

The 20th International Micromachine Nanotech Symposium

MEMS and Sensor Trends - Paving the Way for a True Internet of Things and Services

Karen Lightman, Executive Director
MEMS Industry Group



MEMS INDUSTRY GROUP®

April 23, 2014

Today's Presentation



- MEMS and Sensors Technology Trends
- MEMS and Sensors Market Trends
 - US MEMS Trends
- Challenges and Opportunities
- Introduction to MEMS Industry Group

MEMS is Everywhere



Sony Smartwatch



Google Glasses



Samsung Galaxy S4



Wii U Gaming Device

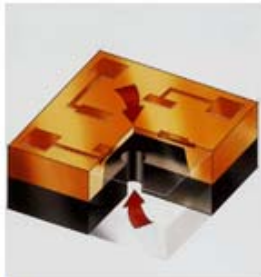


iPad Air Tablet

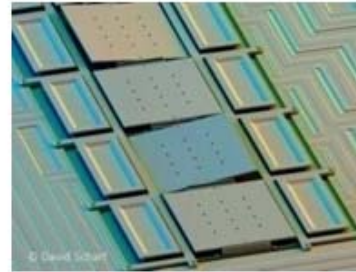


Jawbone Up
Fitness Band

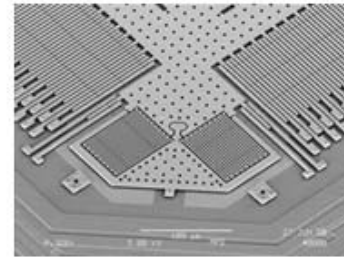
MEMS /S Inside



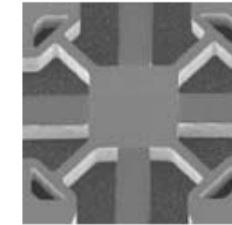
Pressure sensor



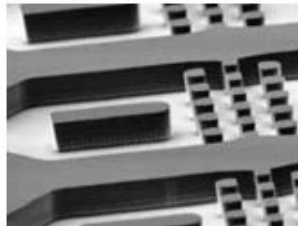
Micro-mirrors
Optical MEMS



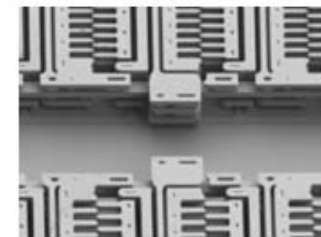
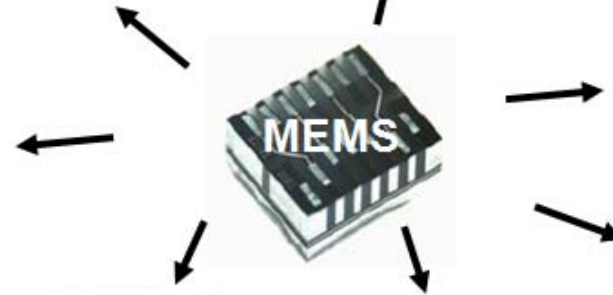
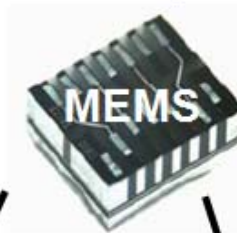
Inertial MEMS
Gyroscopes & accelerometers



RF-Resonators



Ink-jet & Micro-fluidic
Print Heads



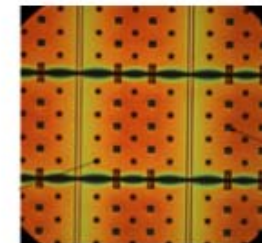
Micro-actuators



RF-MEMS
switches, Filters...



Si Microphones

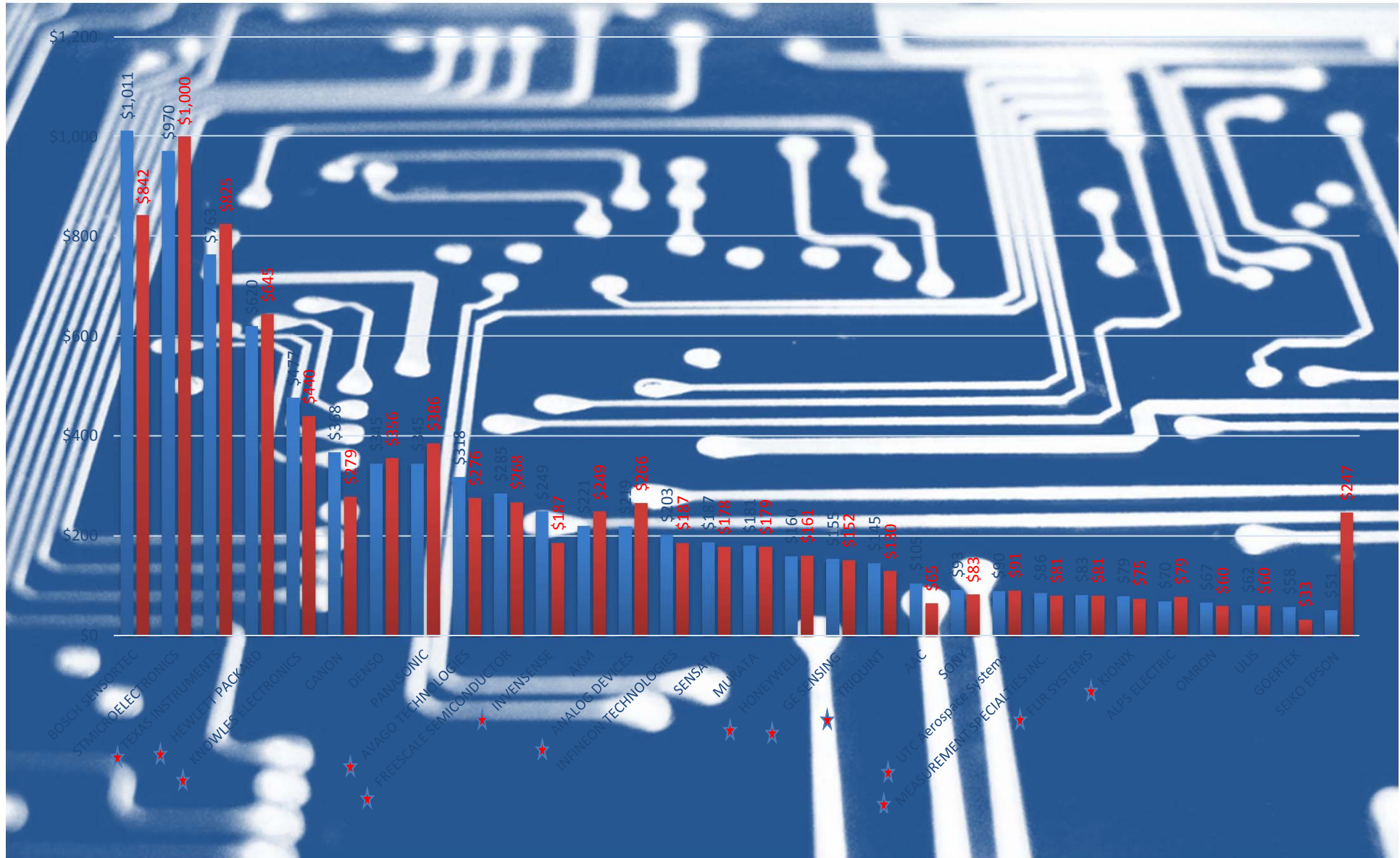


Micro-Displays

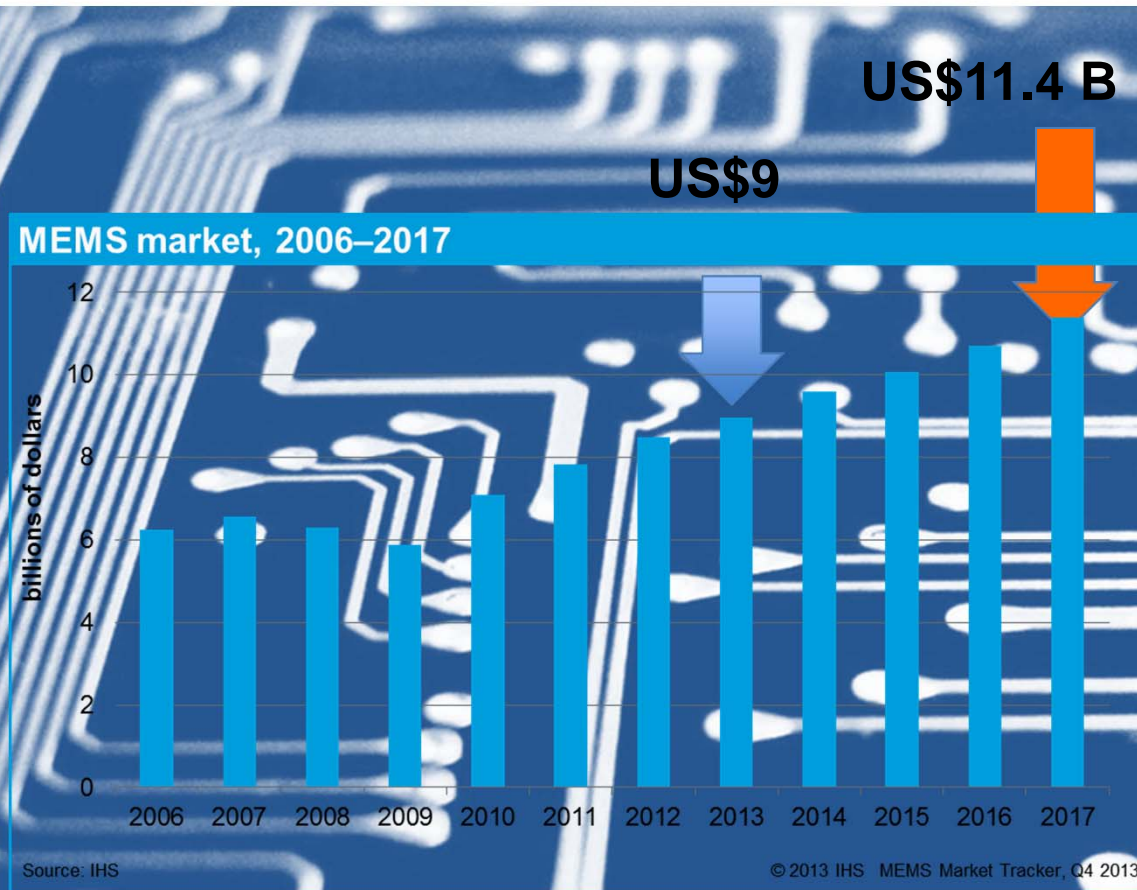
Images courtesy of



TOP MEMS Ranking



MEMS Market Adding US\$1B/Year

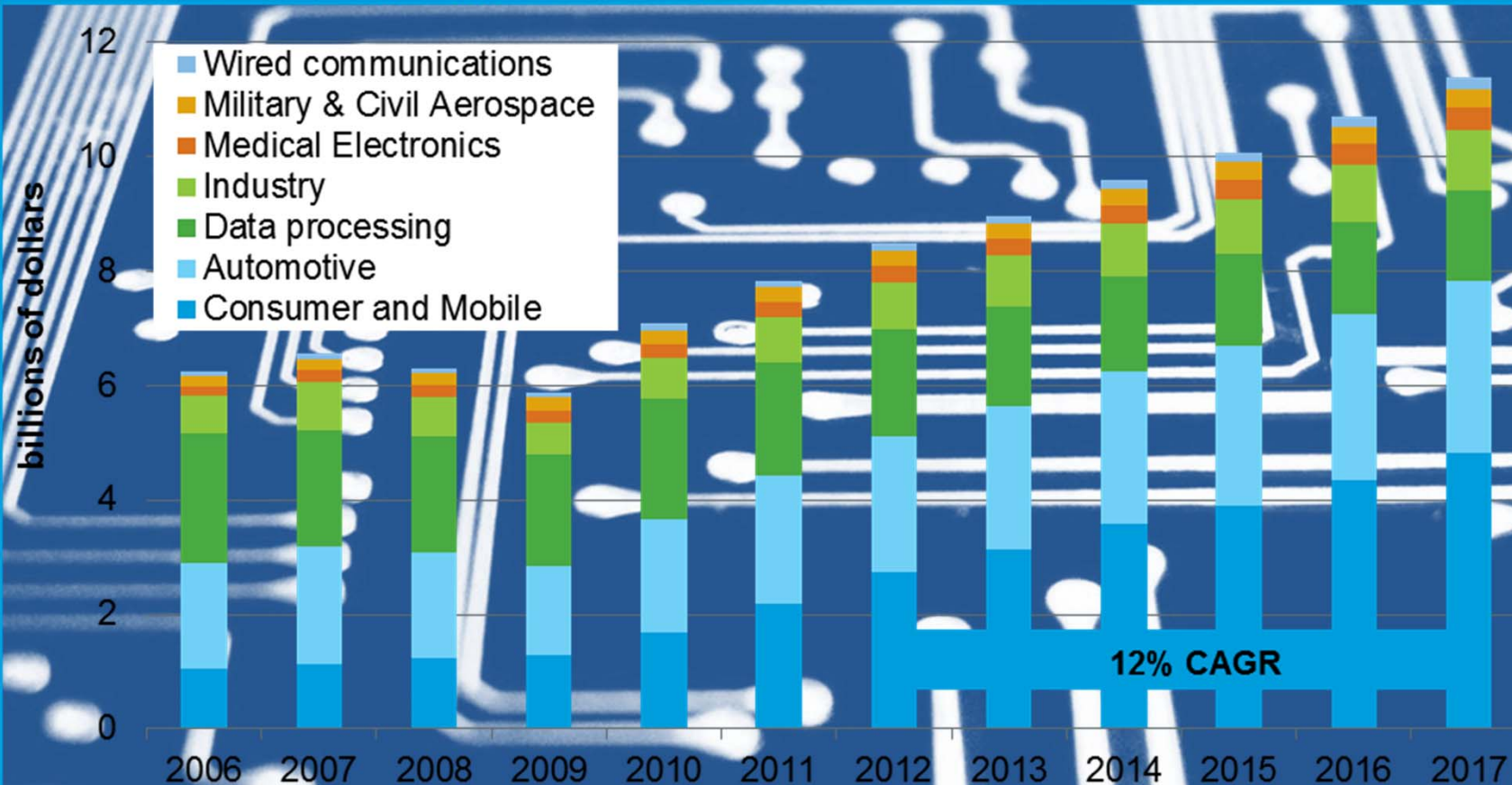


- 2013 another record year
- MEMS growth 2x as fast as semiconductor industry next 5 years
- Consumer market reigns supreme.
- After smartphones and tablets, wearables are third wave in CE

Consumer & Mobile = Today's Powerhouse MEMS Markets



MEMS market by application, 2006–2017

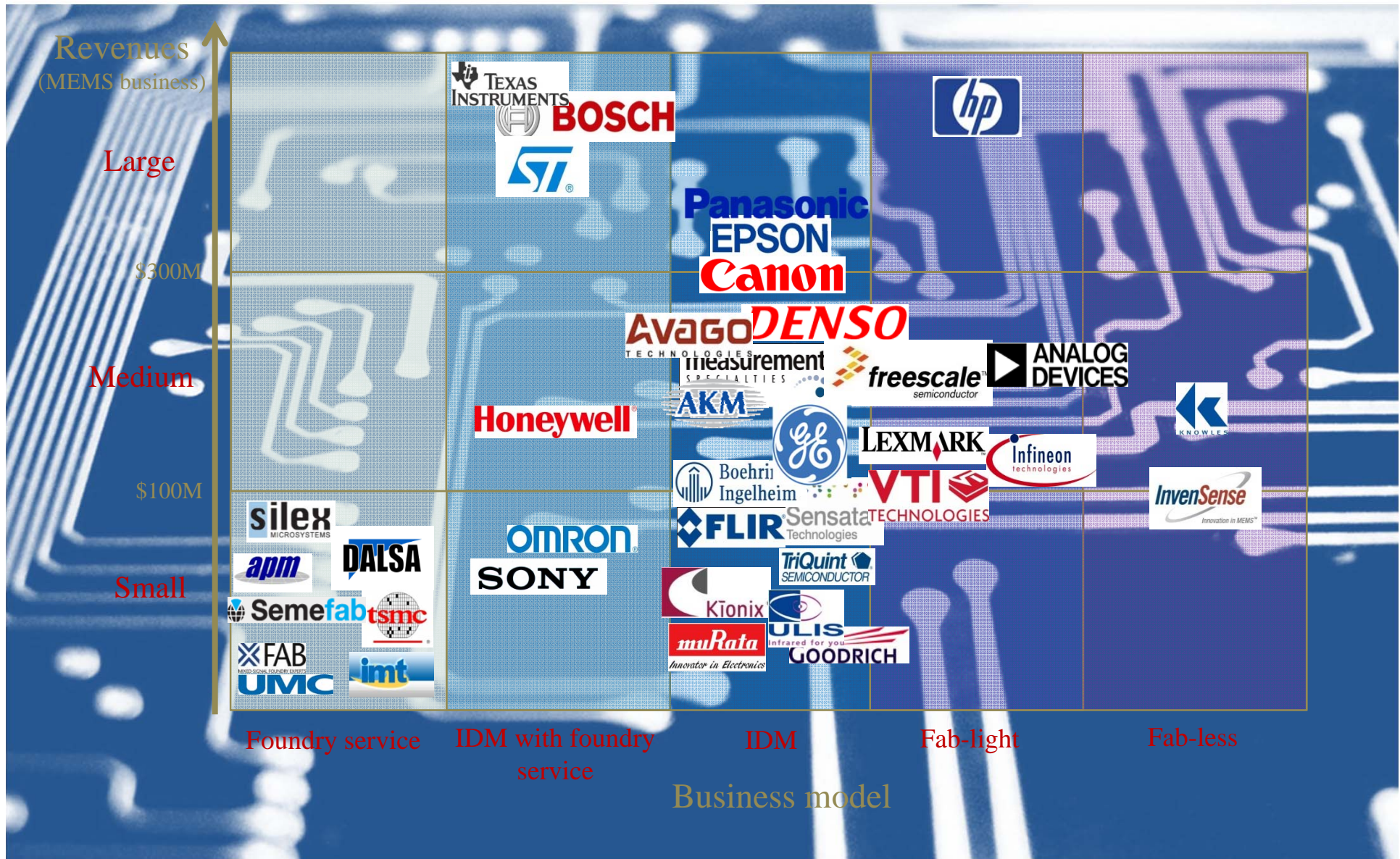


Source: IHS

© 2013 IHS MEMS Market Tracker, Q4 2013

Typology of MEMS Companies

Business model for MEMS manufacturers



MEMS and Sensor Technology Trends



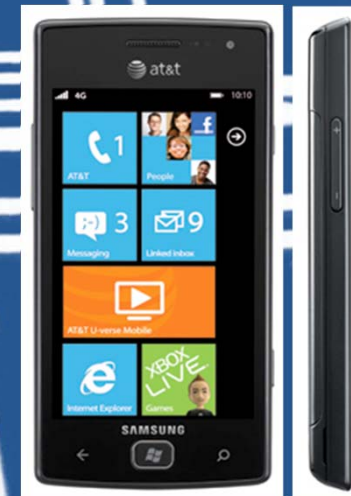
Biggest technology trends are with:

- Sensor Fusion
- Integration
- Energy and Wireless Sensor Networks

MEMS Sensor Fusion



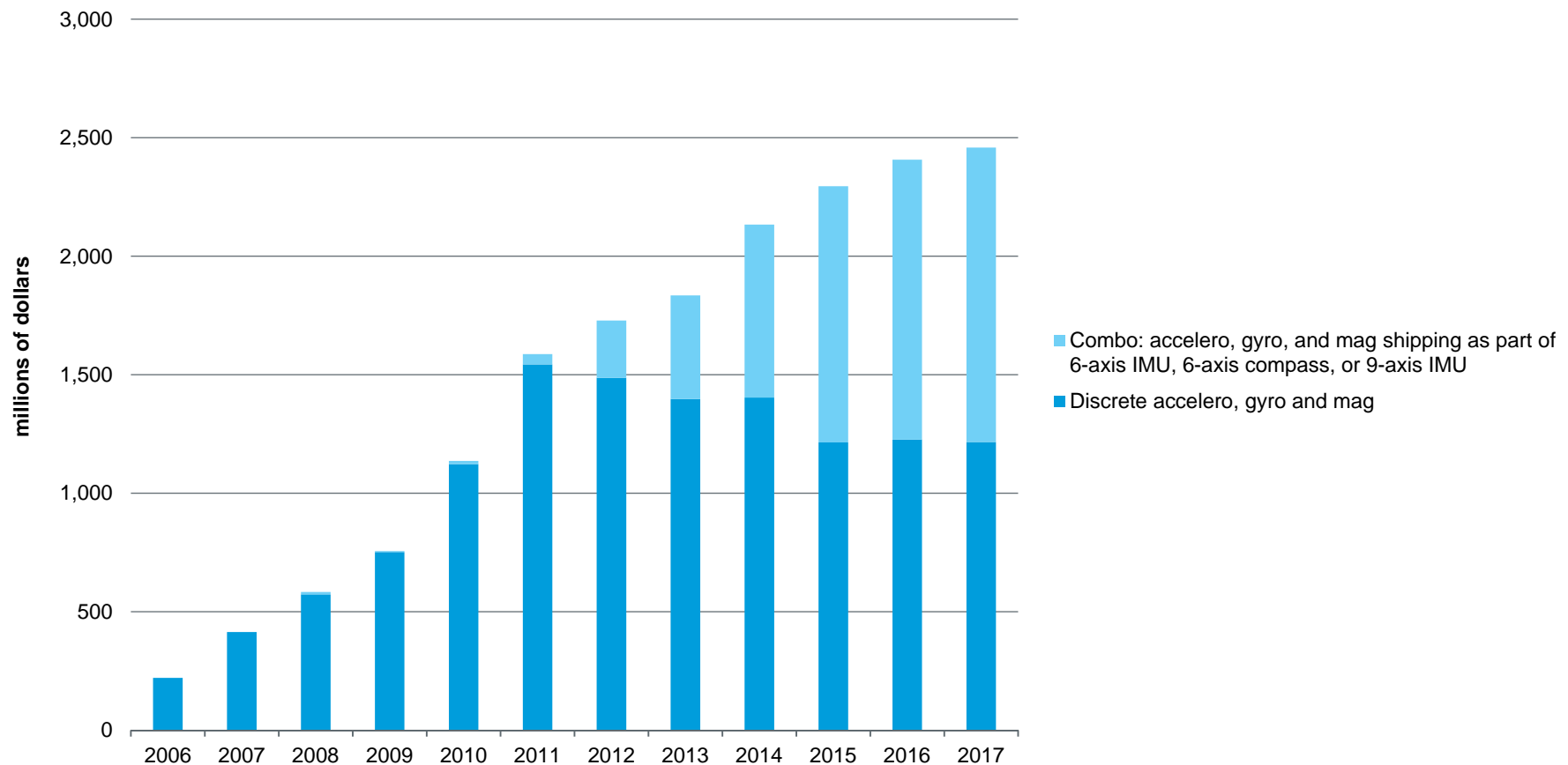
- Combination of software and hardware
- Intelligent, complex and integrated
- Promises increased power and performance while reducing cost
- Often sensor-agnostic



MEMS Integration - Winning Combination



Combo vs. discrete motion sensor market in value, 2006–2017



Source: IHS

© 2013 IHS Consumer & Mobile MEMS market Tracker, H1 2013

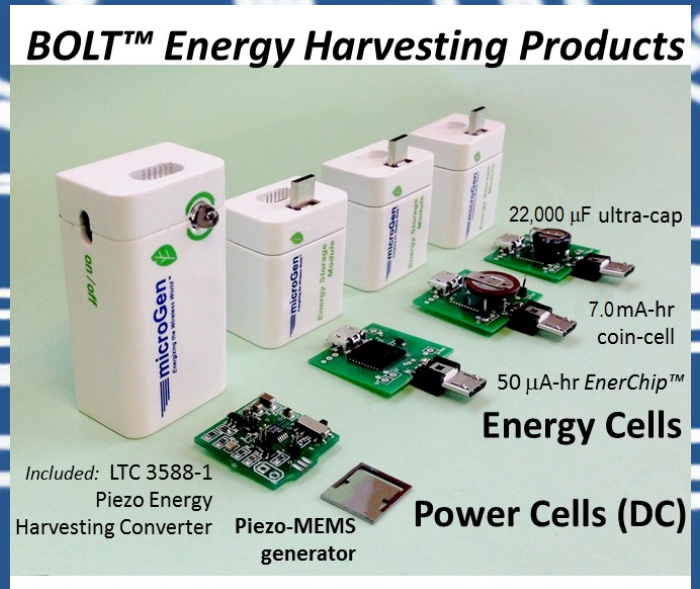
Energy



Conserving and Harvesting all in One!



Imec's Autonomous TPMS System ('unity') with Integrated Piezo-electric Energy Harvester

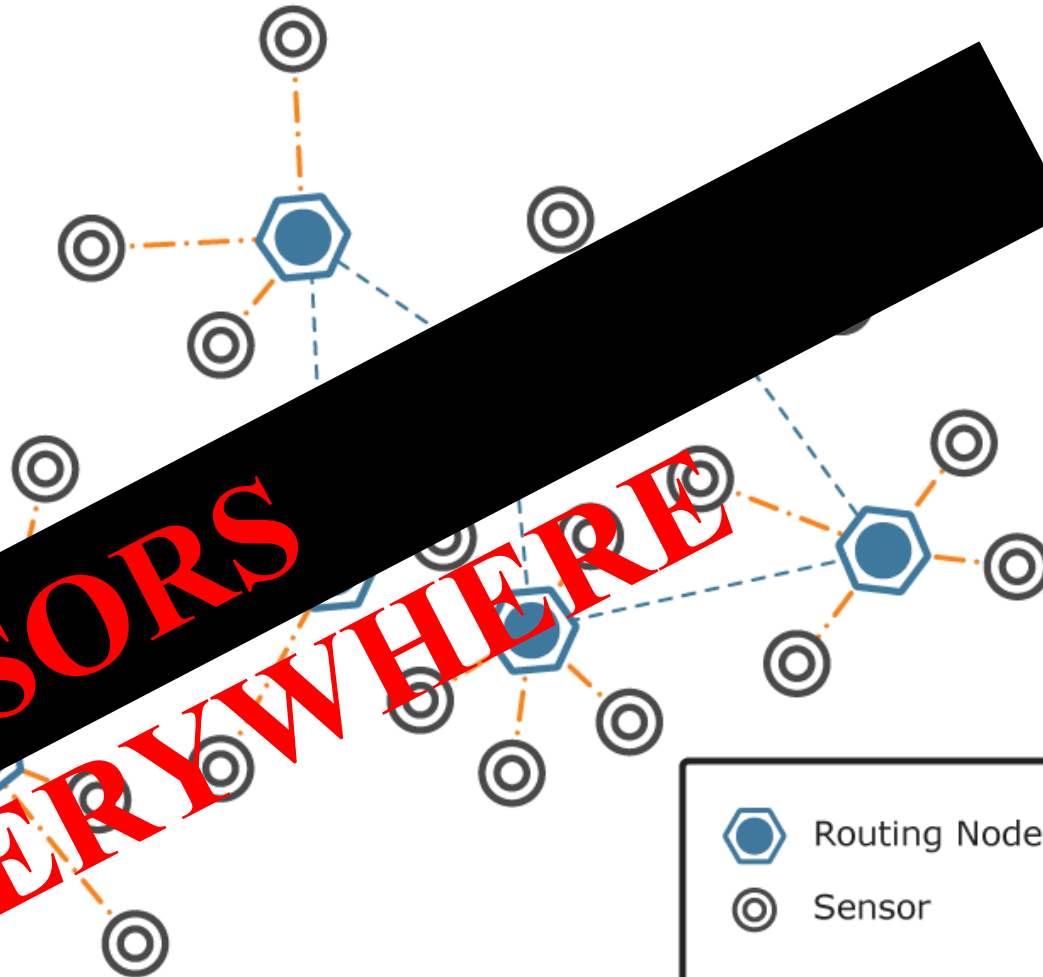


MicroGen Systems' Micro-Power Product Line for Wireless Sensor Applications

Wireless Sensor Networks (WSN)



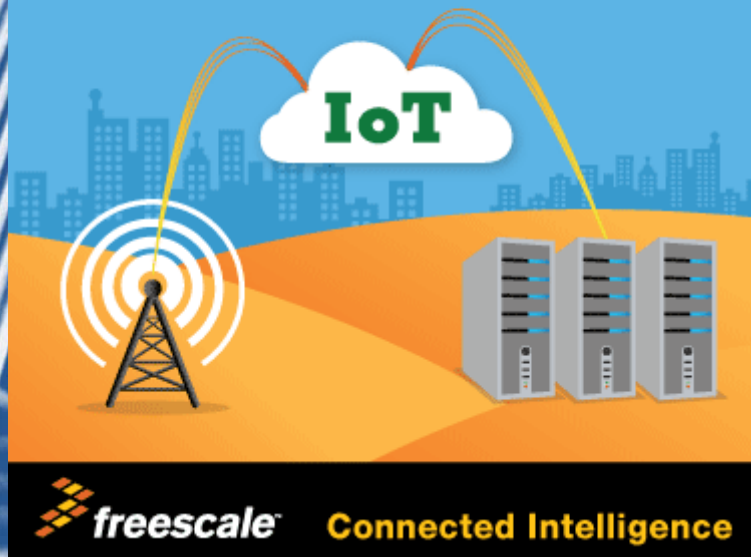
**SENSORS
EVERYWHERE**



Biggest Trend = “Smart Everything”



By 2020, the IoT is estimated to help drive 22 times as much data traffic as exists today



MEMS/Sensor Market Trends:

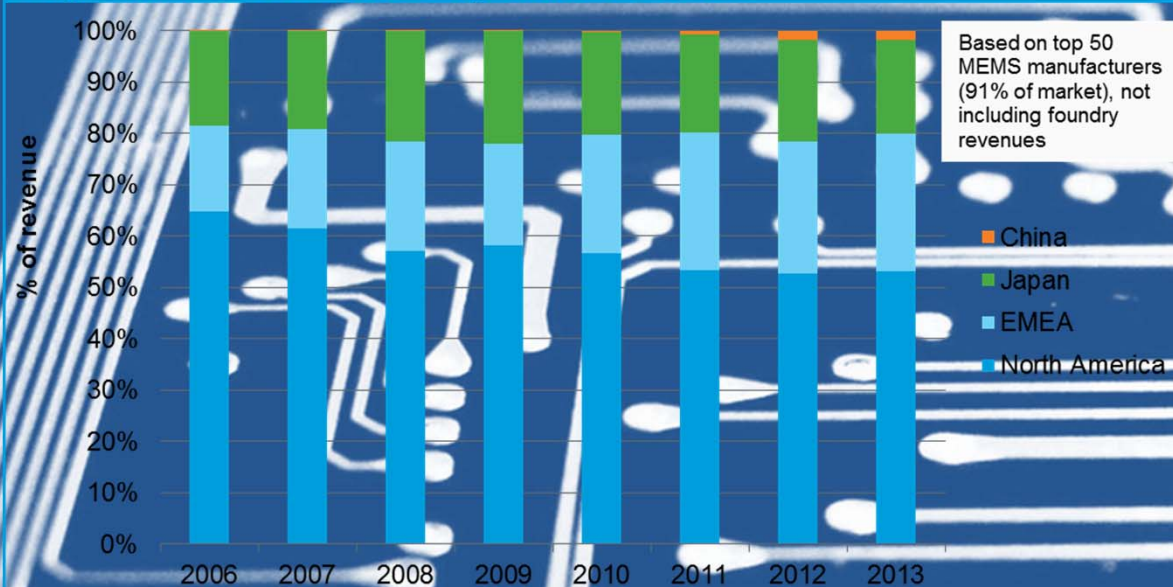
- Wireless everywhere
- Smart MEMS and sensors everywhere
- Quantified Self phenomenon
- Multifunction devices – always on and “at the ready”
- Cloud Computing and “Fog Computing”

*All enabling a **smart** Internet of Things and Services (IoTS)*

North America Dominates MEMS Supply



Regional market shares by HQ , 2006-2013



Source: IHS

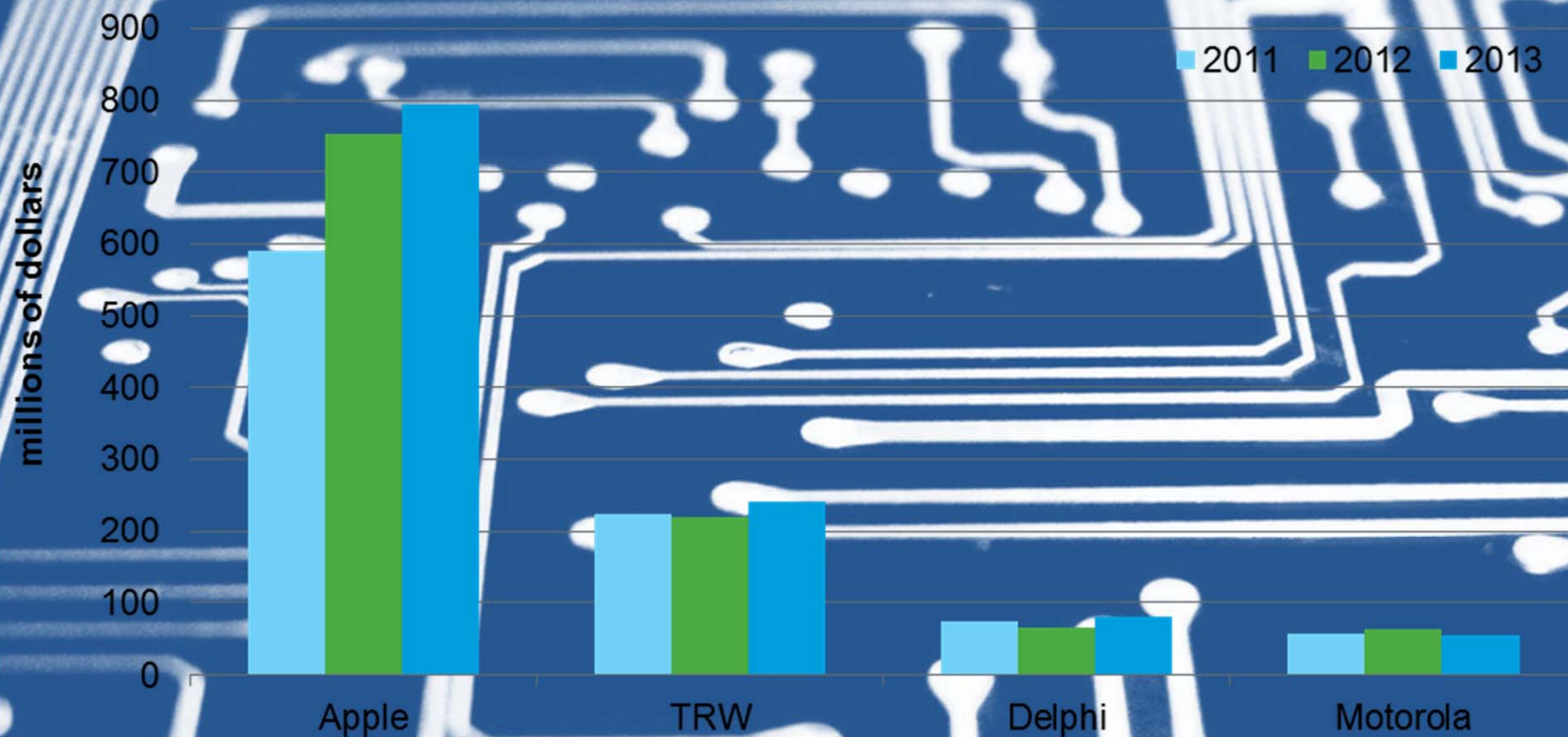
© 2013 IHS MEMS Market Tracker, Q4 2013

- North America holds 53%
- US Largely Influenced by TI and HP
- EU Dominated by Bosch and ST

Who's Buying MEMS in North America?



MEMS purchases by North American OEMs, 2011 - 2013



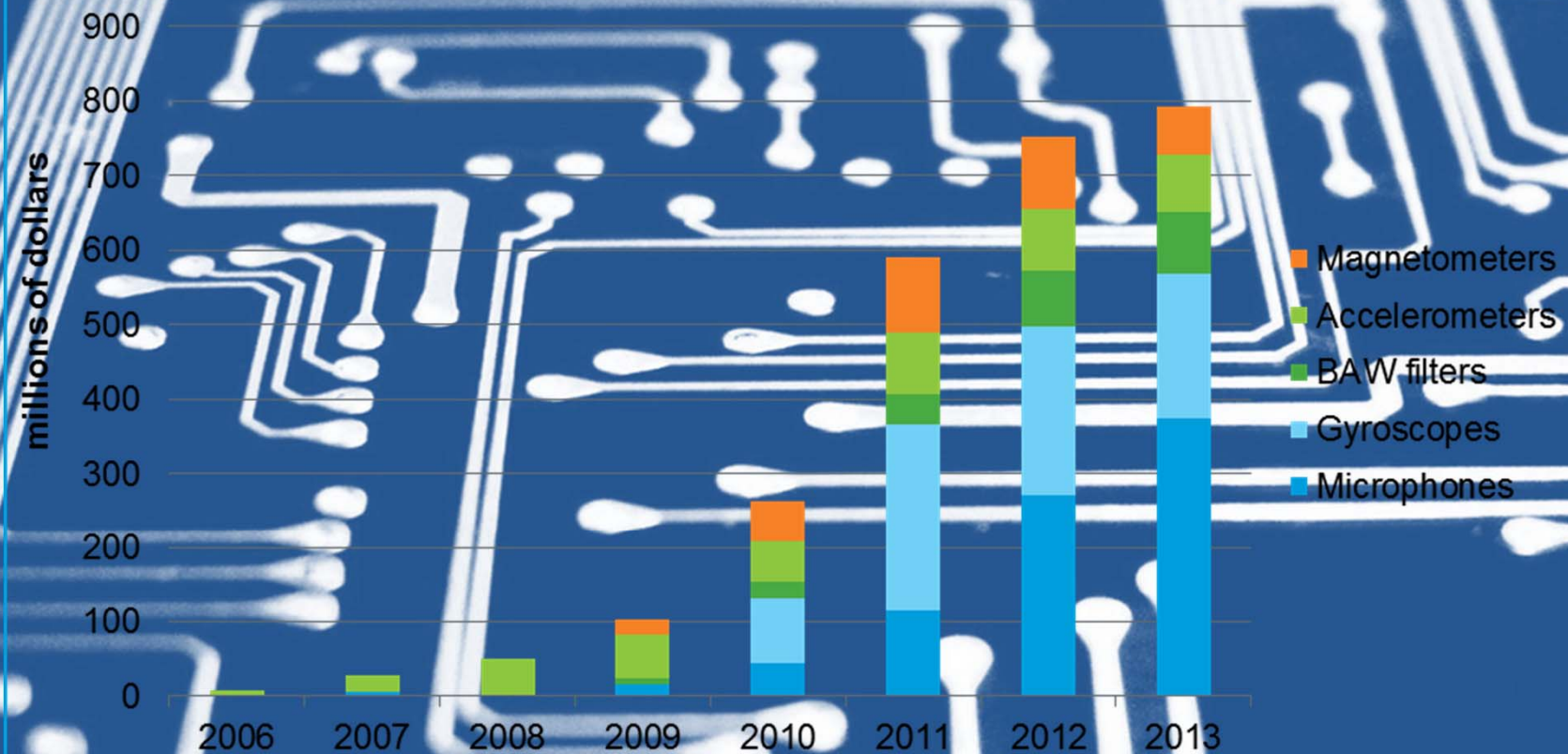
Source: IHS

© 2014 IHS Consumer MEMS Tracker and Automotive MEMS Tracker

Apple+MEMS=Recipe for Success



Apple's MEMS purchasing



Source: IHS

© 2013 IHS MEMS Market Tracker, Consumer and Mobile, H2 2013

US: Fertile for Innovative Startups



MEMS Success Stories:

- InvenSense (INVN) – World’s most successful MEMS start-up ever
- WiSpry and Cavendish Kinetics – RF MEMS Leader
- World’s MEMS Oscillators *Start-ups* are in the US:
 - SiTime
 - Discera
 - Sand 9
 - Silicon Clocks: now part of SiLabs

US MEMS Influences



- Apple and Google
- Qualcomm – Leading Worldwide Wireless Semiconductor Company
- Software - Operating Systems for Mobile Phones
- Funding – Research and Development; Business Funding/Finance
- Regulation – Automotive Sensors

Challenges & Opportunities



MEMS is in the Mainstream...

- ▶ Some markets are saturating e.g. motion sensors in smartphones
- ▶ Commoditization of some devices e.g. accelerometers
- ▶ MEMS infrastructure is maturing, adding stability and diversity
- ▶ MEMS for IoT - Still in its infancy, imagination is the limit!

...Now What?

To Move to Next Phase of MEMS Commercialization
(Hundreds of Millions of MEMS) Requires:

- ▶ Cost efficient, robust systems
- ▶ Complete, integrated packages
- ▶ Standardization

Standardization – “S Word”



Standardization (and lack thereof)

Commonly Requested Sensor Vendors

Vendor	Accel	Gyro	Mag	ALS/ Prox	Baro- Meter
Aichi Steel			•		
AKM			•		
Alps			•		
ADI	•				
Avago					
Bosch	•	•	•		•
Freescale	•				
Intersil					
Kionix	•				
Honeywell					
InvenSense	•	•			
Maxim				•	
MEMSIC	•		•		
OKI	•				
Rohm				•	
ST	•	•	•		•
Taos				•	
Yamaha			•		
18	8	3	8	5	2

18+ Vendors

26+ Sensor Product Lines

MEMS/Sensor Industry Response:

- MIG-led creation of historic Standardized Performance Parameter **MCV17** Definitions (SPD)
- Up next: API Standardization

Courtesy of Qualcomm, used with permission

Courtesy of Qualcomm, used with permission

About MEMS Industry Group® (MIG)



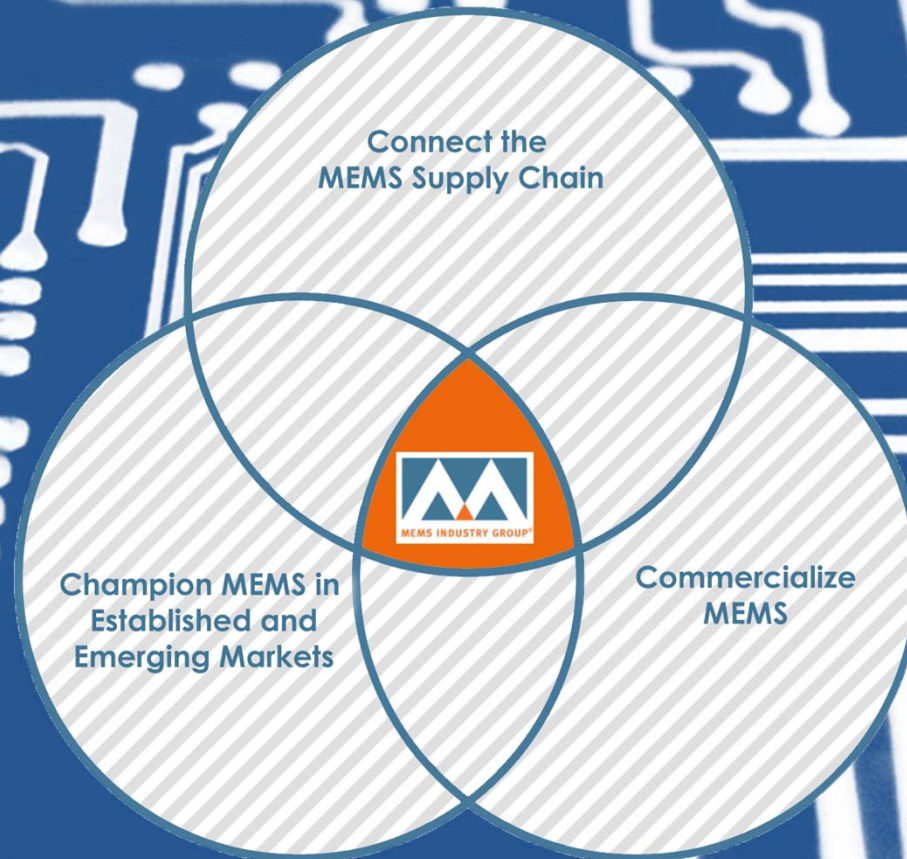
- **Formed in in the US in 2001 with five companies** - outgrowth of MEMS industry executive meetings at Defense Advanced Research Projects Agency (DARPA)
- MIG is an industry trade association incorporated as a not-for-profit organization, based in Pittsburgh, Pennsylvania, USA
- MIG is international -- with over 160 member companies and partners worldwide
- MIG managed by an executive director, Karen Lightman, with Governing Council composed of representatives from member companies



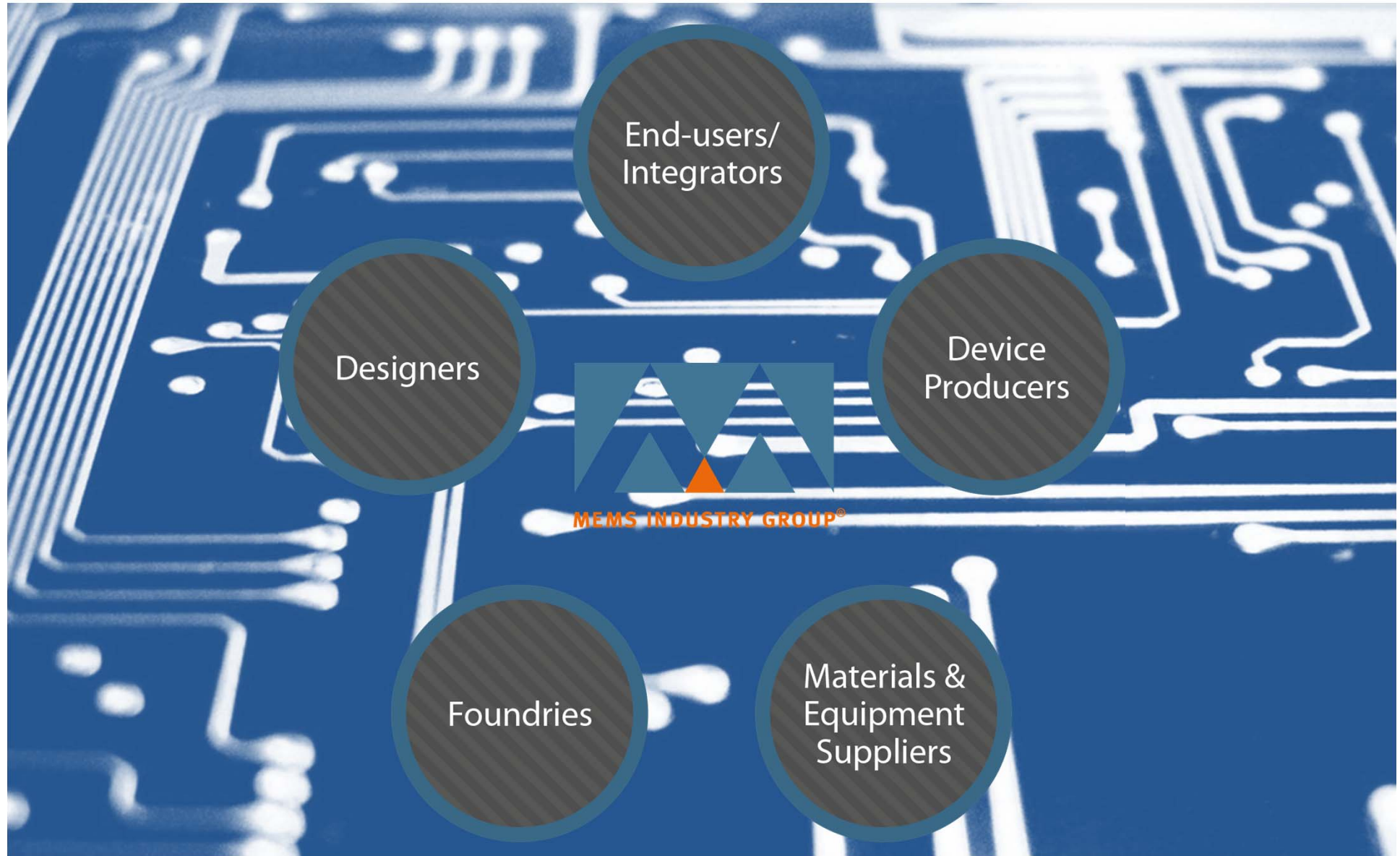
About MEMS Industry Group® (MIG)



MIG is the trade association advancing MEMS across global markets.



MEMS Supply Chain = MIG Members



MEMBERS



P
A
R
T
N
E
R
S



For a complete list of members and partners, please visit www.memsindustrygroup.org.

About MEMS Industry Group Conference Japan



- MEMS Industry Group Conference Japan is a one-of-a-kind international technical conference, with focus on discussing critical global MEMS supply chain challenges
- It is a place for neutral discussion of pre-competitive issues affecting MEMS manufacturing and brings together foundries, equipment vendors, research groups, large companies, start-ups, buyers, and suppliers -- all stakeholders in the global MEMS supply chain
- The goal of the MEMS Industry Group Japan Conference is to share knowledge and solutions, to network and to discuss the current and future global landscape in MEMS manufacturing in order to support your company's imminent MEMS commercialization needs

MIG Conference Japan

Keynote Speakers



Mr. Takeshi Ito

Chief Technology Officer &
Head of Technology
Sony Mobile Communications



Professor Xi Wang

Director General
Shanghai Institute of Microsystems &
Information Technology

MEMS Industry Group Conference Japan – Agenda



Thursday, April 24th, 2014

- 9:00 am - 9:30 am **Registration**
- 9:30 am - 10:00 am **Welcome to MIG Conference Japan**
 - [Karen Lightman, Executive Director, MIG](#)
- 10:00 am - 10:45 am **Opening Keynote Speaker**
 - [Takeshi Ito, Chief Technology Officer, Head of Technology, Sony Mobile Communications](#)
- 10:45 am - 11:15 am **Coffee Break**
- 11:15 am - 11:45 am
 - [Daido Uchida, General Manager, Technology Marketing & Development Center, OMRON](#)
- 11:45 am - 12:15 pm
 - [J r mie Bouchaud, Director and Senior Principal Analyst MEMS & Sensors – Industrial Electronics, IHS Inc.](#)

Agenda, cont.



- 12:15 pm - 1:30 pm **Lunch**
- 1:30 pm - 2:00 pm
 - [Leopold Beer, Regional President Asia Pacific, BOSCH Sensortec](#)
- 2:00 pm - 2:30 pm
 - [Babak Taheri, Vice President and General Manager, Freescale Semiconductor](#)
- 2:30 pm - 3:00 pm
 - [Dr. Liang Shi, Product Marketing Director, SunEdison Semiconductor](#)
- 3:00 pm - 3:30 pm **Coffee Break**

Agenda, cont.



- 3:30 pm - 4:00 pm
 - [Dr. Denise Kaske, Business Development Manager Asia - Korea and India, Fraunhofer-Gesellschaft](#)
- 4:00 pm - 4:45 pm **Closing Keynote Speaker**
 - [Professor Xi Wang, Director General, Shanghai Institute of Microsystem and Information Technology](#)
- 4:45 pm - 5:00 pm **Closing Remarks**
 - [Karen Lightman, Executive Director, MEMS Industry Group](#)
- 5:30 pm - 7:30 pm **Co-Hosted Dinner with MEMS Engineer Forum (MEF)**

Sponsors



EVG®



Registration



- Registration fee for MEMS Industry Group Members is \$125/person, and for Non-Members is \$175/person (via credit card online)
- Receive a 20% discount for the 2nd and subsequent attendees from the same company
- MEMS Engineer Forum attendees will receive a 20% discount on MIG Conference Japan registration

Thank you



[Contact MIG](#)

www.memsindustrygroup.org

Karen Lightman, Executive Director

1620 Murray Avenue
Pittsburgh, PA 15217 USA

PH: +1 412.390.1644

Twitter: @MEMSGroup, @khlightman