Emerging Non Volatile Memory (NVM) Technology

Description: Emerging NVM technological choices are about to be made by key players: STTMRAM/MRAM or RRAM?

Over the last two years, the complex emerging non-volatile memory (NVM) situation has been greatly simplified.

In 2014, Micron, the main phase-change memory (PCM) promoter for stand-alone memory, stopped actively selling PCM chips following the collapse of sales targeting the shrinking entry-level mobile phone market. At the same time, Micron developed a resistive random access memory (RRAM or ReRAM) chip with Sony, part of a technology class that includes conductive bridge RAM (CBRAM). At 16 Gb the Micron-Sony RRAM has the highest density commercialized among emerging NVM technologies. Thus, we believe that PCM is now out of the race for stand-alone memory. For embedded microcontroller unit (MCU) applications 2015 will be a key year as STMicroelectronics, the main PCM promoter in this market, will choose if PCM will remain in its roadmap.

The new emerging NVM report is thus focused on the two most promising technologies: RRAM and magnetoresistive RAM (MRAM). The most attractive category of MRAM is spin-transfer torque magnetoresistive RAM (STTMRAM) that provides higher scalability/density. A main selection criterion for memory is the scalability/density of the chips, as this impacts both performance and cost. The Yole report provides a precise memory roadmap in terms of technological nodes, chip density and pricing.

STTMRAM/MRAM and RRAM have different features and positioning. Nevertheless, they will compete in 2015 and 2016 in some standalone markets, with storage class memory for enterprise storage being the biggest one. They will also compete in embedded MCU markets in the wearable, smart card and other markets. Micron has already selected RRAM for 2015 and other key stand-alone players like Samsung and SK Hynix should react quickly. In the embedded memory space, only Panasonic has selected RRAM and many key players have not yet made their choice. There is still high uncertainty over what will be the best technology to adopt. The next two years will therefore be critical for the future. There are multiple selection criteria, including scalability, retention, speed, endurance and cost. Making the right choice is not an easy task, but this report will provide insights about the main market drivers for each type of memory in each application.

In the long term, STTMRAM is sure to be the only candidate to substitute DRAM thanks to its high endurance. RRAM is sure to substitute NAND thanks to its high scalability/low cost.

This report provides a market forecast for each technology by application, in units, in Gbit, revenues and also number of wafers. It also presents a precise review of all the latest technical developments by the main players to understand the status of the technology and the main technical challenges.

Higher density emerging NVM chips will extend the accessible market from niches to DRAM and NAND mass markets:

The emerging NVM report describes why and how emerging NVM technologies will be increasingly used in various markets. The key markets are: industrial & transportation; enterprise storage; wearable; mobiles phones; mass storage; and MCU smart card and other markets.

Emerging NVM sales are still moderate at $65M in 2014 and limited to niche markets due to the limited density available. This is despite several alliances targeting MRAM development that have driven progress in structuring the ecosystem, and Panasonic and Adesto introducing new RRAM products. MRAM high density product availability has been delayed by Everspin, plus Micron's PCM sales have declined sharply due to the collapse of the entry-level phone market. The emerging NVM market in 2014 is thus considerably lower than the dominant volatile DRAM and non-volatile Flash memory businesses, which had combined revenues of more than $70B in 2014.

However in the next 5 years, scalability and chip density of the new memories will be greatly improved, and this will open up many new applications.
Enterprise storage will be the killer market for emerging NVM by far in 2020. The new technologies will greatly improve data center storage system performance, where requirements are intensifying with the data traffic explosion. Customers will use STTMRAM and RRAM at first for new types of Storage Class Memory (SCM) in their architecture in order to reduce latency of the system. Then DRAM will start to be substituted by STTMRAM in 2018 – if STTMRAM’s cost is sufficiently low.

Embedded MCU for wearable, smart card & other markets will increasingly adopt emerging NVM because embedded MCU flash scalability is running out of steam, especially after 2018 at the 28 nm node. In the short term, emerging NVM will be rapidly adopted in the wearable and smart card markets thanks to its low power consumption, and higher density chips.

Mass storage is currently served by NAND memory, but 3D NAND scaling is expected to slow down by 2020. In the meantime, 3D RRAM scalability is expected to surge thanks to big memory makers’ efforts and a new entrant, Crossbar, that is targeting an aggressive time to market for a 1 Tb chip, expected in 2018. Thus this market will start prior to the end of scaling of 3D NAND thanks to RRAM’s high speed/low power benefit.

Overall, the global emerging NVM market will grow from $65M in 2014 to $7B by 2020, meaning an impressive growth of +118 % /year. Nevertheless, this is a forecast based on a conservative scenario and we also provide a best-case scenario with an even broader adoption of NVM in the report.

Multiple players in the supply chain are playing a part in the emerging NVM adoption process.

The report analyses in detail the different players in the supply chain in both the stand-alone and embedded market:

- Integrated Device Manufacturers (IDMs) with internal manufacturing capabilities: These players dominate the highly concentrated stand-alone memory supply chain, with 5 players supplying 90% of the DRAM and NAND sales.
- Foundries: These players are the main chip manufacturers for embedded memory markets, namely mobile microprocessor units (MPU) and MCUs. They are very interested by the possibility that emerging NVM could help them enter the stand-alone memory market, and feed their expensive fabs.
- Startup companies target both stand-alone and embedded markets and rely on foundries’ manufacturing infrastructure. They are expected to be acquired by big IDMs when the emerging NVM market ramps up.
- Enterprise storage end users: With the data traffic explosion, enterprise storage end users like Google, Facebook, and eBay are driven to find new solutions for their booming data centers. They will therefore influence IDMs’ technological choices; for instance, Micron built up strategic partnerships with Google and Facebook.

We have analyzed the dynamics of the supply chain to understand who are today’s key market players in each application and technology and how the competitive landscape will evolve.

What’s New:

- Forecasts with additional shipments in Gbit and price in US$/Gbit
- Addition of wearable market segment
- In depth analysis of embedded markets (MCU and mobile CPU)
- Addition of MCU markets other than smart card, including general purpose and automotive
- Analysis of foundries’ position in the supply chain
- Startup funding analysis
- In-depth analysis of STTMRAM and RRAM technologies and players
- FRAM excluded from the report scope due to limited evolution and adoption in the future
- PCM excluded from the forecast as it will probably withdraw from the emerging NVM race

Objectives Of The Report:

1. Presents an overview of the semiconductor memory market
   - NAND, DRAM, embedded MCU and mobile CPU main markets, market forecast, and main trends
   - Current technological status and roadmap for the coming years
   - Market landscape

2. Provides understanding of emerging NVM applications:
   - For six application fields (ass storage, mobile devices, MCU smart card & other markets, wearable, enterprise storage, industrial & transportation): total addressable market, market drivers and challenges,
technology roadmap, players, main trends.
- Roadmap with time to market by application

3. Presents market forecasts on emerging NVM business:
- 2014-2020 market forecast in units, in Gbit, US$/Gbit, and number of wafers
- Price evolution by application and technology
- Forecast for six applications and two technologies (MRAM/STTMRAM, RRAM)

4. Describes emerging NVM technologies
- Working principle, manufacturing methods, advantages/limitations, status of development, price, time to market
- Roadmap with technological nodes, and chip density evolution with main players
- Latest product development status for each key market player

5. Describes and analyzes the competitive landscape
- Recent acquisitions and funding
- Latest company news
- Who the key players are by technologies and applications

Contents:
- Executive summary
- Standard memory market introduction
- NAND market overview
- DRAM market overview
- “Niche” standalone memory: Overview
- Embedded SoC memory: Overview
- Memory Market players overview
- Emerging NVM: Overview
- Segmentation / density evolution
- Stand alone memory position in 2014: commercial products performances
- Recent emerging memory products introduction
- Market forecast by technology 2014
- 2020 (in $M / in M Gbit / in # of wafers 12” eq)
- Strategy example: Hynix / Micron / Samsung
- Roadmap: stand alone devices and embedded SoC devices
- Players position
- Dominant players: acquisitions & alliances
- Startup funding
- New emerging NVM players
- Dominant embedded memory MCU players and emerging NVM involvement
- Equipment players involved in Emerging NVM
- Supply chain
- Foundries growing influence thanks to emerging NVM

Emerging NVM applications
- Definitions and specifications
- Positioning: SCM definition
- Positioning by application and current memory used
- 2014 average sales price by application
- Memory density requirements by applications
- Time to market by application / application analysis
- Emerging memories potential applications: density and price positioning
- Market forecast and key industrial players by application

Industrial & transportation applications
- Enterprise storage applications
- Description
- Infrastructure server applications are booming thanks to growing internet needs
- Cloud data centers market and enterprise SSD market are booming
- SSD market players
- Enterprise storage applications need SCM to reduce latency
- STT MRAM SCM solution
- Avalanche MRAM based enterprise storage systems
- RRAM SCM solution
- Enterprise storage supply chain
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- Description
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- Global smart card market
- Smart card telecom NFC market
- Government/ID card forecast
- Smart card MCU market and players
- Embedded flash NOR technology
- MCU supply chain – Smart card focus
- Main MCU smart card players: involvement in emerging NVM

Wearable applications
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- Wearable players: ST Microelectronics / Qualcomm / Adesto / ARM
- Wearable memory architecture and requirements
- Power consumption issue / supply chain

Mobile devices applications
- Description / forecast
- SoC cache memory application
- Players: Toshiba / Qualcomm
- Mobile devices SoC supply chain

Mass storage NAND market
- Description / Mobile devices and SSD drive growth
- Big challenge for emerging NVM: develop a 3D approach
- Players: Sandisk / Crossbar Inc

MRAM technology, forecast & players
- MRAM and STT MRAM technologies description / time to market by application / players positioning / start up's funding / roadmap (stand alone devices) / embedded roadmap / Market forecast in units, Gbit, $/Gbit, $, Wafers
- Singapore MRAM cluster
- MRAM market players: Everspin (US) / Honeywell Aerospace (US) / Aeroflex (US) / Samsung/ Micron/ SK Hynix / Toshiba/ Avalanche technology (US) / Spin Transfer Technologies (US) / Crocus technology (FR) / IMEC/ TDK headway technologies
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RRAM technology & forecast & players 245
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- 3D RRAM challenge: sneak current effect
- RRAM main players: Crossbar Inc / Micron
- Sony / Adesto / Rambus & Unity / Samsung/ HP/ SK Hynix / IMEC/ Sandisk/ TSMC
- Embedded RRAM players: Altis Semiconductor / Panasonic/ ST microelectronics / TSMC / Infineon / Freescale Rambus / Symetrix / Evaderis

PCM Technology, forecast & players 308- PCM technology description / players positioning / development history
- Micron profile / Future product
- Samsung's PCM product
- SK Hynix's PCM development
- Embedded PCM players: ST Microelectronics'/IBM

General conclusions

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