2012 CES - MEMS Conference Session

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10:30-11:30am | LVCC, North Hall, Room N254

Connecting the Real World with the Digital World: Harnessing the Power of

MEMS

Karen's intro – nearly 140 companies, founded 10 years ago, and we are now a global organization representing the MEMS supply chain.

Let's talk about billions!

- MEMS market growth \$8B now expected to almost double in the next few years.
- \$1Billion InvenSense's market valuation as of yesterday. Bosch Sensortec just announced that they shipped their 2 billionth MEMS sensor.

Karen walked through the top 10 MEMS companies and top 10 buyers of MEMS. Use of MEMS in consumer electronics – you're going to see MEMS outpace even automotive.

MEMS frickin' everywhere. It's in the mainstream. If you want to be part of consumer electronics, you're going to need to have MEMS inside your device.

We want to see MEMS everywhere, and I truly believe that this is where we are going.

Karen did a quick introduction - Featuring Panelists:

• <u>Jeff Hilbert, President & Founder, WiSpry – recent teardown of a Samsung smartphone with a WiSpry RF MEMS device in there.</u>

We took on 2 challenges a decade ago. We wanted to push RF MEMS and we wanted to do it on a monolithic chip. We have won our first real design with our partner Samsung. There is now a true RF MEMS device in a smartphone that you can buy in a local store. Understand that the phone is transmitting and receiving efficiently – fewer dropped calls, better battery life, etc. Huge market. Very challenging market. Taking a new disruptive technology and insert it into cell phones. I think that we're at a tipping point for MEMS. It's becoming more generally available and usable. We're at a point where it can be more broadly adopted. You don't really sell technology, though. You sell products and solutions. I think that you'll find that MEMS companies are providing total solutions.

• Frank Melzer, Ph.D., General Manager and CEO of Bosch Sensortec – division of Bosch – strong in automotive and now strong in consumer.

Bosch Sensortec is a clear, integral part of The Bosch Group. All smartphones have MEMS sensors. MEMS is so consumer-friendly and speeds adoption of new technologies. We have developed key processes, including "the Bosch process." Took 17 years for our first billion MEMS sensors. 3 years for next billion MEMS sensors. It won't take another 3 years to get to the 3rd billion.

We make our own MEMS devices so we are the largest MEMS supplier.

Bosch Sensortec – we started with accelerometer and added pressure and magnetic sensors. We announced our first 3-axis gyro and software to make integration of the sensors easier.

Akustica is also part of Bosch MEMS family – maker of MEMS microphones. strong product portfolio for laptops and adding a product for cell phones as well.

"In 2006 MEMS was still a hidden industry. That has changed – and MEMS is now a visible even to the consumer."

• <u>Seyed Paransun, Vice President and General Manager, Sensor and Actuator Solutions Division, Freescale Semiconductor, Inc.</u>

Freescale is very strong in embedded microcontrollers – but we also have a strong presence in MEMS. We started shipping MEMS for automotive more than 30 years ago, and we have also shipped 1 billion MEMS sensors.

We have a smart sensing platform. We leverage our technology for automotive for the consumer space. We believe that we have a differentiated solution.

• Sten Stockmann, VP of Consumer Electronics, VTI Technologies, Inc. – Finnish company also expanding into consumer from automotive.

We also have a strong background in automotive and have just released our new 3-axis consumer gyro – 3 x 3 and low power. We can scale down – smaller size, lower power, lower cost – and this has opened up MEMS for the consumer market.

STARTER OUESTION - Each panelist will answer this question

- 1. MEMS in consumer applications- From where have we come and where are we today (the evolution of MEMS)?
 - a. Frank Melzer in 2005 we were challenged to make portrait/landscape orientation in cell phones. Everyone takes that for granted today – but this is MEMS. Also microphones – large possibilities for digitalization for better voice capture – that's a MEMS device. In the projection business, MEMS helps us improve resolution in displays, etc.

- b. Seyed our heritage is in automotive but our ability to provide context to the consumer is very important. The landscape function in cell phones has now become part of our culture. MEMS is in cameras for image stabilization. MEMS is in laptops to protect hard drive if it takes a fall. MEMS is in sleep apnea machines (pressure sensors). MEMS is improving our lives and it's growing!
- c. Sten there is a multitude of MEMS everywhere in cell phones, for example– timing devices, filters, switches, light sensors, projectors, and more. In the 80's everything was about personal computers. In 90's and 2000, everything about Internet and mobile phones. Now it's about interacting with intelligent devices around us. For a device to be smart, it needs sensors.
- 2. Karen asked Jeff Hilbert could you ever have predicted this growth? JEFF: MEMS has been around for a long time. It's only been the last few years as we have moved into consumer space that MEMS has become more visible. MEMS is extremely powerful and horizontal. It can be adapted and adopted in many ways. I don't think that we learned early enough the lessons learned in the semiconductor industry but we're doing a much better job now.

I asked people who visited our booth yesterday if they knew what "MEMS" is – and about 80% of them understood the term and got the acronym right!

3. The next wave of MEMS - What are the next mass-market and killer apps for MEMS in the immediate future? (Where will MEMS pop up next?)
SEYED: I have told my team that we will see applications for MEMS in 2012 that we haven't imagined yet. We're going to see more MEMS in healthcare apps, for example. MEMS is going to help you with indoor navigation – give you a precise location of where you are in public spaces. Opens a multitude of opps for business to push information to your phone, based on your interests/activities, etc. They sky is the limit in terms of opportunity, in terms of how MEMS can be deployed.

Karen asked Sten about interconnectivity in apps. Sten agreed with Seyed that indoor navigation is a big new application area. We will see MEMS in everyday devices – from waking up in the morning to going to bed in the evening – from razors to doors to your refrigerator, we will see more interconnected devices.

FRANK: Healthcare – activities that monitor your sleep, monitor activity. Indoor navigation – people have talked about it for years – but when you look at navigation, maps have always been flat. It has been changed now, and Google Maps 6.0 shows layers – like multiple floors in a Las Vegas hotel. Reason is clear. You have to navigate in 3 dimensions. Most of us had to find this room – terrible location!:) A pressure sensor will help you to navigate in 3D.

Interconnectivity – home automation, everything gets connected. Everything needs to forward information and sensors play a role in there. They are the interface to the consumer device. The buzzword is "the Internet of things," and I am positive that MEMS is part of the Internet of things.

KAREN ASKED JEFF: How will MEMS revolutionize our world? People are mobile and connectivity will have to move around with them. Things that are wireless have to send huge amounts of data, sometimes in real-time. In some cases, if you are driving through mountains, MEMS can help in areas in which wireless communications are not prominent.

Historically, we started off with sensors collecting data about the real world. Then we added processing. Then we added the ability to act and then interact. This gave us the possibility of learning. This enables "massive personalization" of things. Your world can be highly customized our personalized – clothes that can change colors or jewelry that can change shapes. MEMS lets you "have it your way."

Julie Ask – talked about "Big Mother" and not Big Brother – and Karen mentioned this.

Q&A

1. What has held up the broad adoption of this technology? STEN: cost, size and power consumption. These have all changed dramatically. Accelerometers went from several hundreds of milliamps to less than 10 microamps. In gyros we are seeing same improvements. In small battery-operated devices, this is critical for the user experience.

We all expected this huge growth and we expected consumer mass market to take off in 2006/2007. It's been later than predicted, but growth is now much larger than we predicted.

JEFF: We have to track the industry. We have to make the technology easier to use and integrate. In handsets, for example, there are huge investments in new platform. Part of what we are doing is to integrate more functionality and value into the products themselves.

SEYED: Simplicity of design is important. Design for automotive is quite different than design for consumer. We had to look at size, price and ease of use. Most MEMS suppliers are working hard to make sure that MEMS devices are simple and easy to design.

AUDIENCE QUESTION FROM APPLIED MATERIALS Which companies are you watching that are entering this market?

SEYED: Customers are now looking for a full sensing solution. I think that the days of offering a discrete sensors are gone. There are some barriers to entry for new companies to enter the market. Significant pressures on ASPs will create more consolidation in this space – rather than new companies entering it.

FRANK: Roles of foundries are progressing but IDMs have a strong stake in this. It's non-standardized process technology. It makes it unique. On other hand, it's also classic semiconductor industry. This limits who will enter this space.

KAREN: Fabless is fabulous. InvenSense and WiSpry should be on your radar. I think that there are niches and markets for the foundries. I say "go little guy!"

REPORTER IN AUDIENCE: Mechanical is part of MEMS. Are the sensors really mechanical devices?

JEFF: We tend to talk about actuation – could be thermal, piezo-based, stress-based, etc. KAREN TOLD REPORTER TO GO TO MEMS INDUSTRY GROUP website.

AUDIENCE QUESTION: Asked about power production by sensors. KAREN: Chris Pister from BSAC is looking into this wireless sensor networks – encouraged people to look at this.

AUDIENCE QUESTION: What are the challenges to the MEMS industry today? SEYED: Keep pace with industry in light of technical requirements and ASP. Our customers need increased precision in sensing functionality. It's not just a pedometer – it's a more intelligent pedometer that measures your gait and tells you if you are pronating while you are running, for example. Software is becoming an integral part of our offering – and that takes time.

STEN: On consumer side – very fast-paced. Automotive – like a 10-year lifetime. In medical, clinical test & approval can require 5 years to get to production and then product has a 10 year lifetime. In consumer, design to delivery is like 10-15 months. The challenge now is to combine all of these sensors in consumer devices. Our customers are looking to suppliers to provide a software solution – which increases costs for the sensor manufacturer.

WRAP-UP CROSS FIRE:

I see the future of MEMS in consumer electronics and it is:

IEFF: Mass customization

FRANK: Very broad lots of applications

SEYED: Fusion of sensors

Sten: VTI!!