



shaping tomorrow with you

# What is FRAM?

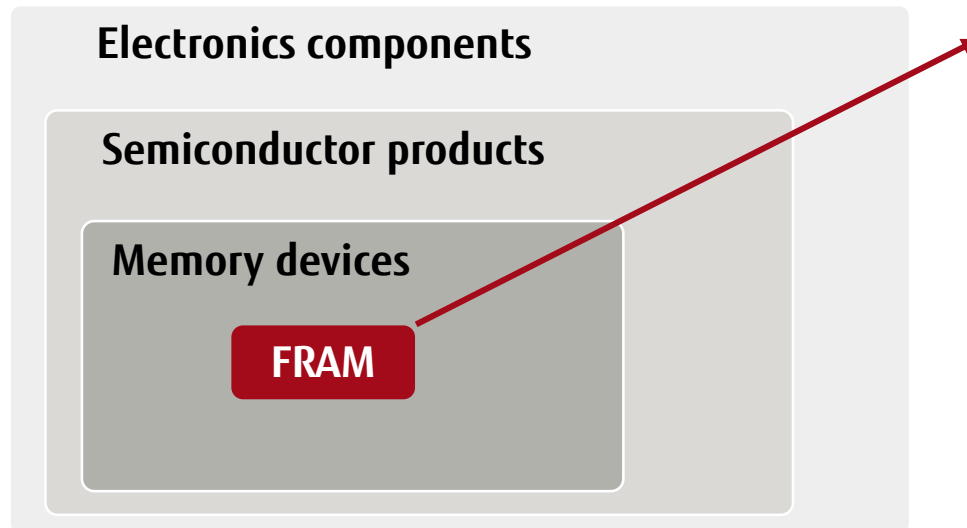
Fujitsu Semiconductor Memory Solution Limited

January 2021

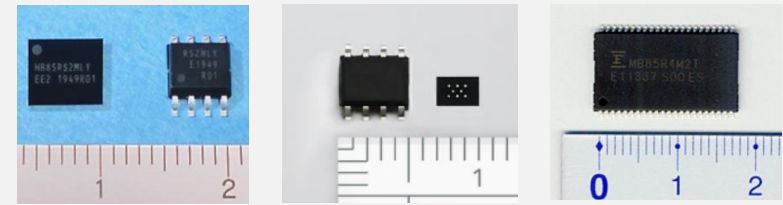
- 1 Overview | **Overview of FRAM**
- 2 Usage | **Applications using FRAM**
- 3 History | **Shipments, Business opportunities, Awards**
- 4 Features | **Features of FRAM**
- 5 Solutions | **Solutions by FRAM to customer issues**

## What is FRAM?

- FRAM is a **memory device** in semiconductor products
- FRAM stands for Ferroelectric Random Access Memory



### Photos of FRAM devices

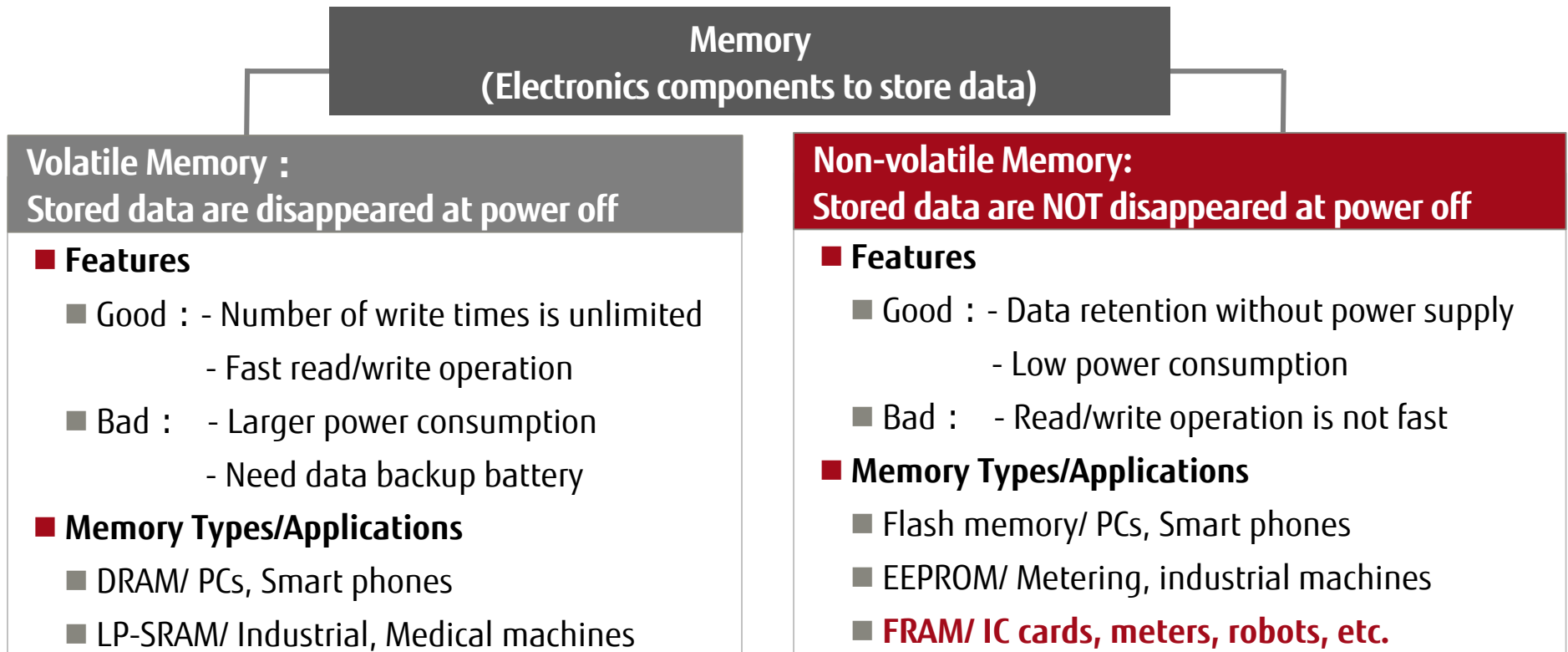


### FRAM packages



## ■ What kind of memory is FRAM?

- FRAM is type of **non-volatile memory**



## ■ FRAM Lineup

- Three interfaces : I2C, SPI, and Parallel
- Memory density : 4Kbit to 8Mbit
- Temperature range : Operating at maximum 125°C

Interface	I2C	SPI	Parallel
Density	<b>4K to 1Mbit</b>	<b>16K to 4Mbit</b>	<b>256K to 8Mbit</b>
Supply Voltage	1.8 to 3.6V 3.3V Max. 5.5V	1.8 to 3.6V 3.3V Max. 5.5V	1.8 to 3.6V 3.3V
Operating Temperature	-40°C to +105°C	Higher: -40°C to +125°C General: -40°C to +85°C Lower: -55°C to +85°C	-40°C to +85°C
Package	SOP, SON	SOP, SON, DFN, WL-CSP	SOP, TSOP, FBGA

\* : Please confirm detailed specs by each product.

[ As of January 2021 ]

Overview

**Usage**

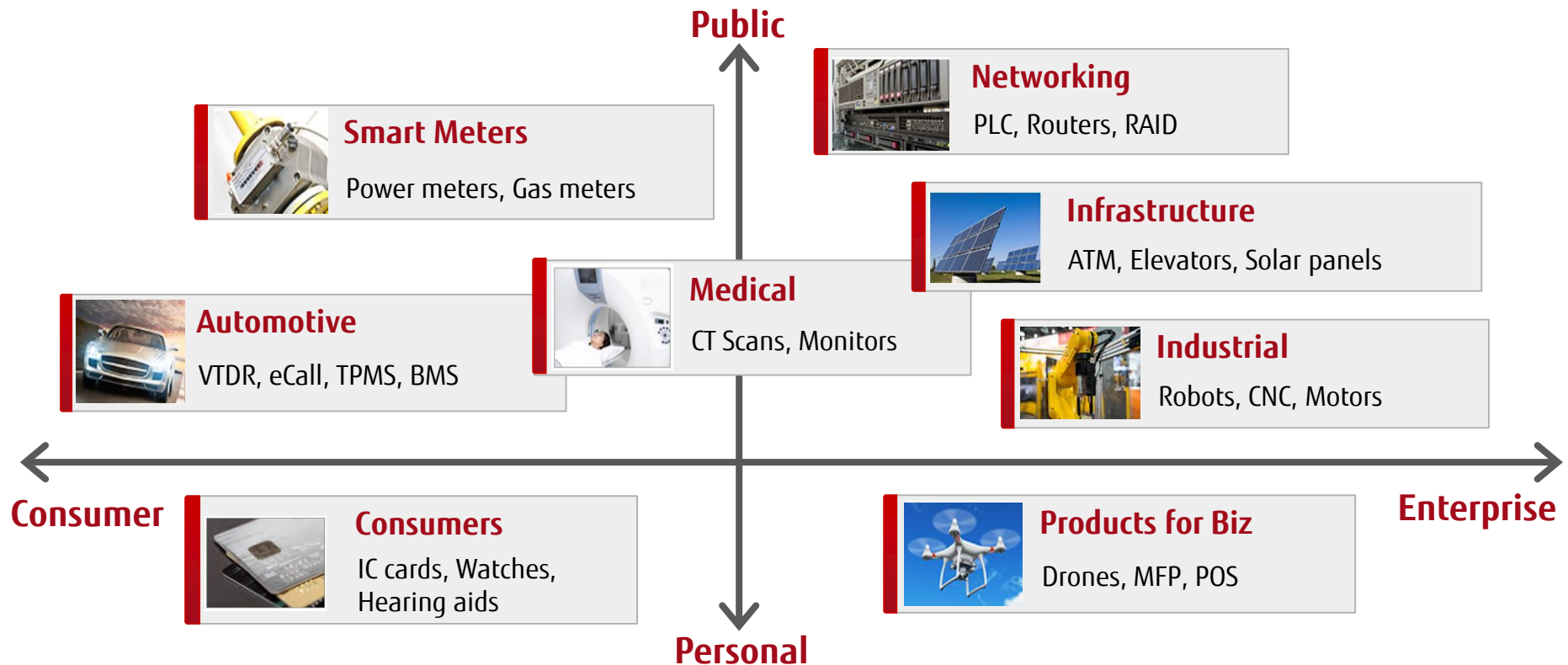
History

Features

Solutions

## ■ Where is FRAM used?

- Used in all kind of market segments, especially strong in the public services
- Suitable for frequent data logging requirement



Overview

Usage

History

Features

Solutions

## Quantity of FRAM shipped

- Production since 1999, total shipment is almost **4 billion pcs**

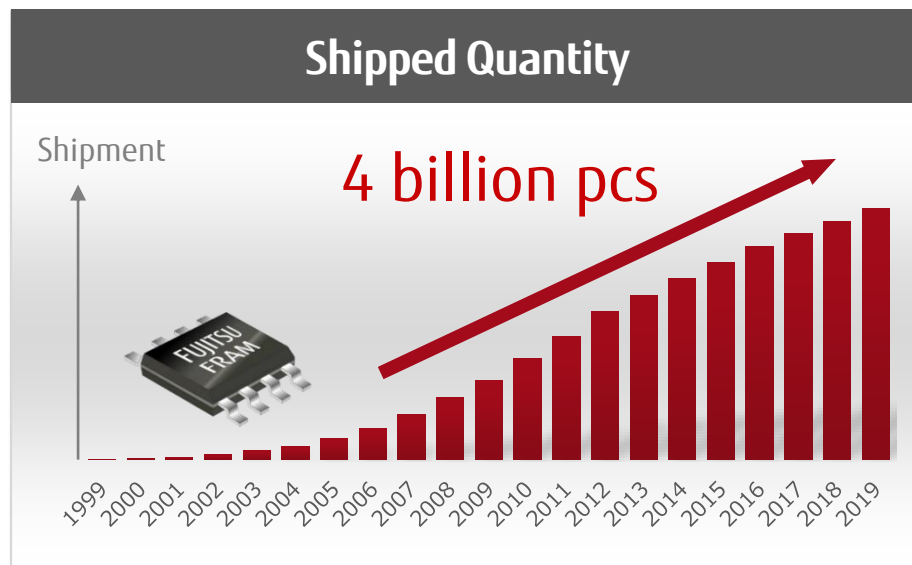


## Opportunities of FRAM business

- Used in **50 countries**, more than **200 types** of applications



### Shipped Quantity



### Business Opportunities



Overview

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## ■ History of receiving awards for FRAM

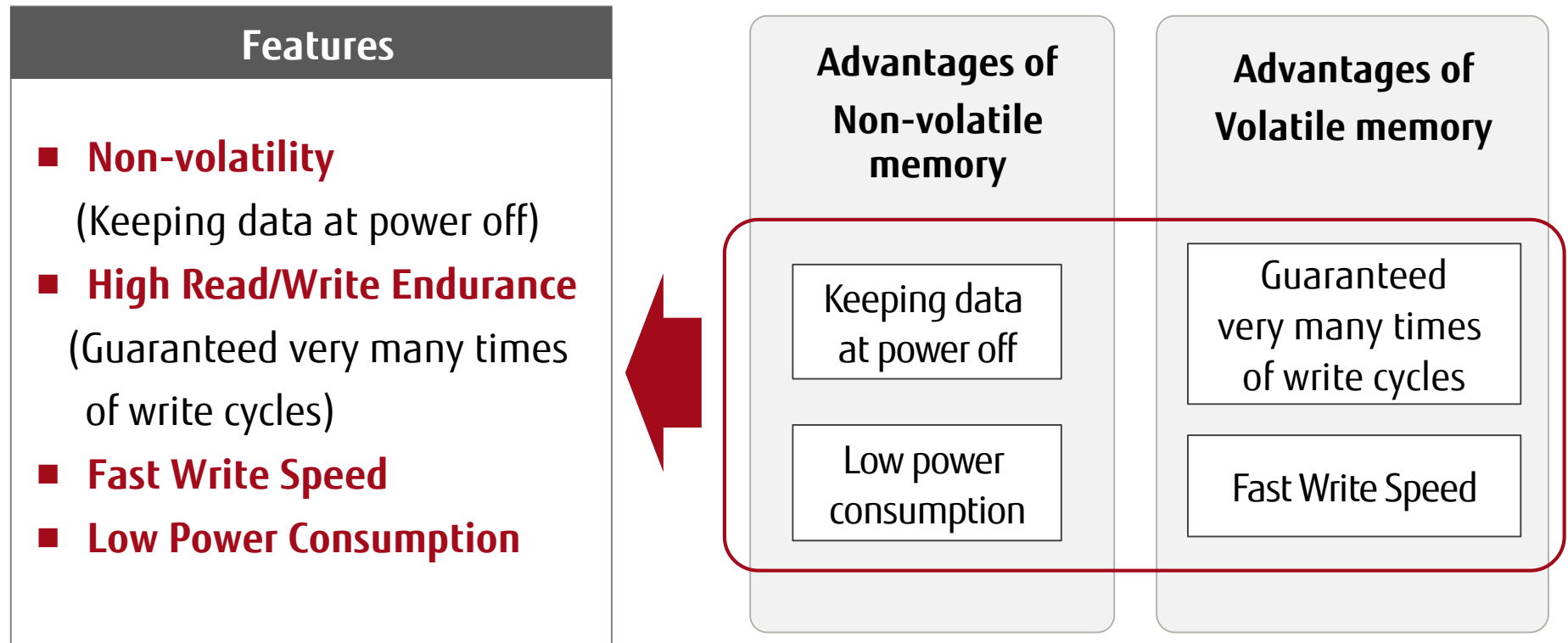
- **Our company received 11 awards in 15 years** from domestic academic societies and government agencies

Year	Award Name	Organizer
2001	第8回LSIデザイン・オブ・ザ・イヤー優秀賞	半導体産業新聞社
2004	CORPORATE INOVATION AWARD	ISIF
2004	文部科学大臣表彰 研究功績者（研究功績者）	文部科学省
2007	第2回 ものづくり日本大賞 優秀賞	経済産業省等
2011	産学官連携功労者表彰 日本経済団体連合会会長賞	内閣府等
2013	応用物理学会フェロー表彰	応用物理学会
2013	文部科学大臣奨励賞、電気科学技術奨励賞	電気科学技術奨励会
2014	大河内記念技術賞	大河内記念会
2014	文部科学大臣表彰 科学技術賞（開発部門）	文部科学省
2014	第14回 山崎貞一賞	材料科学技術振興財団
2015	紫綬褒章	内閣府



## ■ Features of FRAM

- Having advantages of both non-volatile and volatile memories



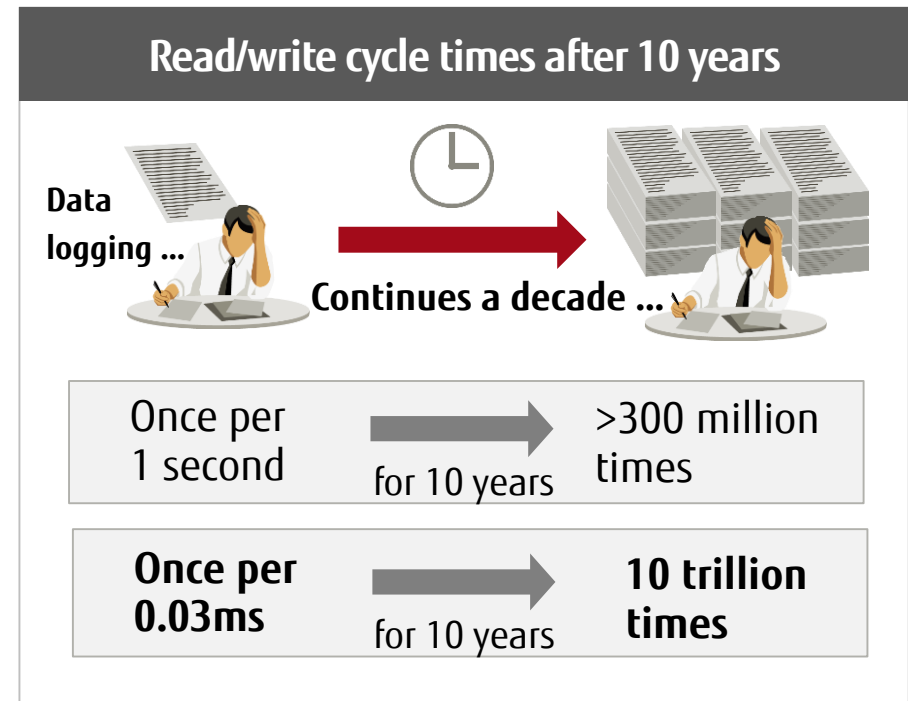
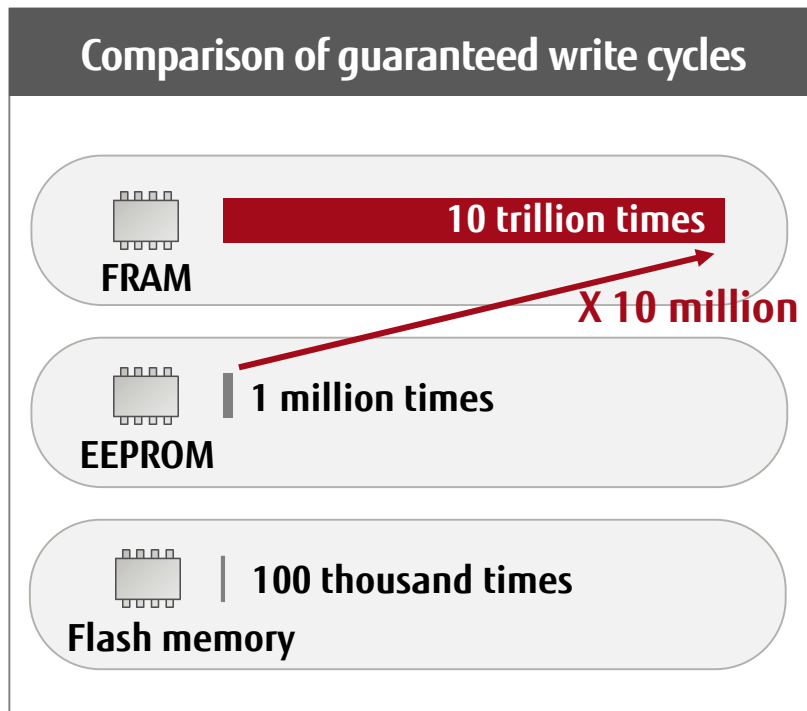
## ■ Comparison to other memory devices

- Having advantages of both non-volatile and volatile memories

	<b>FRAM</b>	<b>EEPROM</b>	<b>Flash memory</b>	<b>SRAM</b>
<b>Memory Type</b>	<b>Non-volatile</b>	Non-volatile	Non-volatile	Volatile
<b>Data Backup Battery</b>	<b>No</b>	No	No	Yes
<b>Guaranteed Write Cycles</b>	<b>10 trillion</b>	1 million	100 thousand	Unlimited
<b>Write Method</b>	<b>Overwrite</b>	Erase + Write	Erase + Write	Overwrite
<b>Write Cycle Time</b>	<b>150ns</b>	5ms	10μs	55ns
<b>Booster Circuit</b>	<b>No</b>	Yes	Yes	No

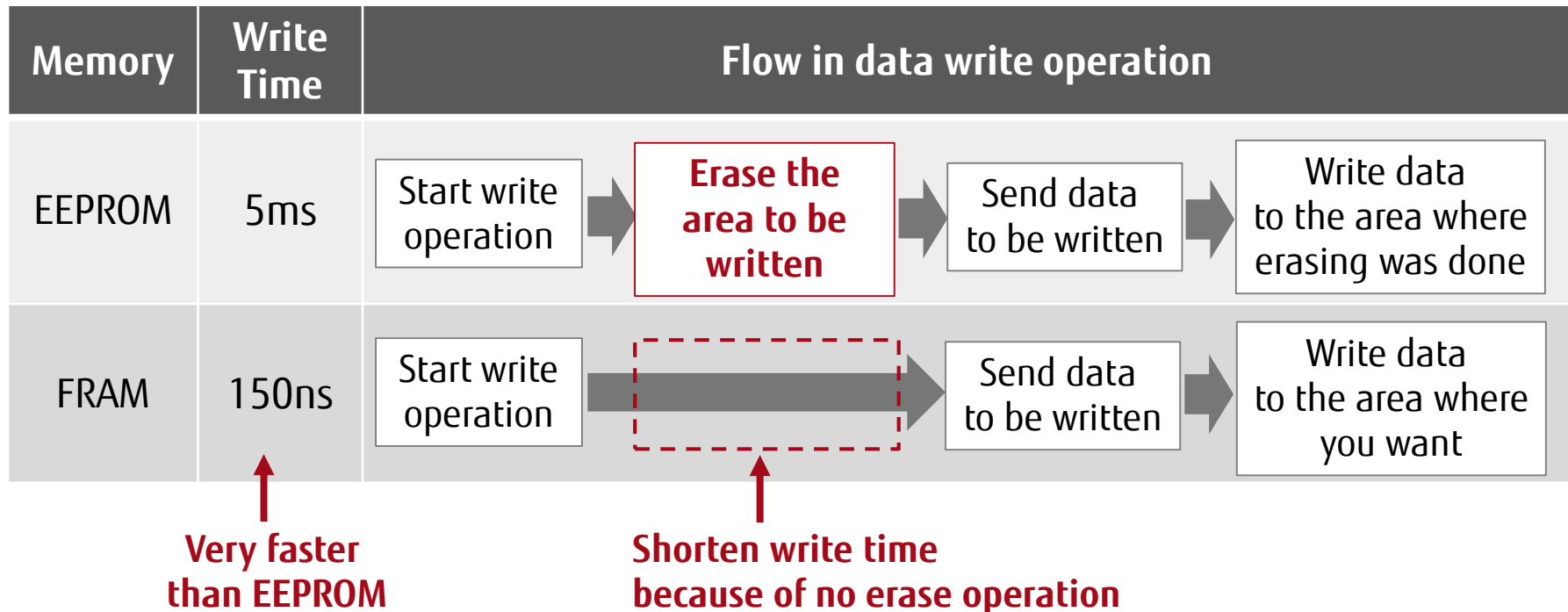
## ■ FRAM Feature – High Read/Write Endurance

- Spec: Guarantees 10 trillion times of read/write cycles
- Reason: Enabled by FRAM cell structure with ferroelectric property



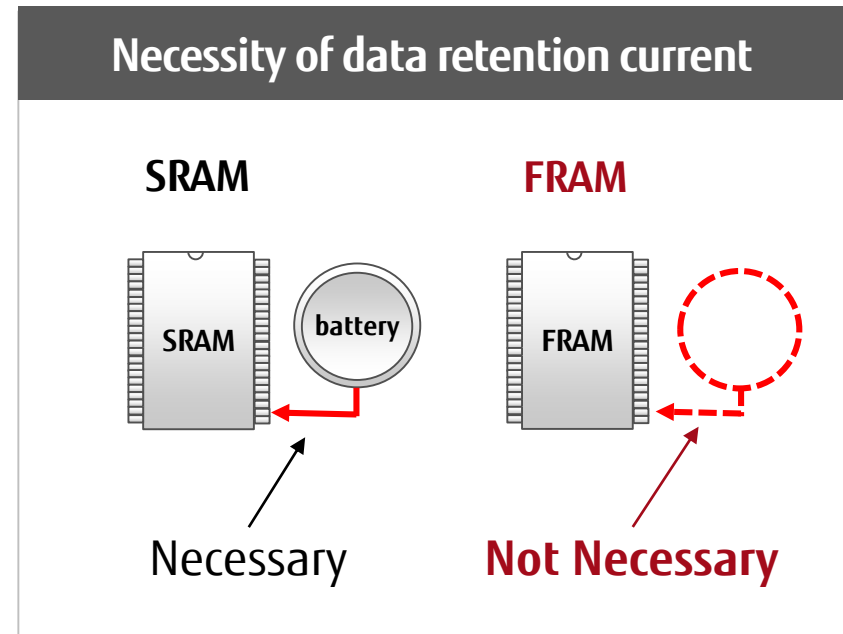
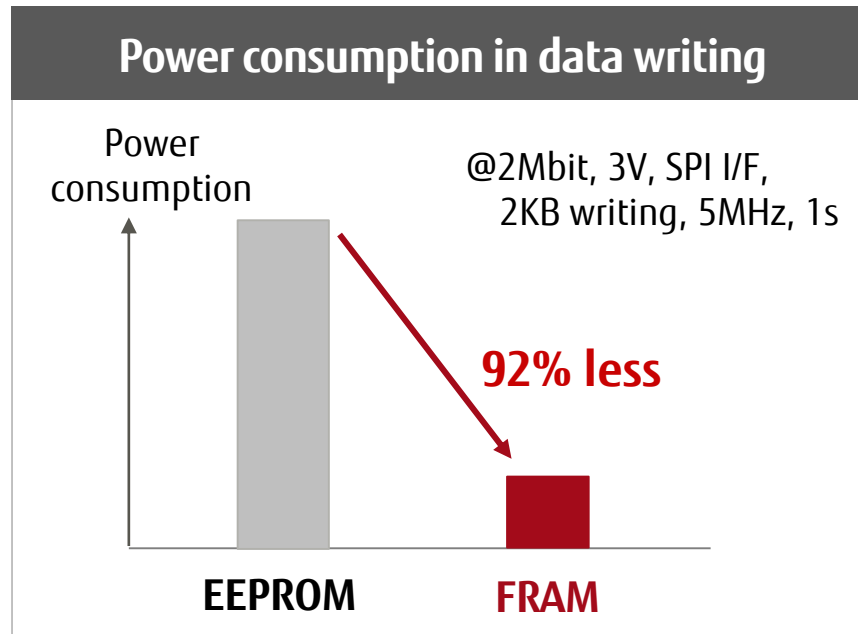
## ■ FRAM Feature – Fast Write Speed

- Spec: Write cycle time of 150ns, faster than EEPROM
- Reason: Data erase operation is not needed during write operation



## ■ FRAM Feature – Low Power Consumption

- Merit #1: Lower power consumption in data writing, due to shorter write time
- Merit #2: No data backup battery, due to data retention current is not necessary



Overview

Usage

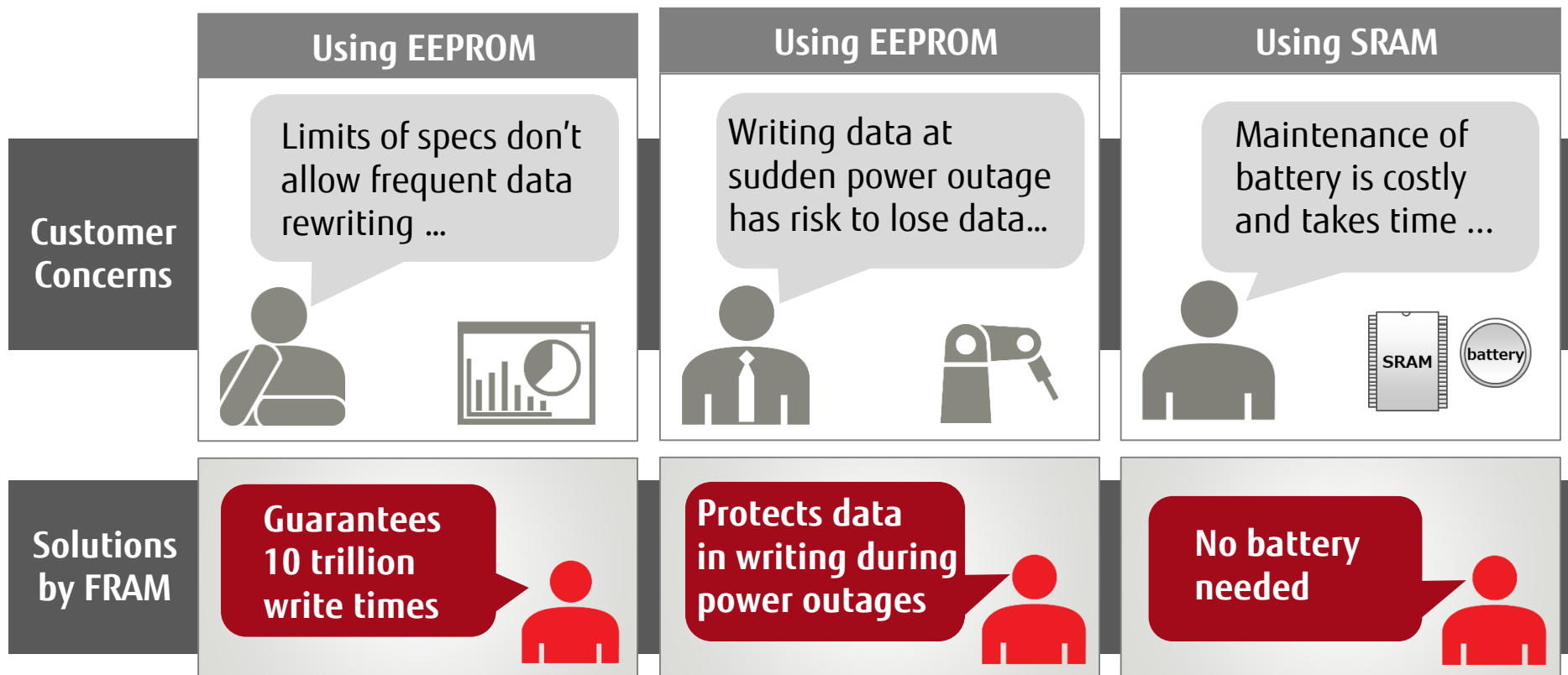
History

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Solutions

## Customer Issues and Solutions

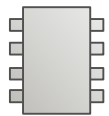
If you have the following concerns, consider solution by FRAM



## Compatibility with EEPROM and SRAM

### EEPROM is replaceable with FRAM

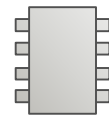
EEPROM



8-pin SOP



FRAM

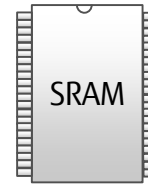


8-pin SOP

\*: Conditions: same pinout & interface

### SRAM is replaceable with FRAM

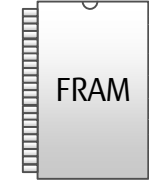
SRAM+ Backup battery



44-pin TSOP



FRAM only



44-pin TSOP

\*: Conditions: same pinout & interface


## Support to evaluate our FRAM device

### Simulation models (Verilog, IBIS)



### Providing FRAMs via online





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