Emerging Non-Volatile Memory

Description: Emerging NVM enter niche memory markets; expected to reach $2B by 2018.

Will NVM eventually replace DRAM and NAND?

KEY FEATURE OF THE REPORT

- Overview of the semiconductor memory market
- Market forecasts on emerging non-volatile memory business (in units, US$, number of wafers, applications, technologies - FRAM, MRAM/STTMRAM, PCM, RRAM)
- Understanding of the emerging non-volatile memory applications for five applications fields (Industrial & Transportation, Smart Card, Enterprise Storage, Mobile Phones, and Mass Storage)
- Emerging NVM technologies: status of development and roadmap
- Competitive landscape description and analysis

HIGHER-DENSITY NVM CHIPS WILL SPAWN MANY NEW APPLICATIONS AND INCREASE THE BUSINESS TEN-FOLD IN JUST FIVE YEARS

This Yole Développement report describes why and how emerging NVM (FRAM, MRAM/STTMRAM, PCM, RRAM) will be increasingly used in various markets: Industrial & Transportation, Enterprise Storage, Smart Card, Mobiles Phones and Mass Storage.

Until recently, only FRAM, PCM and MRAM were industrially produced and available in low-density chips to only a few players. Thus the market was quite limited and considerably smaller than the volatile DRAM and non-volatile Flash NAND dominant memory markets (which enjoyed combined revenues of $50B + in 2012).

However, in the next five years the scalability and chip density of those memories will be greatly improved and will spark many new applications, with the following NVM market drivers explained in detail in this report:

- With the adoption of STT MRAM and PCM Cache Memory, Enterprise Storage will be the largest NVM market. NVM will greatly improve the input/output performance of enterprise storage systems whose requirements will intensify with the growing need for web-based data supported by cloud servers.

- Mobile Phones will increase its adoption of PCM as a substitute to flash NOR memory in MCP packages thanks to 1GB chips made available by Micron in 2012. Higher-density chips, expected in 2015, will allow access to smart phone applications that are quickly replacing entry-level phones. STTMRAM is expected to replace SRAM in SoC applications thanks to lower power consumption and better scalability.

- Smart card MCU (microcontrollers) will likely adopt MRAM/STTMRAM and PCM as a substitute to embedded flash. Indeed, flash memory cell-size reduction is limited for the future. NVM could reduce the cell size by 50% and thus be more cost-competitive. Additional features like increased security, lower power consumption and higher endurance are also appealing NVM attributes.

- Mass storage markets served by flash NAND could begin using 3D RRAM in 2017-2018, when 3D NAND will slow down its scalability as predicted by all of the main memory players. When this happens, a massive RRAM ramp-up will commence in the next decade that will replace NAND, if sufficient 3D RRAM cost-competitiveness and chip density are available. Overall, the global emerging non-volatile memory market will grow from $209M in 2012 to $2B in 2018, equating to an impressive growth of +46 %/year. Nevertheless, this is a forecast based on a conservative scenario, and the report also provides a best-case scenario for an even broader adoption of NVM.

MRAM/STTMRAM AND PCM WILL LEAD THE NVM MARKET, REACHING A COMBINED $1.6B BY 2018
Market adoption of memory is strongly dependent on its scalability. This Yole report provides a precise
memory roadmap in terms of technological nodes, cell size and chip density for each NVM (FRAM,
MRAM/STTMRAM, PCM, RRAM). A market forecast is provided for each technology by application, units,
revenues and also # of wafers. A comprehensive review of the latest technical developments of every main
player is presented in order to understand the technology's status and the main technical challenges.

By 2018, MRAM/STTMRAM and PCM will surely be the top two NVM on the market. Combined, they will
represent a $1.6B business by 2018, and their sales will almost double each year, with double-density chips
launched every two years.

FeRAM will grow at a steadier growth rate (+10%/year) and will focus on industrial & transportation
applications because of the low-density available. RRAM revenues won't really surge until 2018, with the
availability of high-density chips of several 10's of Gb that could replace NAND technology.

GIANT MEMORY MANUFACTURERS AND START-UP COMPAGNIES COMPETE ON TECHNOLOGY
DEVELOPMENT

The Memory supply chain has been highly concentrated in the last 10 years, supporting a huge price/Gb
decrease (-20 to 40 %/year for NAND and DRAM). Five players (Samsung, Micron, Sk Hynix, Toshiba and
Sandisk) hold 90 % of DRAM and NAND sales. These leading players will have a key role in the competitive
landscape of emerging NVM. This report identifies and positions the key emerging NVM players based on
the technology developed, market presence (new entrant or established memory player), and targeted
markets. The supply chain dynamic is analyzed in order to understand who today's key market players are in
each application and technology, and to illustrate how the competitive landscape will evolve.

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- Big challenge for emerging NVM: develop a 3D approach like for NAND and DRAM

Emerging NVM applications

- General Solid State Memory Applications
- Emerging NVM applications: some definitions
- Memories Specifications
- Emerging NVM applications positioning
- Emerging NVM Applications
- Emerging NVM positioning by application and current memories used
- Memory Density Requirements by applications
- Emerging NVM Time to market by Application
- Emerging NVM application analysis
- Emerging Memories potential applications: density and price positioning
- Emerging NVM key industrial players by application

Industrial applications

- Industrial Applications Description

Smart Card market

- Smart Card Application Description
- Global Smart Card Forecast: 10 B units for 2017
- Telecom SIM Card Market forecast and accessible market for emerging NVM
- Telecom SIM NFC Market
- Government/ID card forecast
- Smart Card supply chain
- Smart Card MCU market and players
- Embedded Flash NOR current technology
- Main MCU smart card players: memory technologies and involvement in emerging NVM
- Crocus Technology MLU (Magnetic Logic Unit)
- Smart Card Embedded memories technological roadmap of Key players
- Smartcard manufacturers
- Conclusions on Smart Card application

Enterprise Storage applications

- Enterprise Storage Application Description
- Infrastructure Servers applications are booming thanks to growing internet needs
- Cloud Data Centers Market is booming
- Enterprise SSD market is booming
- Potential enterprise storage applications for emerging NVM at different levels of the systems
- Impact of emerging NVM on enterprise storage systems
- Cache Memory for enterprise storage SSD: Skyera case study
- Enterprise storage supply chain
- Conclusion on Enterprise Storage Applications

Mobile phone applications

- Mobile Phone Application Description
- Mobile phone forecast in Units
- Smart Phone Memory will surge
- Mobile phone applications
- Mobile phone application: SoC embedded
- Smart Phone Power Consumption: memory has a huge impact for entry level phones
- Toshiba STT MRAM development
- NOR mobile phones embedded SiP applications and players
- Micron PCM sales in mobile phone applications: for entry level mobiles and smart phones
- Mobile phone supply chain
- Conclusion on Mobile Applications

Mass Storage NAND market
MRAM technology & forecast & players

- MRAM and STT MRAM technologies
- STT RAM : benefit from the manufacturing experience of HDD
- MRAM players positioning
- STT MRAM chip density roadmap
- MRAM / STT MRAM market forecast in units, in $, in wafers
- MRAM / STT MRAM Price evolution in $
- MRAM market players : Everspin
- Samsung Electronics – Semiconductor activity
- STT RAM Samsung developments
- Qualcomm/ TSMC - STT MRAM developments
- Micron STT MRAM developments
- Hynix STT RAM development
- Toshiba STT MRAM development
- Avalanche STT MRAM activity
- IMEC STT MRAM roadmap
- Conclusions on MRAM / STT MRAM

PCM technology & forecast & players

- PCM technology description
- PCM market forecast in units, in $, in wafers
- PCM Price evolution in $
- PCM players positioning
- PCM roadmap and history of development
- PCM material
- PCM positioning compared to NAND and DRAM
- Micron profile
- Micron roadmap Micron latest commercial product
- Micron PCM Development Trends
- Samsung PCM products and developments
- Embedded PCM ST Microelectronics development
- Hynix PCM development
- Conclusions on PCM

RRAM technology & forecast & players

- RRAM technology description
- RRAM market forecast in units, in $, in wafers
- RRAM Price evolution in $
- RRAM players positioning and chip density roadmap
- RRAM material candidates
- Cell and array configuration
- RRAM selector element : general constrains
- Rambus RRAM technology and roadmap
- Adesto CBRAM development
- Samsung RRAM developments
- Micron – Elpida - Sony RRAM R&D
- HP RRAM development
- Hynix RRAM R&D
- SK Hynix profile
- IMEC RRAM roadmap
- Sandisk RRAM development
- Macronix CBRAM and RRAM R&D
- Panasonic RRAM R&D
- Conclusions on RRAM

FeRAM market
- FeRAM technology
- FeRAM players
- FeRAM roadmap
- FeRAM TAM
- FRAM Research
- Conclusions on FeRAM

General Conclusions

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