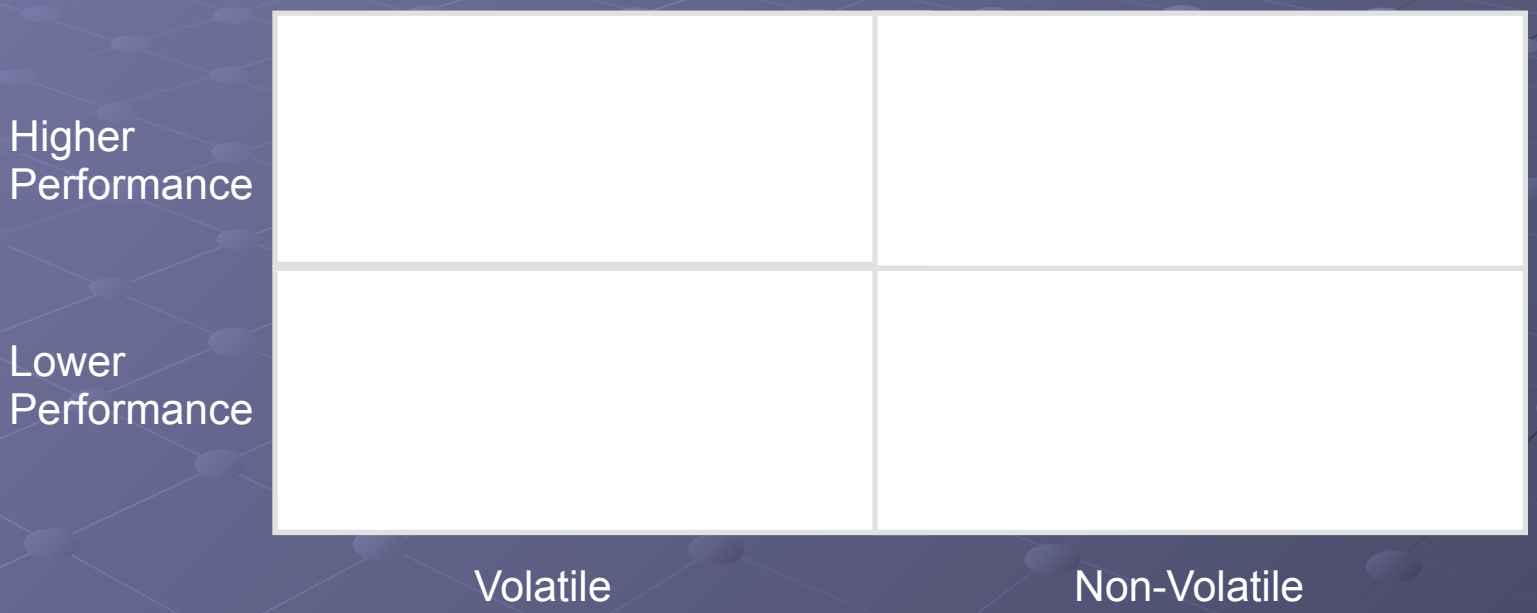
TAS-MRAM Production Ready & Scalable

"From Lab to Fab"

Crocus Technology

August 2009

Comparison to Traditional High Volume Memories



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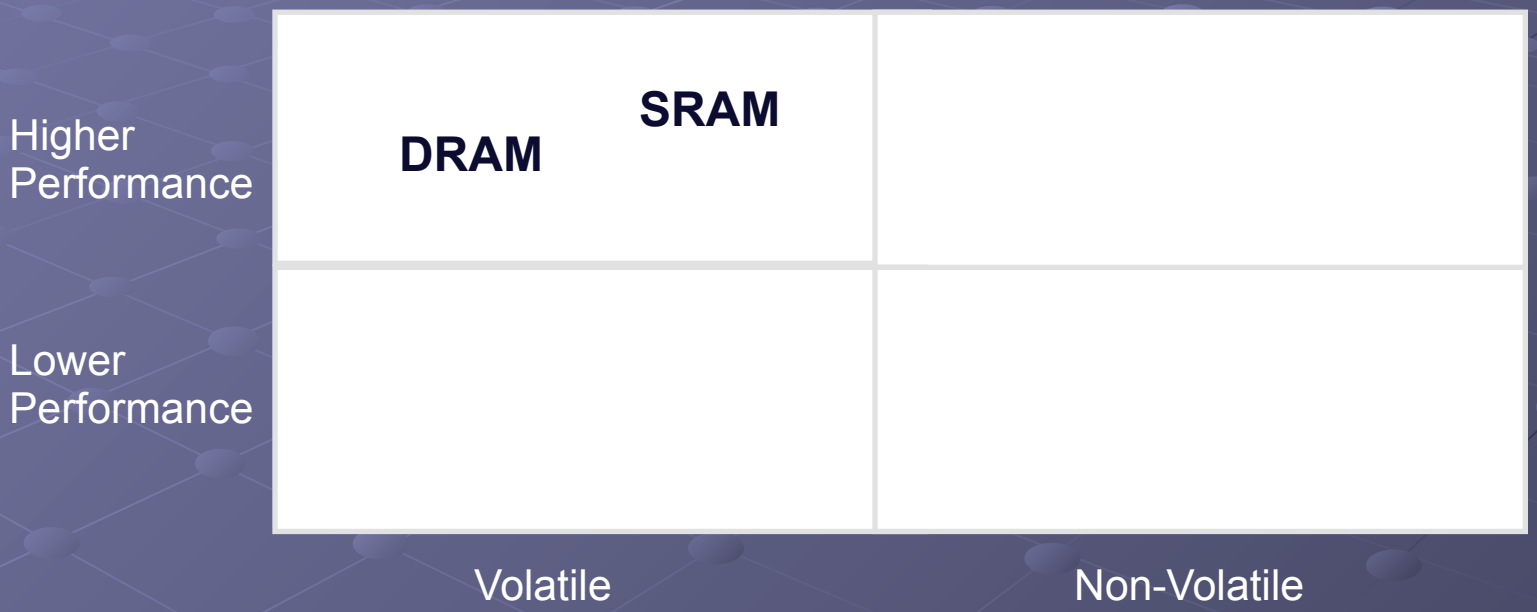

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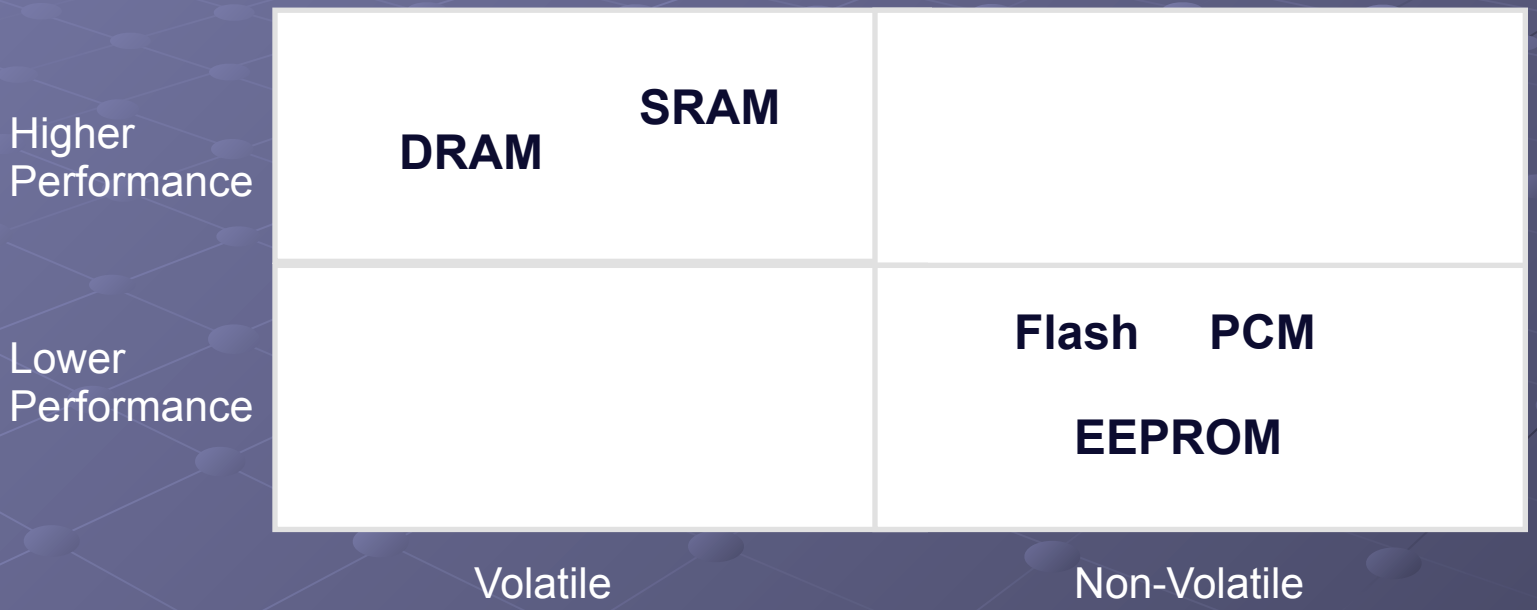

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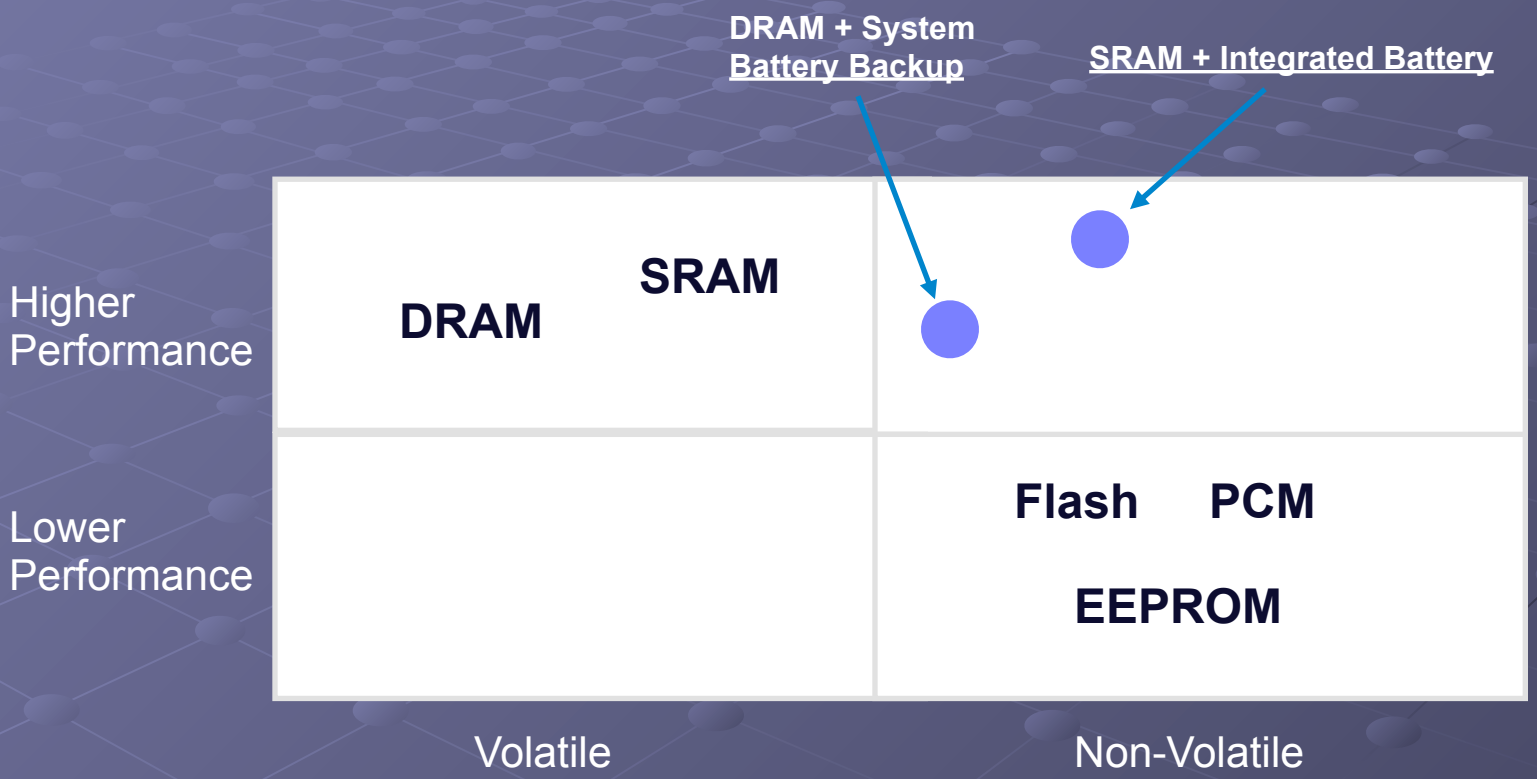

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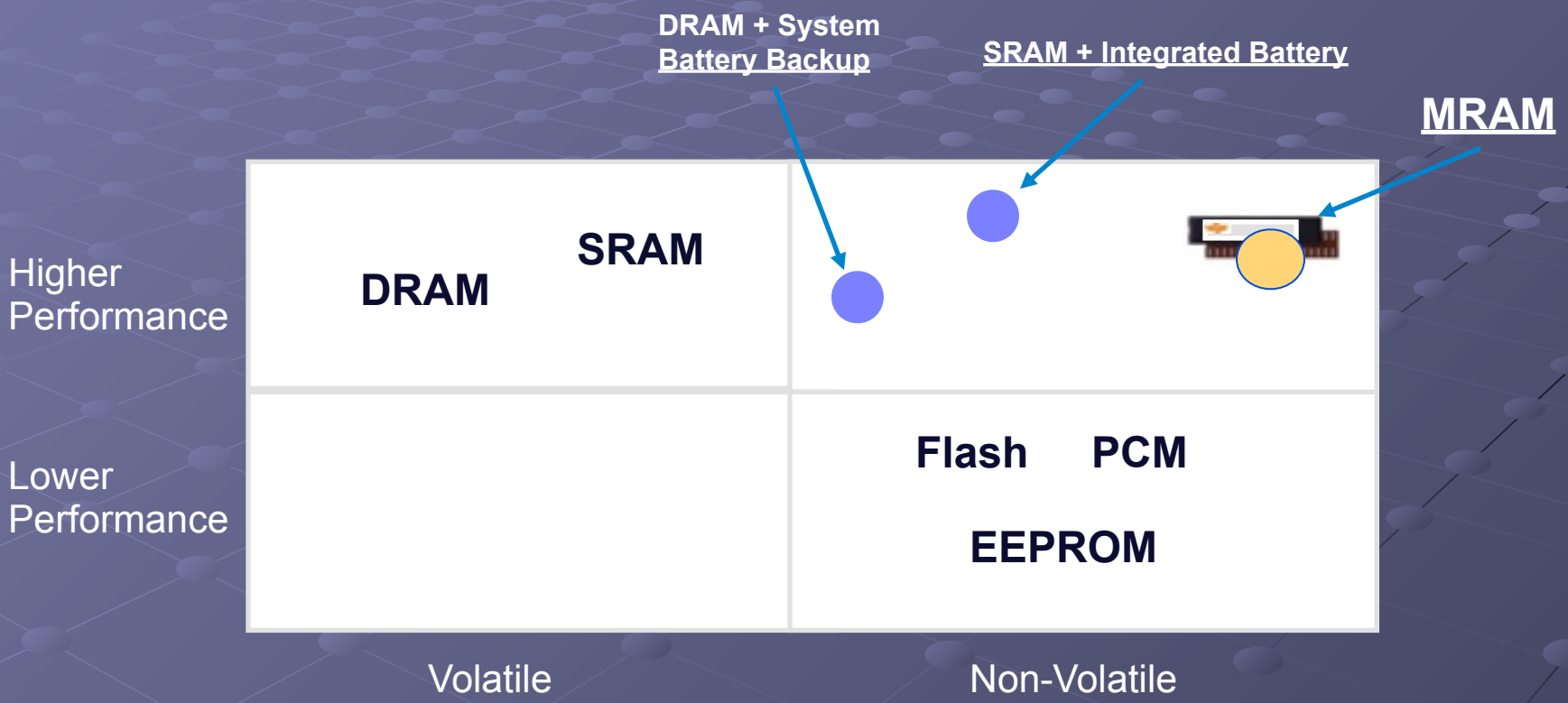
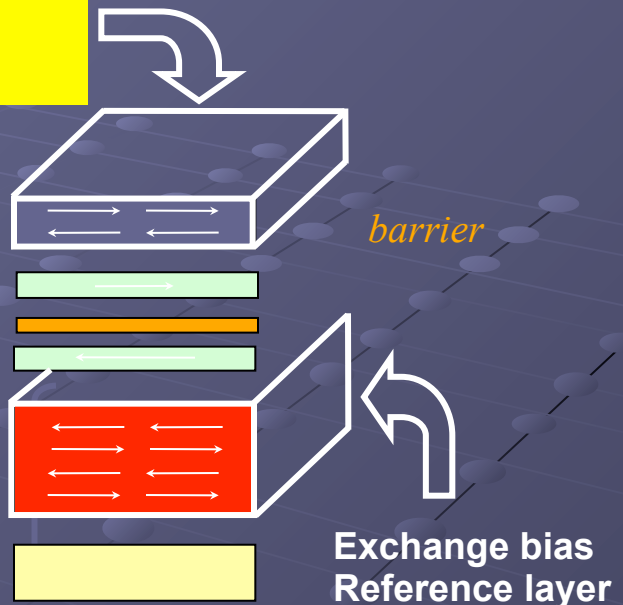


Data is stored in magnetic elements (Magnetic Tunnel Junction - MTJ) vs. stored charge (Flash, DRAM, etc.) or Flip-flop (SRAM)

MRAM Generations

1st Generation	FIMS
2nd Generation Production in 2010	TAS
3rd Generation Samples in 2010	STT

Crocus Innovation :
Exchange biased storage layer



- MANUFACTURABLE
  - SELECTIVITY
  - STABILITY
  - SCALABILITY

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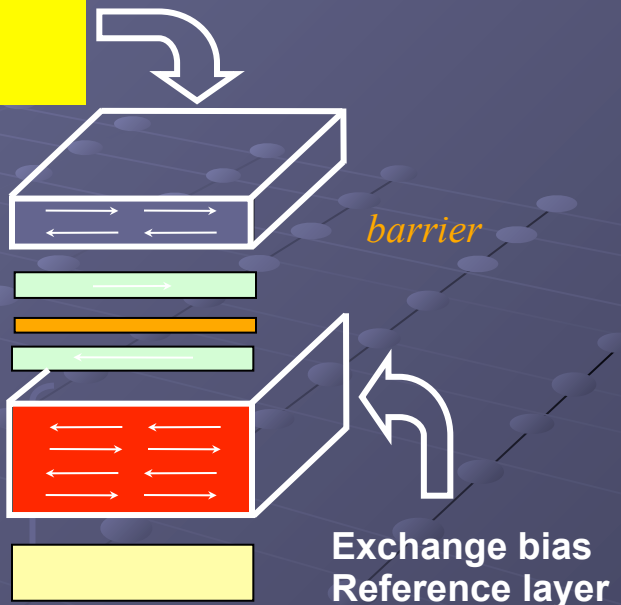

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TAS-MRAM…..Volume production in 2010 on Tower Semiconductor's 130nm CMOS process!!

TAS-MRAM - Discrete

- Replacement for BBSRAM, nvSRAM, and FeRAM

	TAS-MRAM	BBSRAM	nvSRAM	FeRAM
Write Cycle	35ns	70ns-150ns	15ns-45ns	90ns-115ns
Endurance	Unlimited	Unlimited	$2x10^5$(store)	10^{14}
Data Retention	10yr	10yr (battery lifetime)	10yr	10yr
Relative Cost	Low	High	Medium	Low

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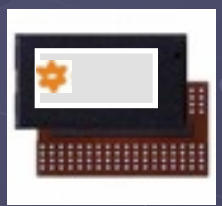
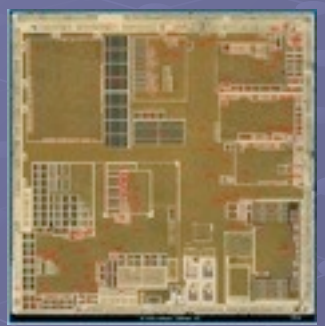
1Mb -256Mb Densities
x8 and x16 Configurations

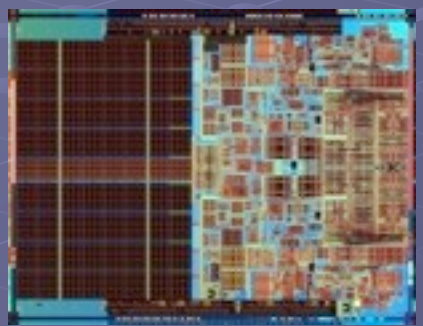


TAS-MRAM - Embedded

- Replacement for embedded SRAM and Flash



SOCs with over
150 SRAM macros



MPUs with L2/L3 caches

30% - 50% of the die area is SRAM
6T SRAM bit cell size is 4x MRAM equivalent

- **TAS-MRAM Benefits over SRAM….**
  - **Die size savings of 25% to 38%**
  - **Power savings - "zero" standby current**
  - **Non-volatility is bonus**

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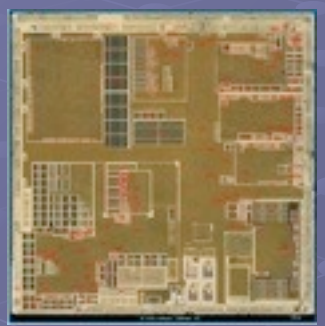

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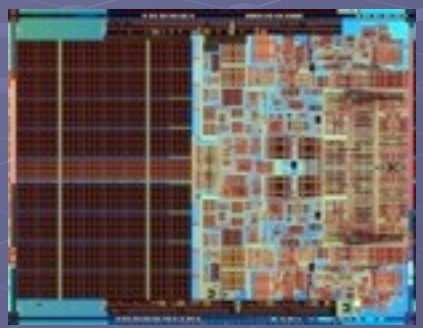

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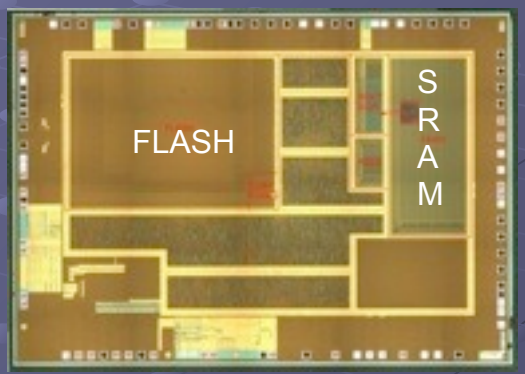

32Bit RISC MCU
- 64KB SRAM
- 512KB FLASH

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- **TAS- MRAM Benefits over Flash….**
  - **Faster write – Bit level write**
  - **Higher endurance - No "wear leveling" needed**
  - **Fast wake up - "Instant on"**
  - **Cell size**
    - **35f^2 bit cell**
    - **<1x circuit overhead**
  - **Process**
    - **No high voltage / pump charge required**
    - **3-4 process steps over CMOS**

TAS-MRAM Applications

- Cache Memory
- Buffer Memory
- Data Logging

Wide range of applications !!

- **Storage**
- **Networking**
- **PC Servers**
- **POS Terminals**
- **Advanced Metering**
- **Cell Phone**
- **Set top box**
- **Medical Instrumentation**
- **Casino Gaming**
- **Industrial Control**
- **Aerospace**
- **Automotive**

TAS-MRAM Production Ready & Scalable

- Discrete ICs
- Embedded Memory Blocks
- Technology Licenses
- Foundry Services

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