MEMS for Cell Phones & Tablets

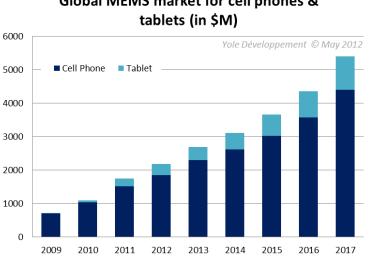
TECHNOLOGY & MARKET REPORT – MAY 2012

20% annual growth to reach \$5.4B in 2017!

10 NEW MEMS APPLICATIONS TO BE >\$100M in 2017

 $\ensuremath{\mathsf{MEMS}}$ devices are extremely popular in mobile applications. Despite this interest, only 3 categories of MEMS devices are in high volume production today:

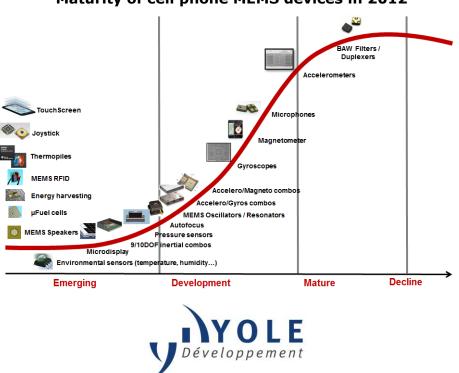
- 1. Motion sensors: including accelerometers. magnetometers and more recently gyroscopes is the hottest market segment. It is still growing quickly and many business and technical evolutions are expected. One of them is the launch of combo sensors which provide a higher level of integration and possibly embed sensor fusion algorithms
- 2. MEMS microphones: which are promised to a bright future, driven by ECM replacement and by new functionalities that require multiple microphones
- 3. BAW filters and duplexers: BAW is popular since many years for the Band 2 in particular, and new opportunities will appear with some of the bands that will be used in 4G standards.



Global MEMS market for cell phones &

Many other MEMS products are under development. The report highlights that novel MEMS opportunities need to be watched as they will fuel this market significantly:

- While limited to weather forecast applications today, pressure sensors are going to be used in combination with inertial sensors to provide location-based services
- RF MEMS switches had a successful start in 2011 and will benefit from the current hype for antenna tuning
- Oscillators is another hot area where silicon MEMS has a high potential, both for replacing TCXO quartz oscillators and for integration of resonators
- Another hot market is going to be MEMS auto-focus which provides significant added value compared to the existing VCM technology, but will face competition with other technologies as well
- And many other types of MEMS are emerging: microdisplays, microspeakers, environmental sensors, touchscreen, joystick...



Maturity of cell phone MEMS devices in 2012

NEWCOMERS TO JOIN ST AND THE OTHER LEADERS IN THIS ATTRACTIVE MARKET

Opportunities are thus huge for MEMS device makers, as this market tripled from 2009 to 2011. The ranking of the top players has also evolved the past 2 years: ST Microelectronics was number 3 in cell phone applications in 2009 and is now the number one supplier by far with \$477M cellphone and tablet revenue in 2011. ST Microelectronics still dominates the MEMS accelerometer market, had an impressive start with MEMS gyroscopes, only challenged by InvenSense, and_continues to expand to many other MEMS devices to become a one-stop supplier.

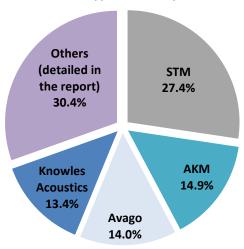
ST Microelectronics major clients are Apple, Samsung, Nokia, RIM and HP. Other large players are very focused on their core markets: AKM is the number 2 with \$260M sales of magnetometers for electronics compass solution, Avago is leading the BAW filters and duplexers market with \$244M sales, and Knowles is number 4 with \$233M revenues from MEMS microphones. The trends which are shaping the competitive landscape of tomorrow are analyzed carefully in this report:

 Many start-ups are about to introduce disruptive technologies on the market: both for emerging markets (RF MEMS switches and variable capacitors, scanning mirrors for picoprojectors, silicon timing devices, speakers, auto-focus...) and for the current large markets (MCube for inertial sensors, 3S for microphones...)

MEMS in cell phones and tablets

- 2011 market shares - total = \$1.7B

Yole Développement © May 2012



- Attracted by this growing and high-margin market space, large semiconductor companies are now eyeing MEMS: Fairchild and Maxim already made the move through acquisitions, and others should follow
- New business models are being developed and it appears that some players specialize on a specific part of the value chain (MEMS manufacturing, signal processing...) while others are offering complete solutions (e.g. combo sensors which integrate MCU and software)

The market for MEMS in cell phones and tablets will grow 19.8% to reach a \$5.4B value in 2017. New MEMS devices will benefit from the mobile device growth that is predicted for the coming years: phones and tablet will represent a 2.9B units in 2017 and most of them will integrate 5 to 10 MEMS devices. The MEMS industry will be largely impacted by global trends in mobile devices: connected devices, video and music consumption, social networking, diversity of users and usages, mobile advertising. In the reverse way, we also note that the booming demand for smartphones and media tablets can be partly explained by the integration of MEMS sensors which provide new functionalities.

REPORT OUTLINE

• 14 MEMS product types:

- MEMS accelerometers, MEMS gyroscopes, Magnetometers, Accelerometer / Magnetometer combos, Accelerometer / Gyroscope combos, 9DOF combo solutions, Pressure sensors, MEMS microphones, BAW filters and duplexers, MEMS switches and variable capacitors, Silicon MEMS oscillators / resonators, Micromirrors for picoprojectors, Microdisplays, MEMS Auto-focus, Emerging MEMS
- All types of mobile phones (smartphones, feature phones and voice phones) + media tablets
- Historic data and forecasts worldwide market metrics: 2009 2017 market (\$M, M units, ASP)
- Market dynamics, technical trends, key players, 2011 market shares market forecasts for each device
- 200+ companies included in the report
- Report is a 300+ slide PowerPoint format and Excel spreadsheets included

KEY FEATURES OF THE STUDY

The objectives of this report are the followings:

- To provide a global overview on the market data for the MEMS components used in cell phones and tablets key market metrics & dynamics:
 - Unit shipments and revenues by type of sensor
 - Average selling price analysis and expected evolution
 - Market shares with detailed breakdown for each player and major OEM contracts
- To provide an analysis of the major technology trends for each type of device:
 - Teardown of key MEMS components to show the device structures today
- Current technologies and new development: disruptive front end and packaging technologies to be introduced in the future
 To provide a deep analysis of the challenges and opportunities for MEMS sensors and actuators in handsets and tablets:
 - Description of the different drivers for integration and historical data on penetration of MEMS
 - Which drivers for new MEMS devices, why will it start, how market adoption will be like?
 - Different levels of software and trends for sensor fusion: strategies for integration in the system (MCU...) and major software specialists
 - Insight about architecture changes linked to the emergence of combo solutions and of MEMS data processing
- To provide a clear understanding of MEMS value chain, infrastructure & players for the cellular handset and tablet business:
 - List of major players for each device under consideration
 - Analysis on the potential new entrants with disruptive technologies
- · Description of the ecosystem: technology providers, combo solution players, software companies, final integrators

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WHO SHOULD BUY THIS REPORT ?

MEMS device manufacturers

- Evaluate market potential of future technologies and products
- Understand the differentiated value of your products and technologies in this market
- Build roadmap for modules: which type of modules? When?
- Identify new business opportunities
- Identify potential strategic partners or technology providers
- Monitor and benchmark your competitor's advancements

MEMS foundries, material and equipment suppliers, packaging houses

- Understand what are the applications that will drive the volumes in 2017
- Identify new business opportunities and prospects
- Specialists of microcontrollers, baseband/ transceiver, application processor...
 - Spot new opportunities and define diversification strategies

Mobile phone and media tablet OEMs

- Evaluate market potential of future technologies and products to differentiate your products
- Evaluate the benefits of using these new technologies in your end system, design architectures for the next generation of systems

17

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- _ Screen potential new suppliers able to provide new functionalities, or cost and size savings
- R&D centers
 - Evaluate market potential of future technologies and products for new applicative markets
 - Identify the best candidates for technology transfer

Financial & strategic investors

- Understand the structure and value chain of the cellular handset and media tablet industry
- Estimate the potential of new devices such as RF MEMS tuners, oscillators, auto-focus...
- Get the list of the main key players and emerging start-ups of this industry worldwide

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BIO OF THE AUTHOR



Laurent Robin is in charge of the MEMS & Sensors market research at Yole Développement with a focus on inertial sensors & RF MEMS related technologies. He holds a Physics Engineering degree from the National Institute of Applied Sciences in Toulouse, plus a Master Degree in Technology & Innovation Management from EM Lyon Business School, France.

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- In-depth analysis & Quarterly Technology Magazines: MEMS Trends – 3D Packaging – PV Manufacturing – iLED – Power Dev'
- Online disruptive technologies website: <u>www.i-</u> micronews.com
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