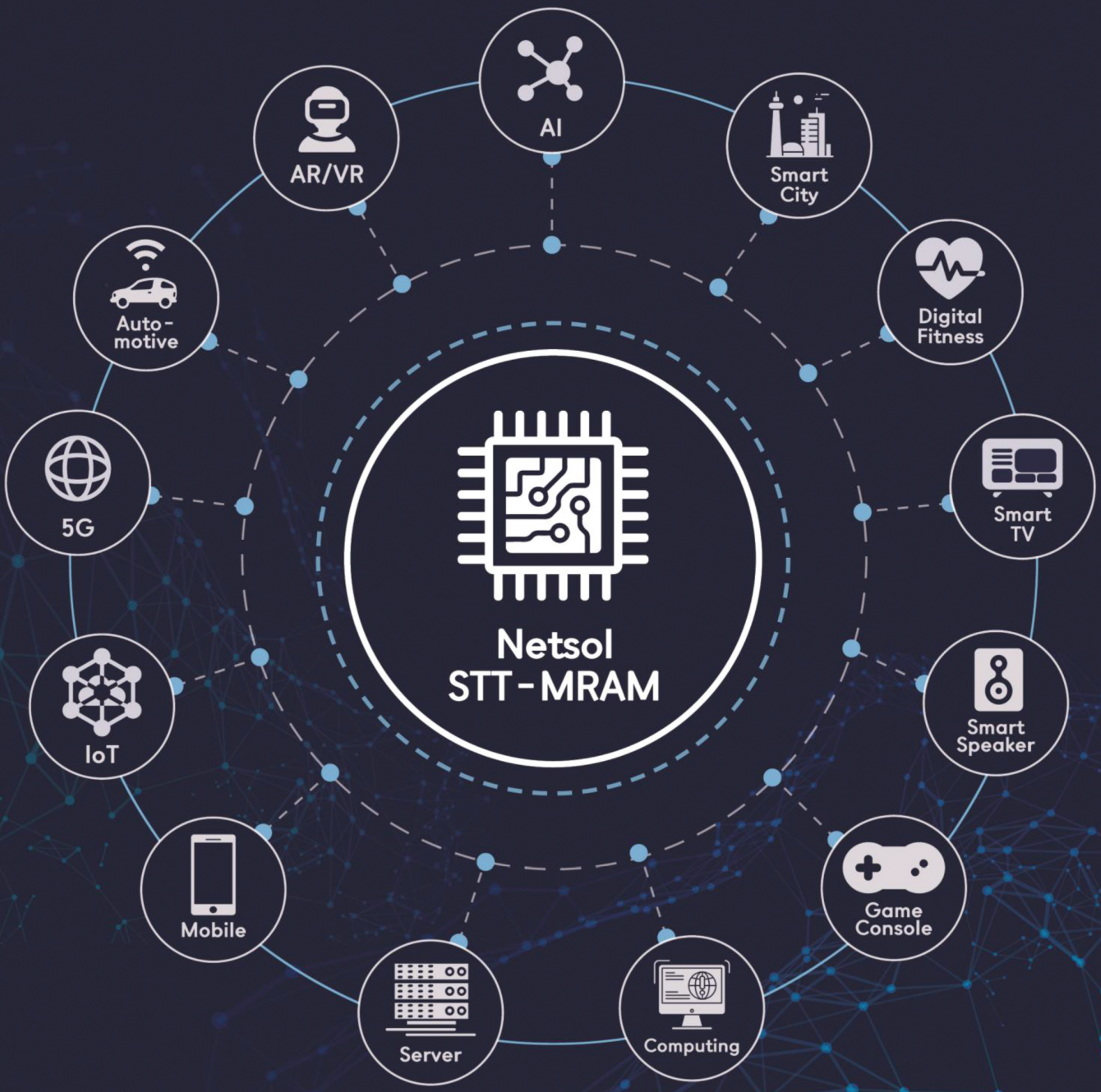
NETSOL

New **E**volution of **T**echnology and **SOL**ution



NETSOL

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- Fabless memory IC company in Korea
- Over 30 years experience of engineers
- STT-MRAM and Fast SRAM Products
- Long term and stable supportability with higher quality level

Product Line Up

Serial - MRAM

Density	Process	SPI Mode	Speed	Vcc	Package	Status
1Mb, 2Mb, 4Mb 8Mb, 16Mb, 32Mb	28nm	Single Dual Quad	108MHz	3.3V 1.8V	8WSON 8SOIC	Customer Sample at Dec. 2022

Parallel - MRAM

Density	Process	I/O Org.	Access Time	Vcc	Package	Status
1Mb, 2Mb, 4Mb 8Mb, 16Mb, 32Mb	28nm	x8, x16	70ns	3.3V 1.8V	44TSOP2 54TSOP2 48FBGA	Customer Sample at Feb. 2023

Fast Asynchronous SRAM

Density	Process	I/O Org.	Access Time	Vcc	Package	Status
1Mb, 2Mb, 4Mb 8Mb, 16Mb, 32Mb	90nm	x8, x16	8ns 10ns	1.8V, 2.5V 3.3V, 5.0V	44TSOP2 48TSOP1 48FBGA	Mass Production
1Mb, 2Mb, 4Mb 8Mb, 16Mb, 32Mb	55nm	x8, x16	8ns 10ns	1.8V, 2.5V 3.3V	44TSOP2 48TSOP1 48FBGA	Under Development

Serial STT-MRAM

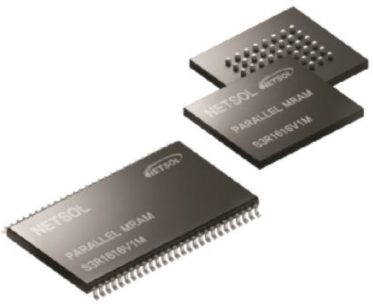
Features

Density	1Mb, 2Mb, 4Mb, 8Mb, 16Mb, 32Mb
Interface	Single, Dual and Quad SPI with SDR and DDR XIP for read and write operations Non-volatile registers
Performance	108MHz (432Mbps)
Operating Voltage	3.3V, 1.8V
Operating Temperature	-40℃ ~ 85℃
Low power consumption	Standby current : 330uA (3.3V), 280uA (1.8V) Deep power down current : 80uA (3.3V), 25uA (1.8V) Read current : 11mA (3.3V), 8mA (1.8V) Write current : 25mA (3.3V), 21mA (1.8V)
Process	28nm FDSOI STT-MRAM, Samsung Foundry
Reliability	Data Retention : 10 years Read Endurance : unlimited Write Endurance : Virtually unlimited,10^{14} No external ECC required.
Package Type	8-WSON, 8-SOIC
Compatibility	FRAM, NOR, nvSRAM, MRAM
Application	Industrial, IoT, Smart, Medical, Storage System, etc.
CS Schedule	Dec. 2022

Parallel STT-MRAM

Features

Density	1Mb, 2Mb, 4Mb, 8Mb, 16Mb, 32Mb
Interface	Parallel asynchronous interface page mode function for high performance
Performance	Interpage/Intrapage read access : 70ns/15ns Interpage/Intrapage write access : 320ns/15ns
Operating Voltage	3.3V, 1.8V
Operating Temperature	-40℃ ~ 85℃
Low power consumption	Standby current : 350uA (3.3V), 300uA (1.8V) Read current : 15mA (3.3V), 13mA (1.8V) Write current : 15mA (3.3V), 13mA (1.8V)
Process	28nm FDSOI STT-MRAM, Samsung Foundry
Reliability	Data Retention : 10 years Read Endurance : unlimited Write Endurance : Virtually unlimited, 10^{14} No external ECC required
Package Type	48-FBGA, 54-TSOP, 44-TSOP
Compatibility	FRAM, Low-power SRAM, nvSRAM, MRAM
Application	Industrial, IoT, Smart, Medical, Storage System, etc.
CS Schedule	Feb. 2023



STT-MRAM Competitiveness

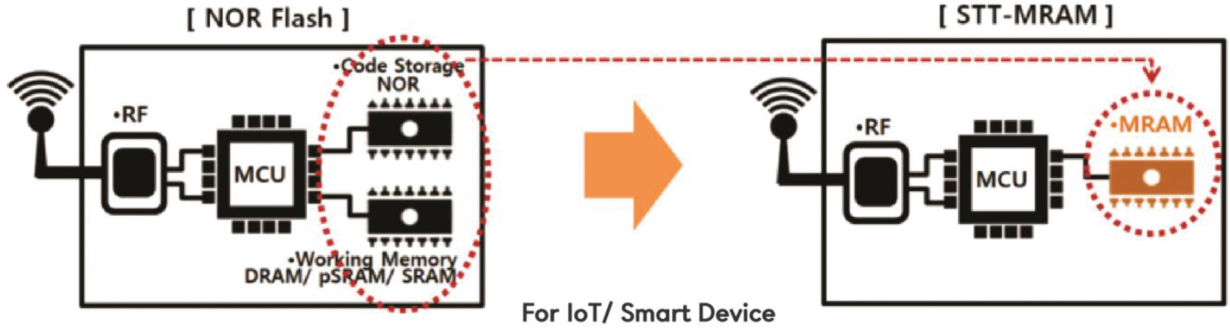
• Direct Replacement for FRAM, NOR Flash, EEPROM •

STT-MRAM vs FRAM

	FRAM	STT-MRAM (NETSOL)	
Available Density	16Kb~16Mb	**1Mb~32Mb**	High Scalability
Operating Frequency	108MHz	**108MHz**	High Speed
Endurance	10^{13} ~10^{14} cycles (read and write)	**10^{14} cycles (only write)**	High Endurance
Data Retention	10 years	**10 years**	High Retention

STT-MRAM vs NOR Flash

	NOR Flash	STT-MRAM (NETSOL)	
Available Density	512Kb~2Gb	**1Mb~32Mb** **Higher Density in the future**	High Scalability
Write Time	Program : 1~3ms Erase : 40~400ms	**20~350ns No Erase Function**	High Speed
Write Endurance	10^{5} cycles	**10^{14} cycles**	High Endurance
Random Accessibility	Limited by Page and Block size	**No Limit**	Efficient Memory Space Utilization
Data Retention	10 years	**10 years**	High Retention



MRAM Applications

Replace LP SRAM, FRAM, NOR Flash, EEPROM in future single chip MCU

Industrial, Automotive, Avionics & Space
Wide Temperature Range, Lower Soft Error Rate, More Reliable Than Flash

Systems Enterprise Data Storage
Write Buffers, Meta Data Storage, Index Memory

Medical Systems
Fast Data Logging, Data Never Lost During Power Fail

Instant-On Systems
No Need to Boot Data from Flash to DRAM or SRAM