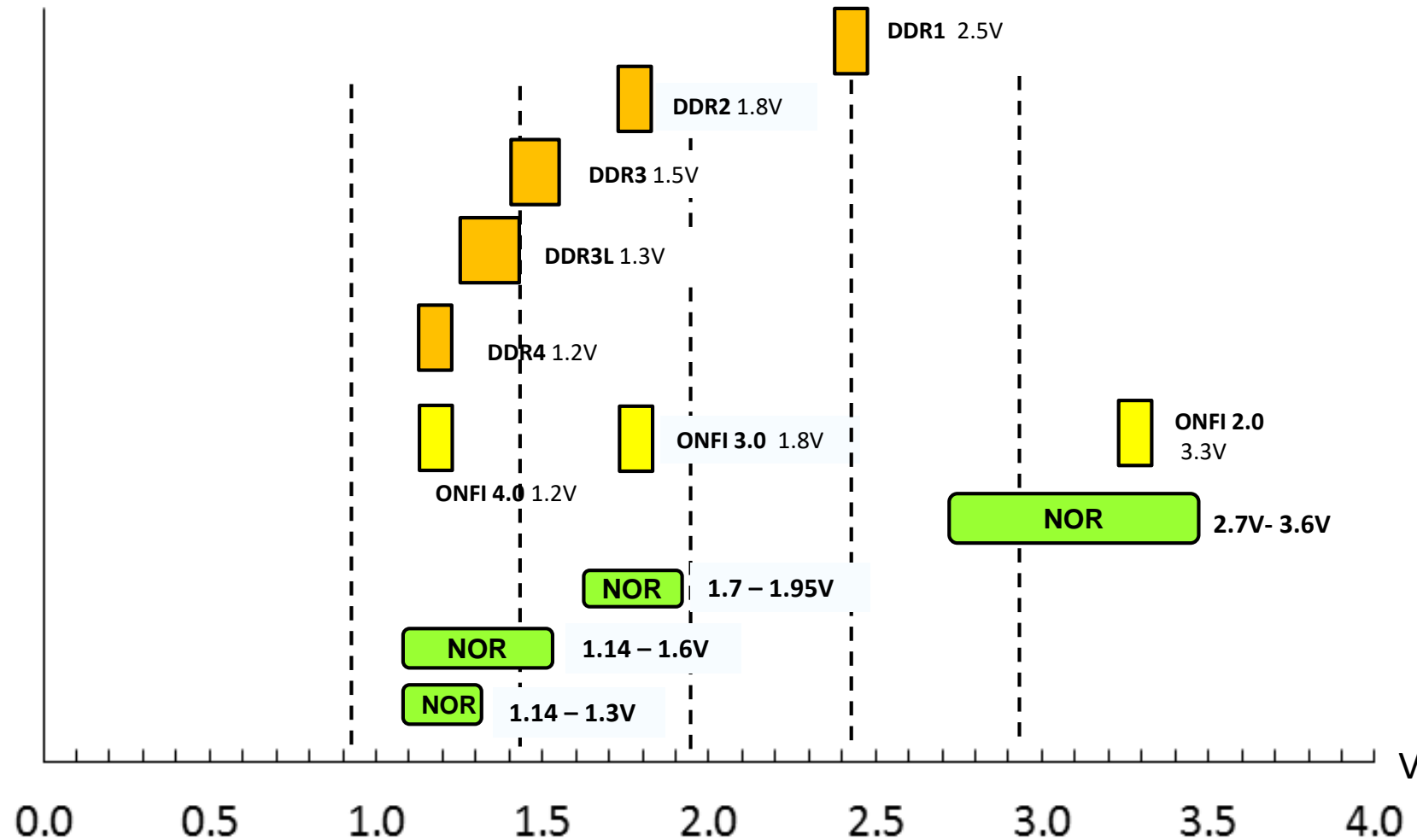


# Optimizing Power and Cost



1. Reduce power consumption by turning off NOR while sleeping
2. Reduce system BOM cost by simplifying power rails

# Memory Low Voltage Trends



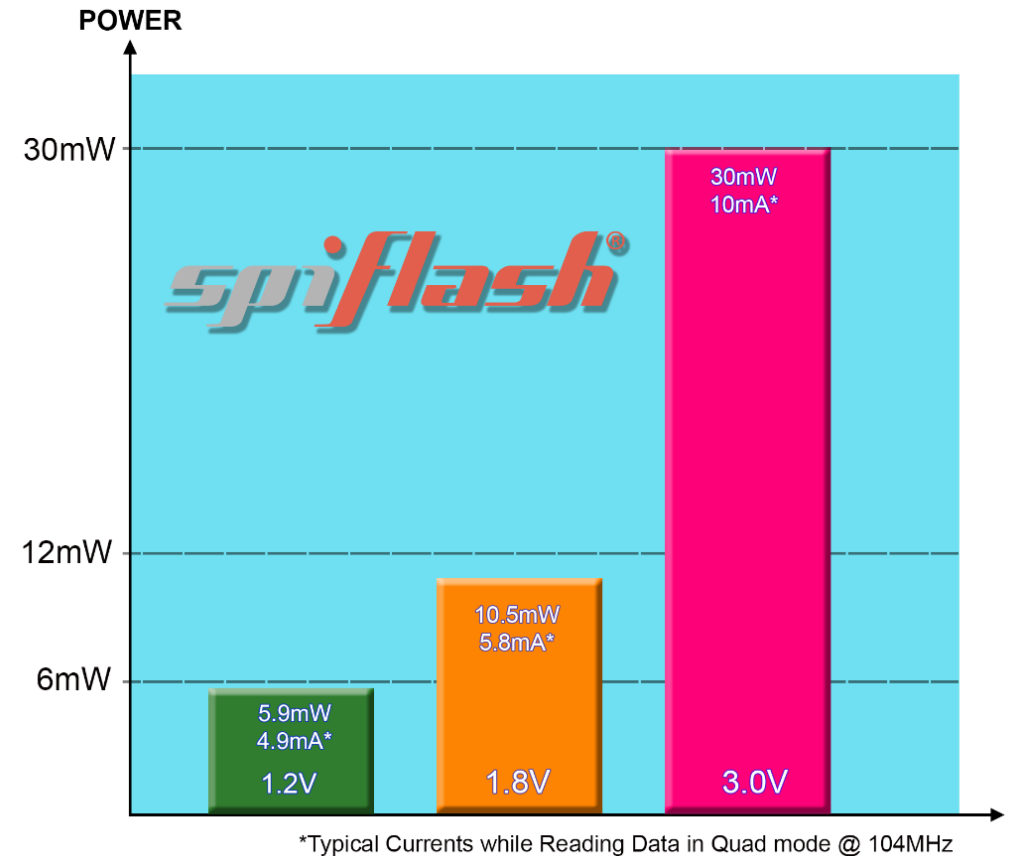


# Winbond Ultra Low Power Flash

**winbond**

- Low Power, Wide Temperature Range
  - Single 1.14V to 1.30V supply (W25Q80NE)
  - Single 1.14V to 1.60V supply (W25Q80ND)
  - 2mA active current 1MHz (1.8V device 3mA)
  - 0.5  $\mu$ A Power-down current
  - -40°C to +85°C operating range

1. High clock rate
2. Lower DPD current
3. Fully SW compatible





The graphic features a dark background with a bright, glowing sun or star in the center, surrounded by jagged, orange lightning bolts. Two white clouds are positioned above the central light. The left cloud contains the text 'Code Storage' in green, followed by a list of features: '- NOR Technology', '- Small Density', and '- High Reliability'. Below this cloud is a small image of a green circuit board. The right cloud contains the text 'Data Storage' in red, followed by a list of features: '- NAND Technology', '- Large Density', and '- High P/E Speed'. Below this cloud is a small image of a purple circuit board. In the center, below the sun, is a 3D rendering of a black 8-pin package with a die visible on top. Surrounding this package are several phrases in white italicized text: '“Small 8-pin Packages”', '“Concurrent Operations”', '“Flexible Density Combinations”', '“Software Die Select”', '“Continuous Read”', and '“Compatible SPI protocols”'. At the bottom center is the 'spistack' logo in a stylized, italicized font, with 'spi' in grey and 'stack' in red, followed by a registered trademark symbol.

**Code Storage**

- NOR Technology
- Small Density
- High Reliability

**Data Storage**

- NAND Technology
- Large Density
- High P/E Speed

*“Small 8-pin Packages”*

*“Concurrent Operations”*

*“Flexible Density Combinations”*

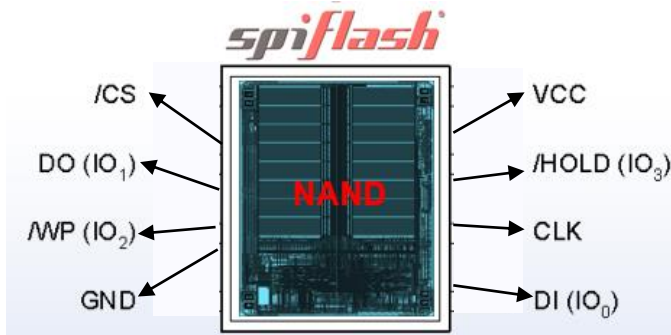
*“Software Die Select”*

*“Continuous Read”*

*“Compatible SPI protocols”*

**spistack®**

# SpiStack Using NOR + W25N Serial NAND



Same Pinout as SPI NOR

**SPI Interface, 8-pin small package,**

**Built-in features offloads external controller – ECC, Bad Block Management,**

**Continuous Read – Improves system efficiency**

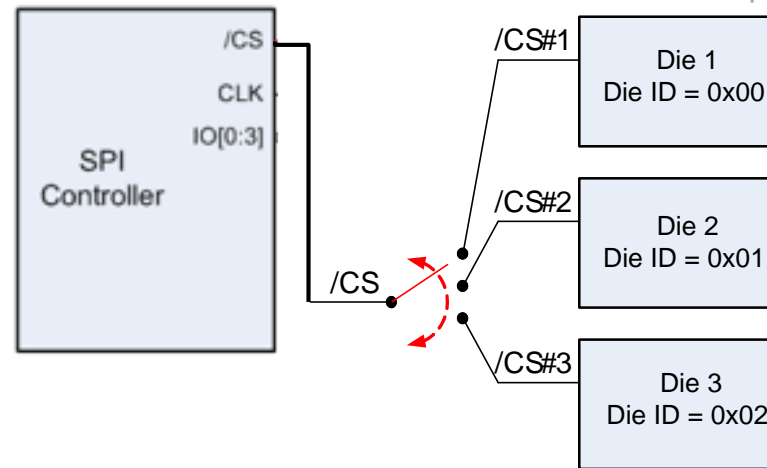
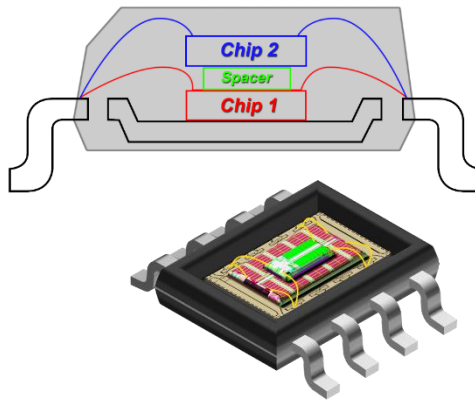
## W25N Serial NAND

- Seamless NOR transition with SLC NAND using standard SPI interface and package
- Compatible with [SpiFlash Instruction Set\\*](#)
- Robust 46nm SLC NAND technology in Winbond's 12" Fab
- 512Mb to 2Gb available; 1Gb used in SpiStack
- 3V or 1.8V power supply
- Continuous 52MB/s read data throughput ideal for Code-Shadowing applications
- On Chip 1-Bit ECC and On Chip Look-Up-Table for Bad Block Management
- Using low pin-count SpiFlash packages (WSON-8 & TFBGA-24)
- Flexible device configurations tailor to customers' need (Buffer/Continuous Read, Array/Device Lock-Down/OTP/write protection)

\* With minor additional commands

# SpiStack Structure and Block Diagram

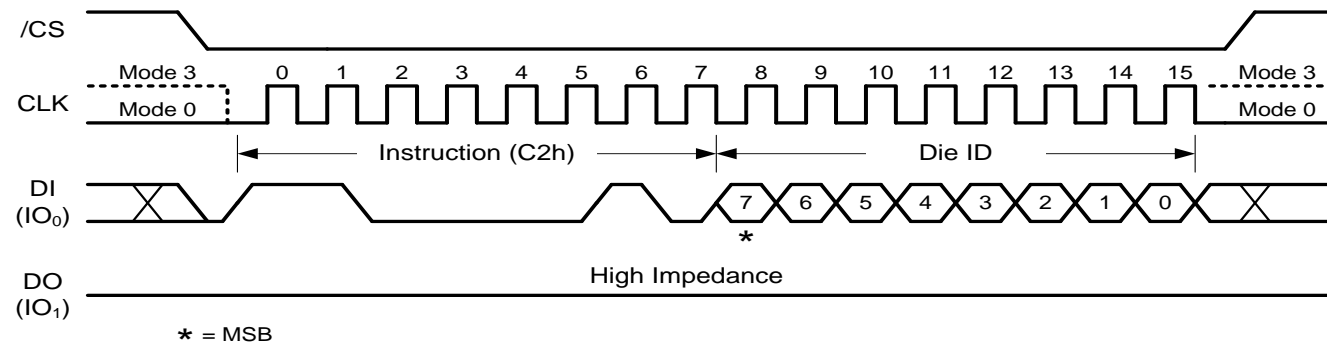
Dies and bonding  
wires on Lead frame  
or Substrate



## “Software Die Select” (C2h)

- This command is used to select any die within the MCP package
- Each die is assigned with an 8-bit “Die ID” in the factory
- Only one “Selected” die is active on the SPI bus at any given time

- 1) Saves board space
- 2) Reduces system BOM cost



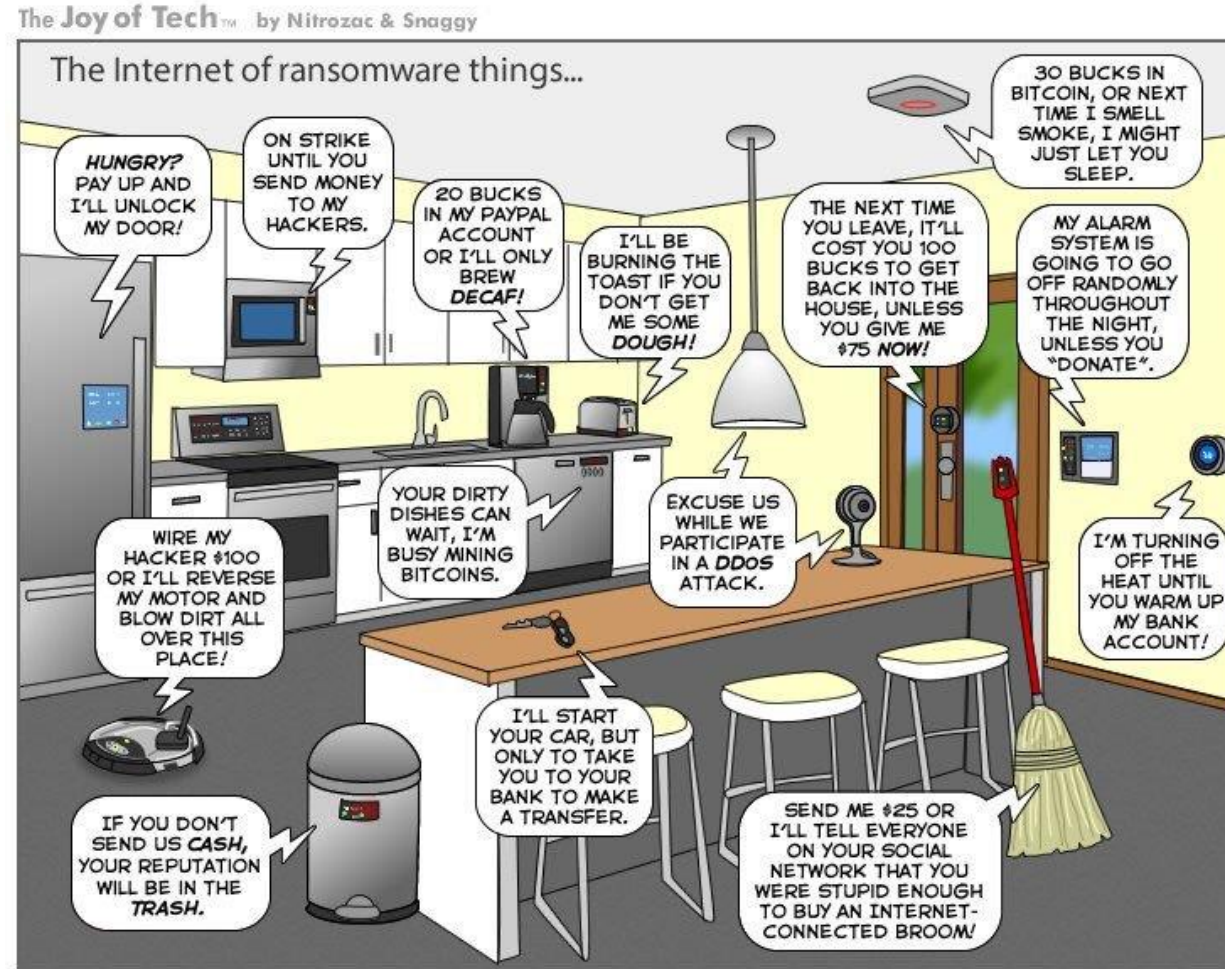






# Security Issue in IoT

- Public Safety
- Economic Loss
- Business interruption
- Information leakage

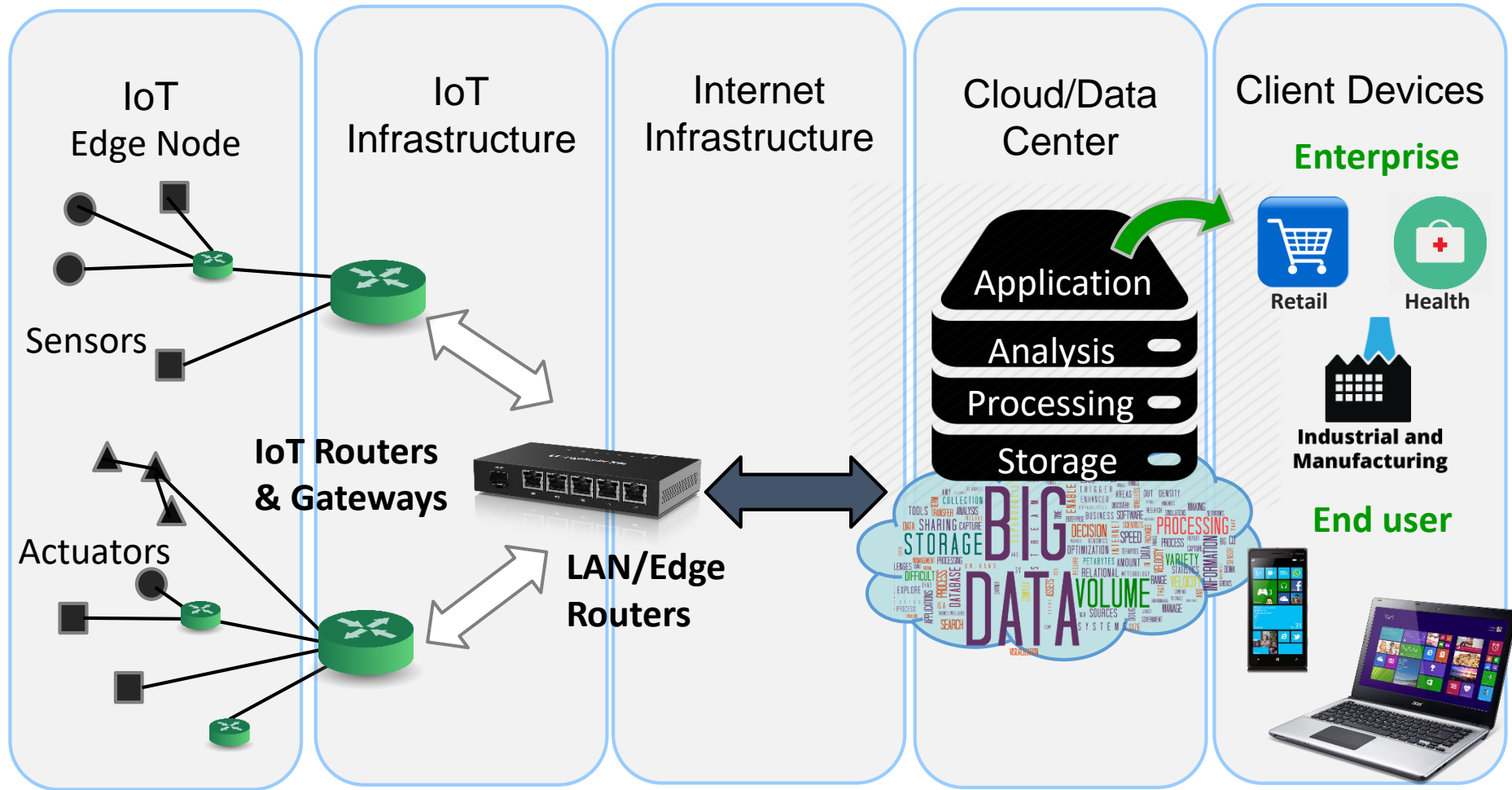


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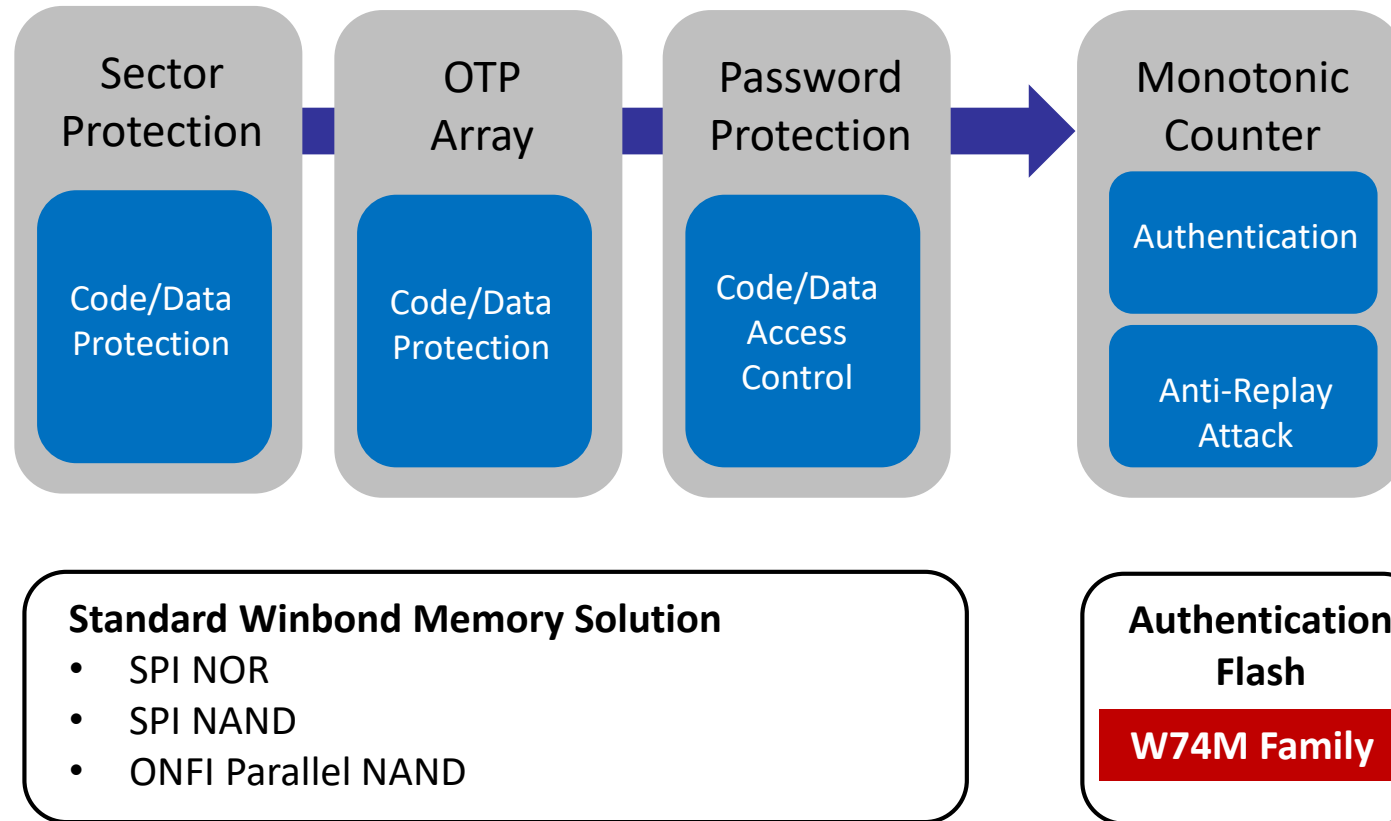
- Flash is everywhere – **indispensable for systems**
- End-to-end security: Each device is important
- Flash can be/has become the easy target for hackers
  - Standard/De-facto interface
  - Technology well known by the public
  - Ease access to abundant SW/HW tools @very low cost
  - A passive device lagging in security
- Winbond security flash solutions
  - Memory with **embedded HW security**

# IoT Connectivity



# Flash Memory Security Evolution

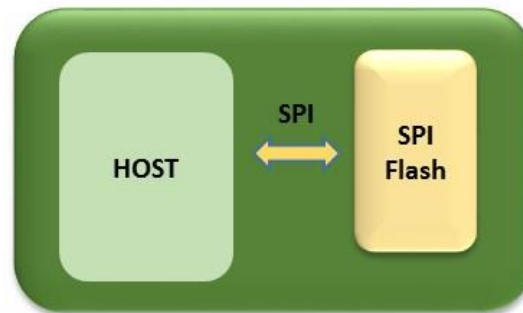
Staying ahead of the hackers requires technology advances...



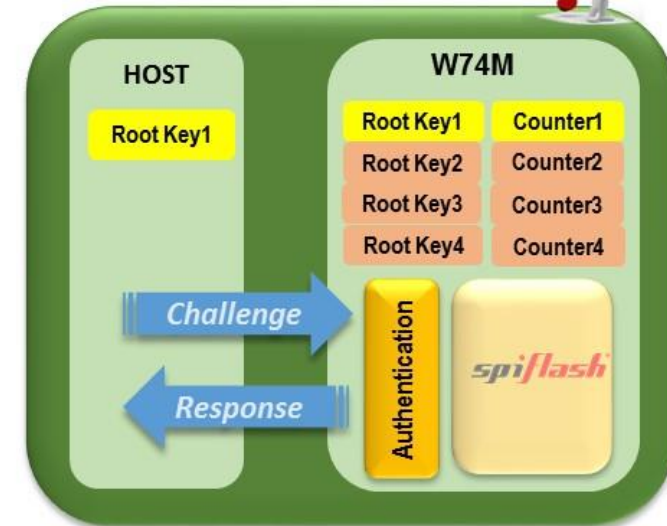
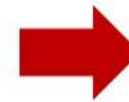
# W74M Authentication Flash

## What is Authentication Flash?

- SPI Flash with Authentication (2-in-1)
- Adds security intelligence into SPI Flash
  - Built-in HMAC-SHA-256 engine for the Challenge-Response with HOST(s)
  - 4 sets of security volatile & non-volatile storage ideal for multi-layered authenticity
  - Authenticate and anti-replay
- HOST to validate before accessing data and executing the codes



Regular Flash Usage

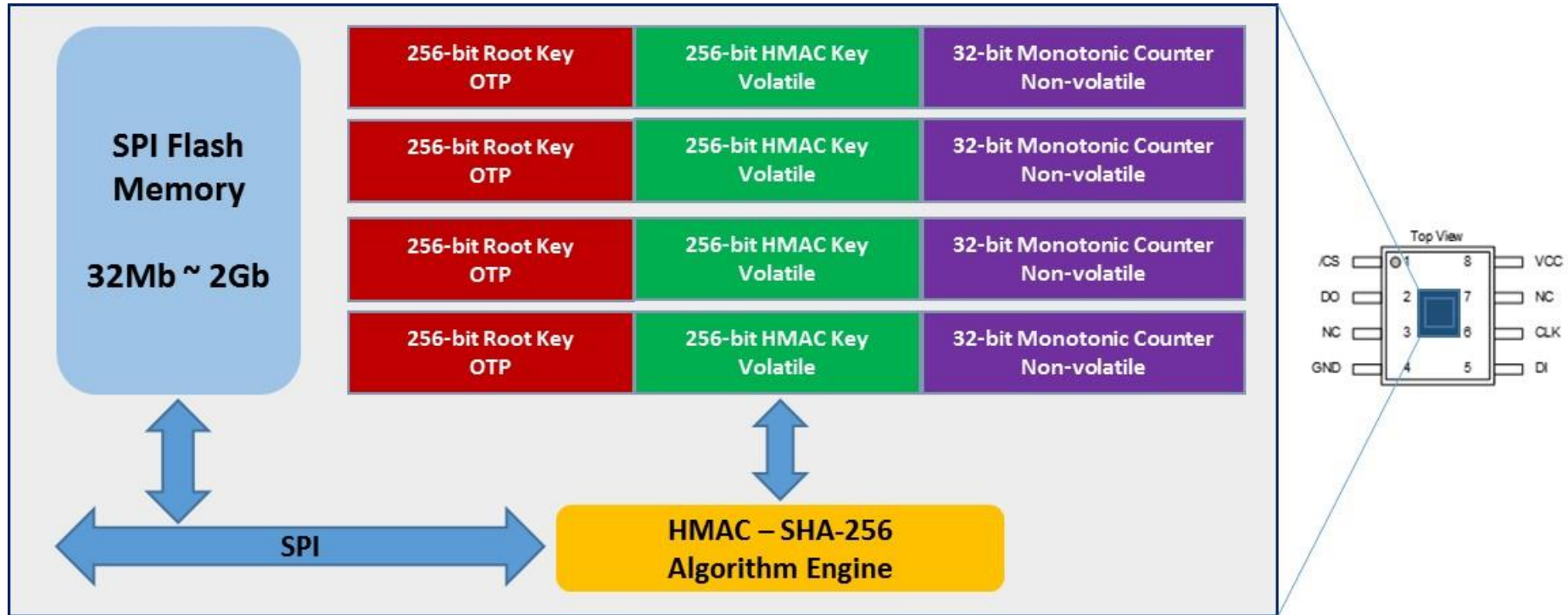


Flash with Authentication Usage



# W74M Authentication Flash

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Advance security with multi-layered authenticity

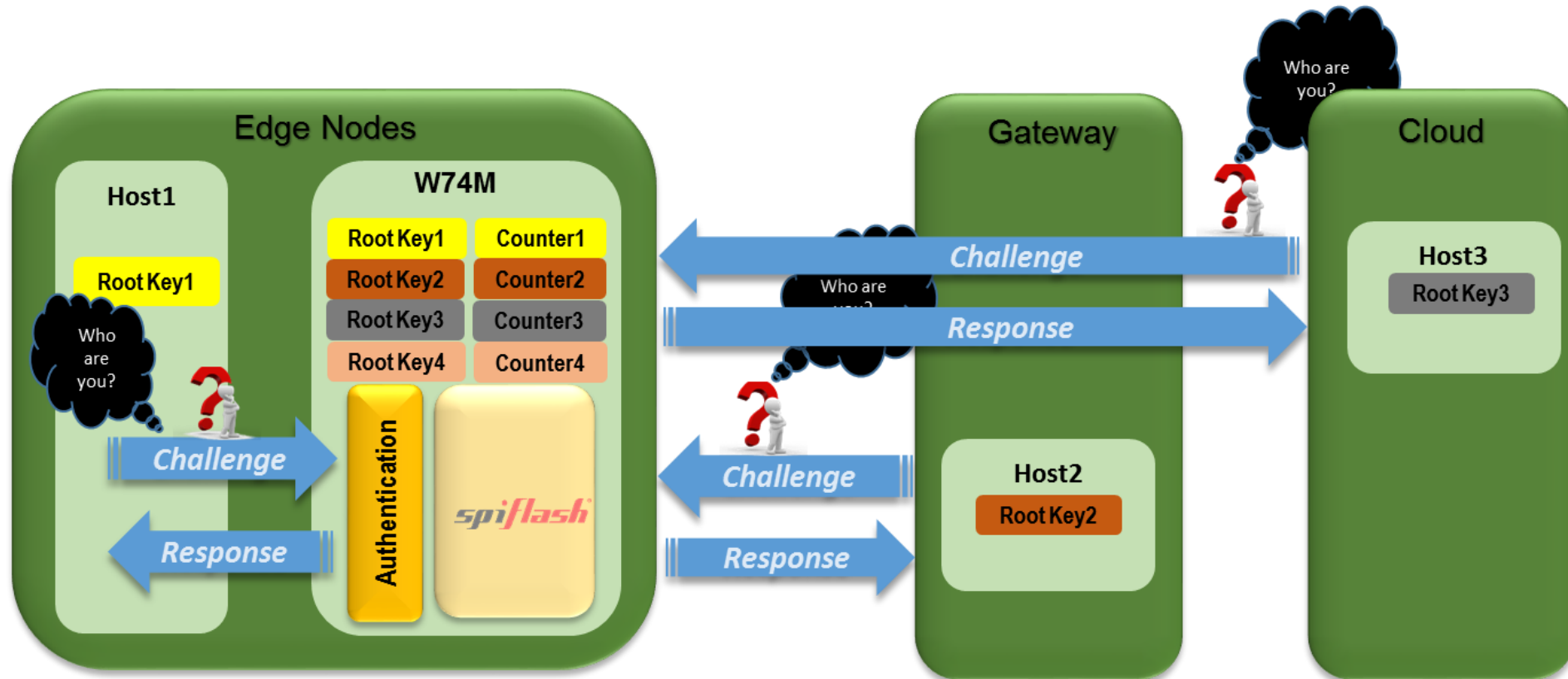
- ❑ HMAC-SHA-256 standard crypto algorithm
- ❑ 4 sets of 256-bit OTP Root Key
- ❑ 4 sets of 256-bit volatile HMAC Key
- ❑ 4 sets of 32-bit Monotonic Flash Counter

- ❑ Standard serial flash interface
  - Single, Dual, Quad
- ❑ Multichip package

# W74M Multi-Layered Authentication

## Binding with up to 4 HOST

- ❑ Use case: IoT





# | Thank You

**Winbond Electronics Corporation**

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