



On the Road to \$1T?

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Kionix, Inc.

Sensing the Future

Overview

- MEMS adoption rates and the breadth of opportunities are growing very rapidly
- Device shipments are well into the billions of units annually
- Janusz Bryzek's provocative questions:
 - Can we reach a \$1T annual market?
 - What would it take to get there?

MEMS in mobile devices

- IBM Thinkpad drop detection, October 2003
- Seagate HDD with integrated MEMS, early 2005
- Samsung SCH-S310 cell phone, early 2005
- Wii, holiday season 2006
- Apple iPhone, June 2007



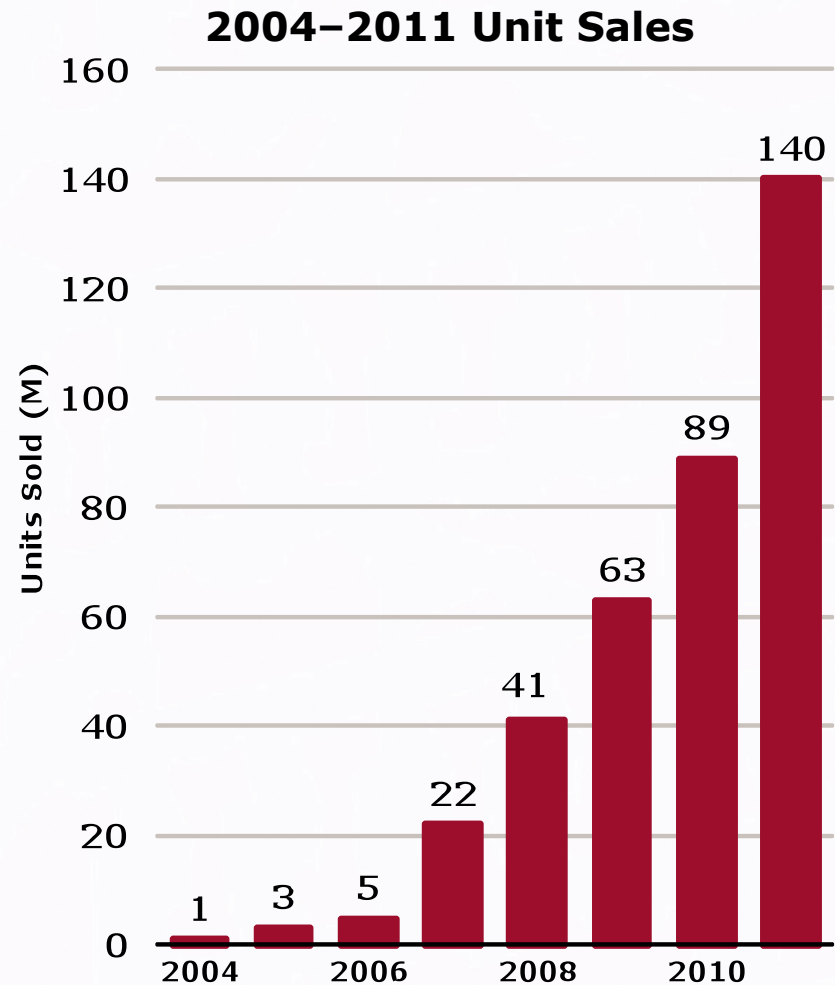
Kionix company overview

- Kionix Inc., founded in 1993, supplies leading electronics companies with inertial sensors derived from its silicon micromachining (MEMS) technology
 - IC manufacturing techniques are used to sculpt three-dimensional silicon devices
- Kionix specifically focuses on inertial sensors
 - Accelerometers
 - Gyroscopes
- Kionix serves inertial sensor markets with high volume and strong underlying demand
 - Consumer electronics
 - Automotive
- Kionix is wholly owned subsidiary of Rohm Co, Ltd., a Kyoto-based multibillion dollar diversified electronics supplier



Kionix as a microcosm

- Not the largest supplier (yet)
- So far mostly just accelerometers
- So far mostly in consumer electronics
- Nearly 100% CAGR in units

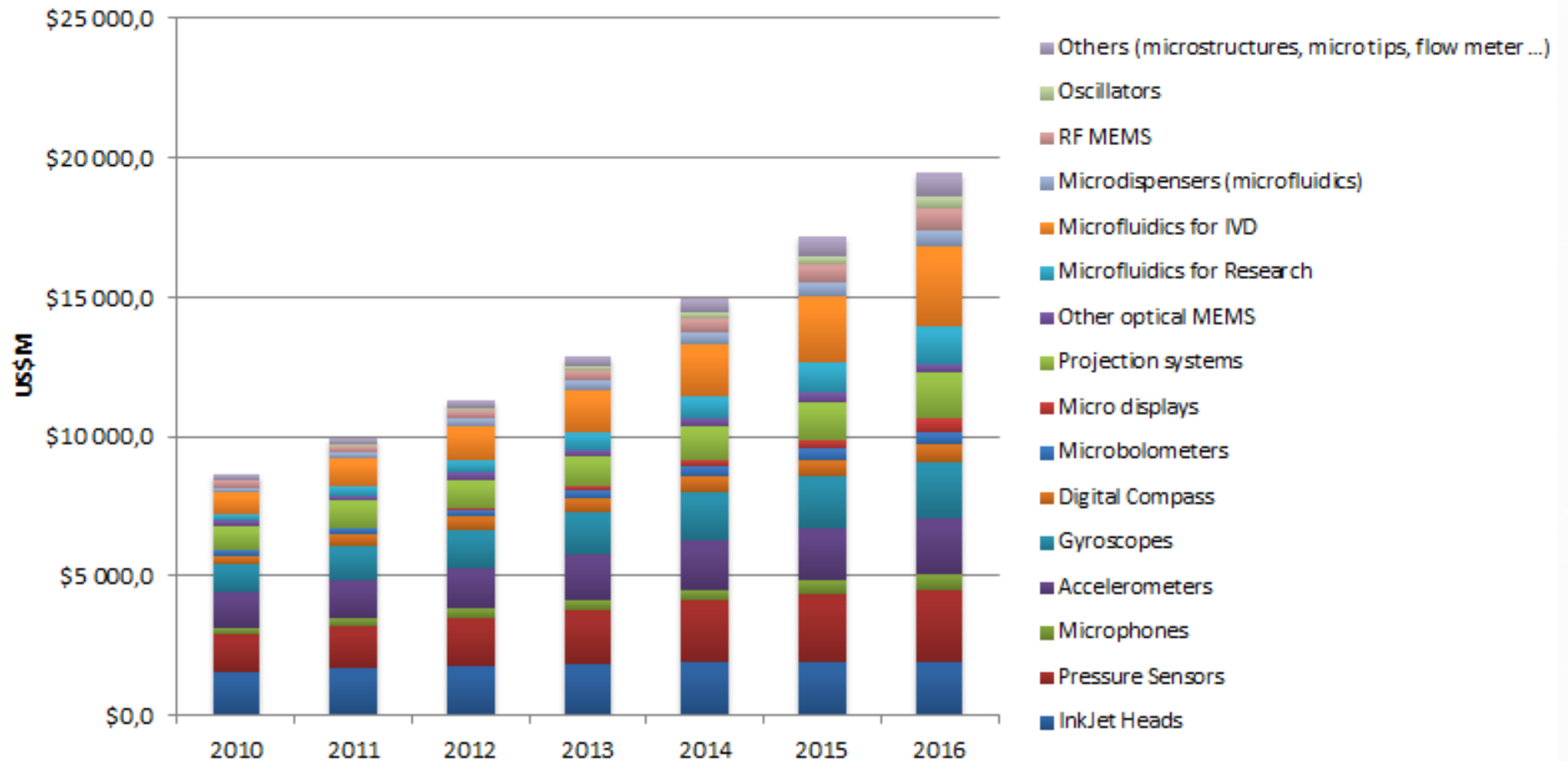


Rapid proliferation

- Motion
 - Accelerometer, gyroscope
 - One axis, two, three, combinations, various ranges
- Direction
 - Magnetometer
- Altitude
 - Pressure
- Non-motion sensing
 - Filters, oscillators, chemical sensors, displays, ...

Rapid growth

2010-2016 MEMS Market Forecast - US\$M
March 2011



Why?

- Mobility
 - Sophisticated, personal and indispensable systems
- Interconnected
 - With each other and with the rest of the world
 - Gathering and sharing information
- Self-aware
 - Situational awareness leading to improved user experience and enhanced capabilities

Today's automobile

- Airbag
- ESC
- Auto park
- Auto follow
- Lights on/off
- Wipers on/off, faster/slower
- Proximity start
- Infotainment, integrated bluetooth phone, ...
- How far away is the autonomous vehicle?

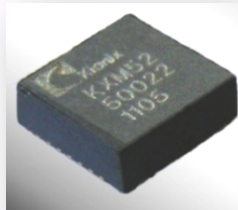
Today's phone

- Screen auto rotate
- Ambient light and proximity for display control
- Cameras of every growing pixel counts
- Multiple microphones, speakers for audio quality
- GPS for location and navigation
- Connectivity to devices, to networks, to the internet
- Magnetometer for absolute heading
- Power management through situational awareness
- RF MEMS for improved performance

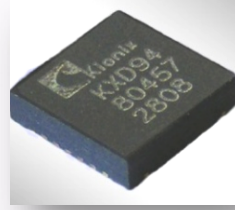
MEMS evolution, so far

- Smaller physical packages
- Greater functionality
- Increasing diversity of applications
- Lower power consumption
- Lower cost
- Growing complexity
 - Hardware and software
 - System integration

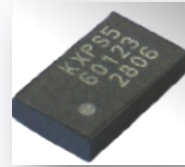
System in Package (SiP)



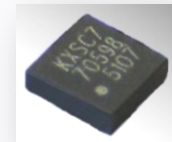
5x5x1.8mm
2004



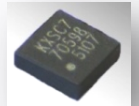
5x5x1.2mm
2005



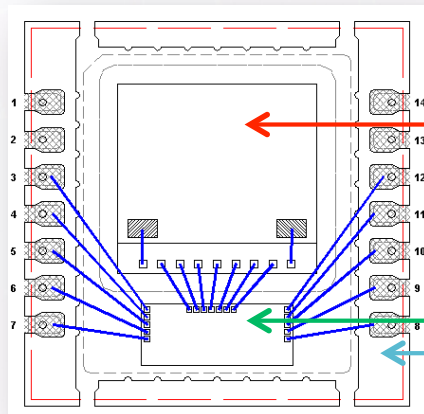
3x5x0.9mm
2006



3x3x0.9mm
2008



2x2x0.9mm
2011



MEMS Sense Element

- Proprietary design, technology and manufacturing

Mixed-Signal IC

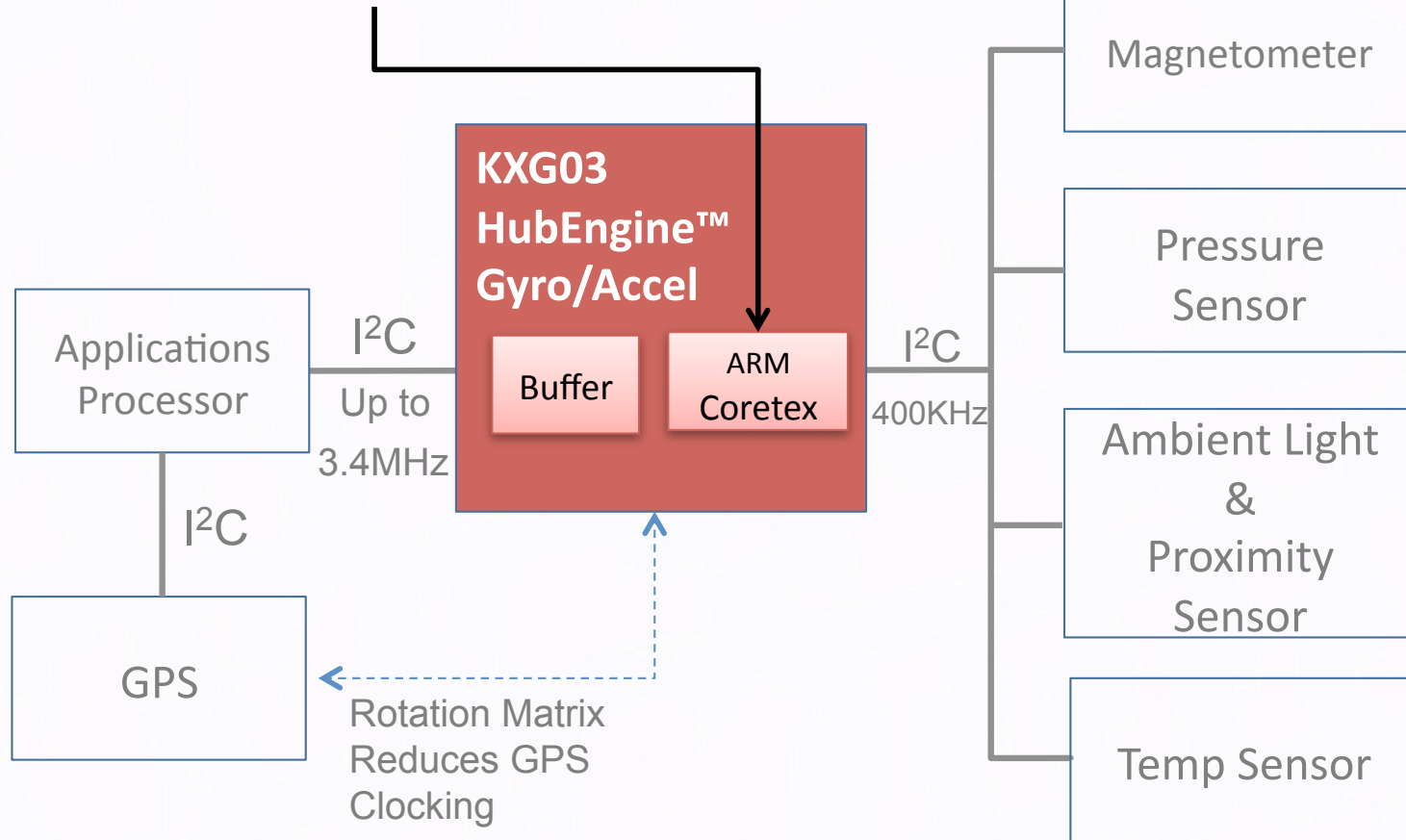
- Mixed-signal IC design in standard 0.5 and .18 μ m processes

Package

- Standard LGA and DFN

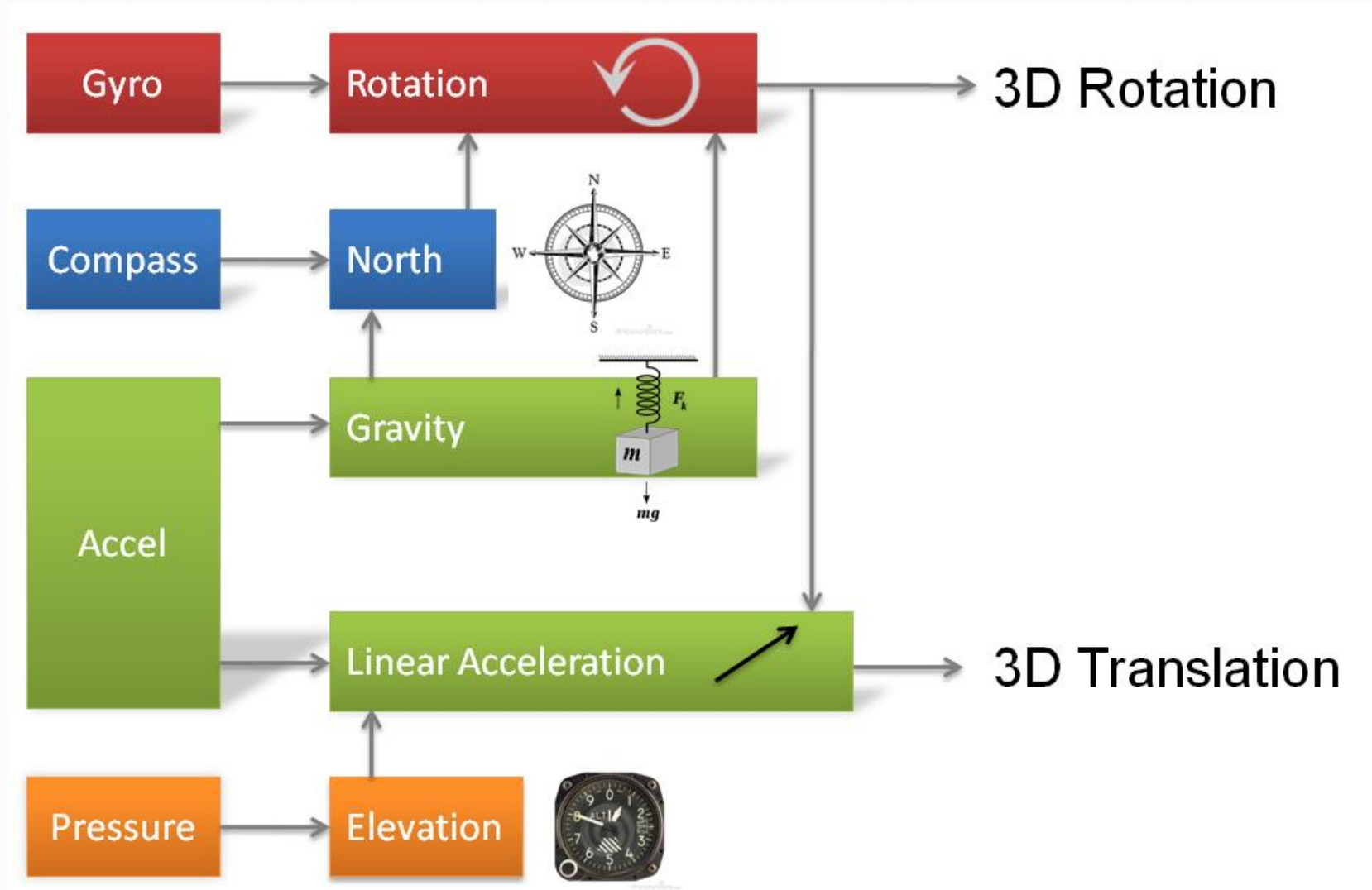
Growing hardware complexity

Sensor fusion processing will occur inside the KXG03



Motion sensor interaction

Combining data from multiple sensors corrects for the deficiencies of the individual sensors to calculate accurate positional and orientation information.

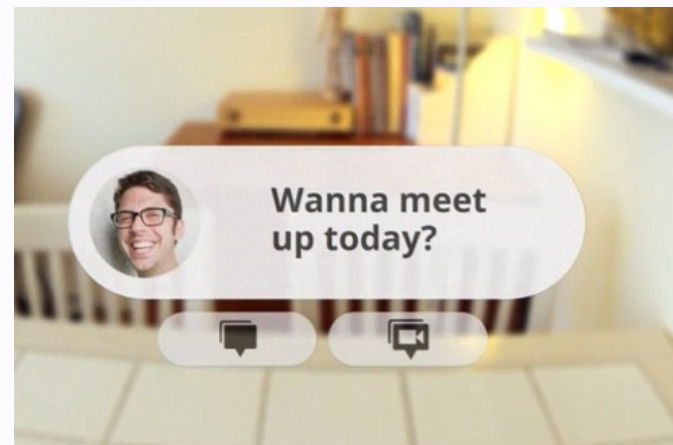
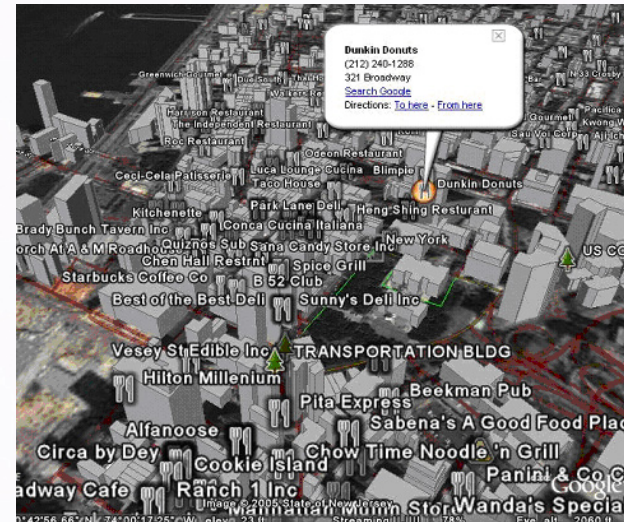


Growing software complexity

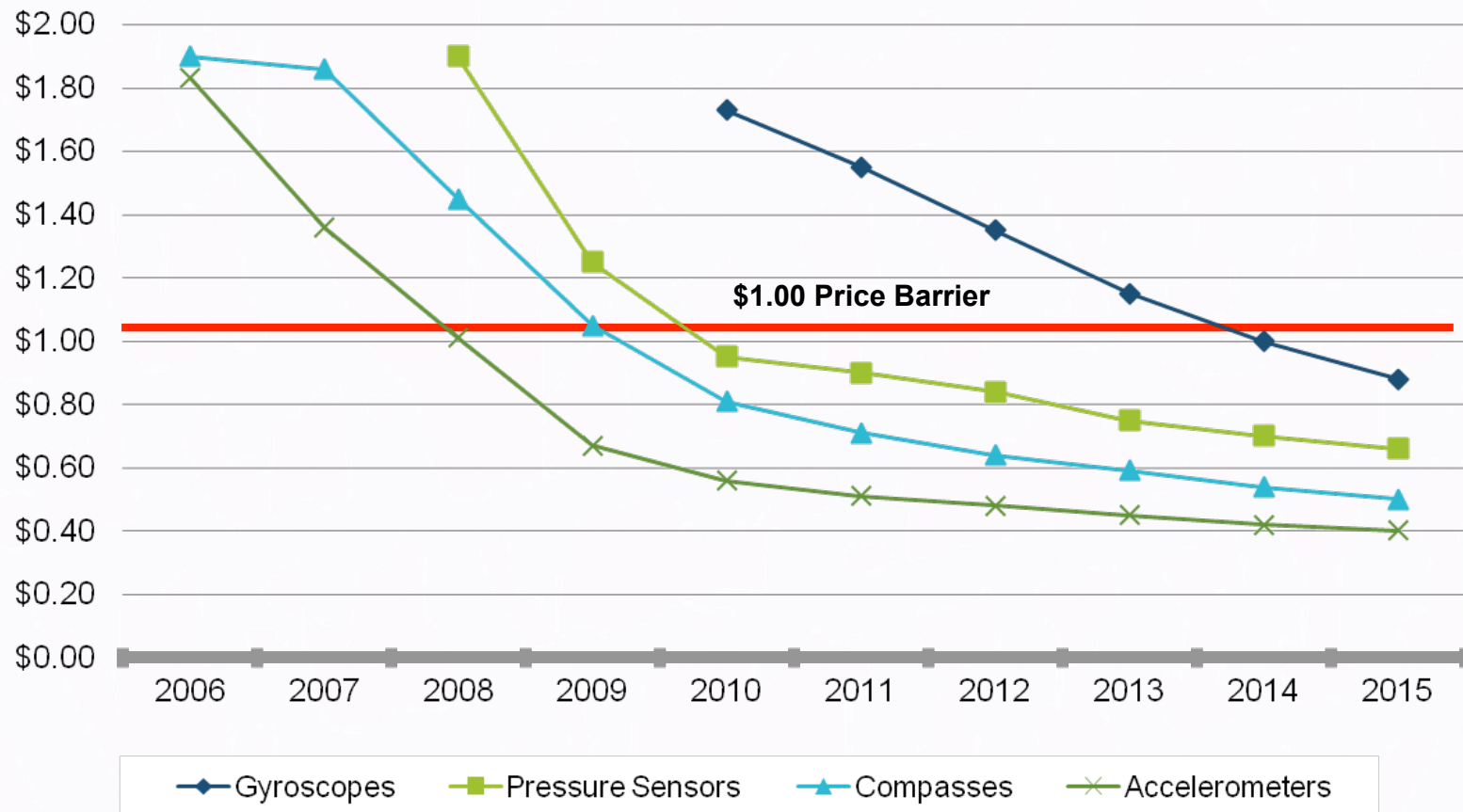


Coming next?

- Location based services
- Augmented reality
- Health monitoring



Challenge: making money



Source IHS iSuppli

Bryzek's white paper

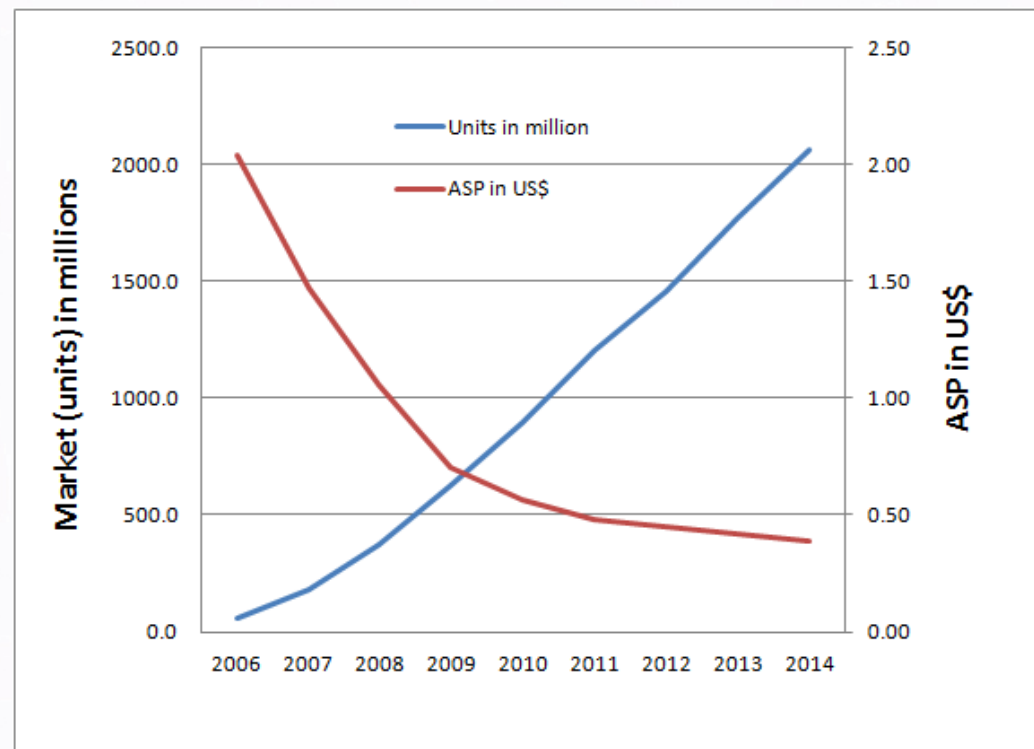
- Potential drivers to \$1T market
 - Central Nervous System for the Earth
 - Sensory Swarms
 - Smart Business
 - Personal health monitoring and delivery
- Everyone in the world (7B) with a MEMS device?
- Units versus economics

GDP perspective

- World GDP in 2010 was \$63T
 - A \$1T MEMS market would be 1.6% of world GDP
- USA as a proxy
 - 23% of world GDP in 2010
 - Only health care was > \$1T
 - 23% of \$1T = \$230B MEMS market in the U.S.
 - \$230B is 2.2% of total “Personal consumption expenditures”
 - \$230B is 6.3% of total “Goods” (i.e. no services)

MEMS vs end products

- High volume MEMS end product users
 - iPhone, iPad, Wii controller, HDD's, automotive
- Strong elasticity of demand (e.g. 3-axes accels)



Source IHS iSuppli

MEMS economic content

- MEMS devices enable great products
- They are not large contributors to the cost, hence the high demand
- Averaging 2% of end product cost

Product	BOM \$	MEMS \$	MEMS%
iPhone4	\$196	\$4.15	2.1%
Wii remote	\$32	\$2.70	8.4%
Kinect	\$56	\$0.50	0.9%
iPad	\$364	\$4.15	1.1%
HDD	\$35	\$0.50	1.4%
Auto	\$50K	\$400	0.8%

Impact on GDP

- If MEMS were a \$1T market
 - At 2% of the cost of the end products
 - Implies a \$50T market for the end products
 - That would be 80% of the world GDP
- Add the sectors of GDP and industrial production that could in theory use MEMS devices - \$7T (\$1.6T U.S.) end product market
 - At 2% MEMS proportion = \$140B MEMS market
 - Could grow to \$0.5T in 10 years (15% CAGR)

Conclusions

- \$1T MEMS component market?
 - Not likely
- 1T MEMS component unit market
 - Likely
- \$1T market of MEMS enabled products
 - No doubt
- MEMS is an exciting and significant business with a very good future