

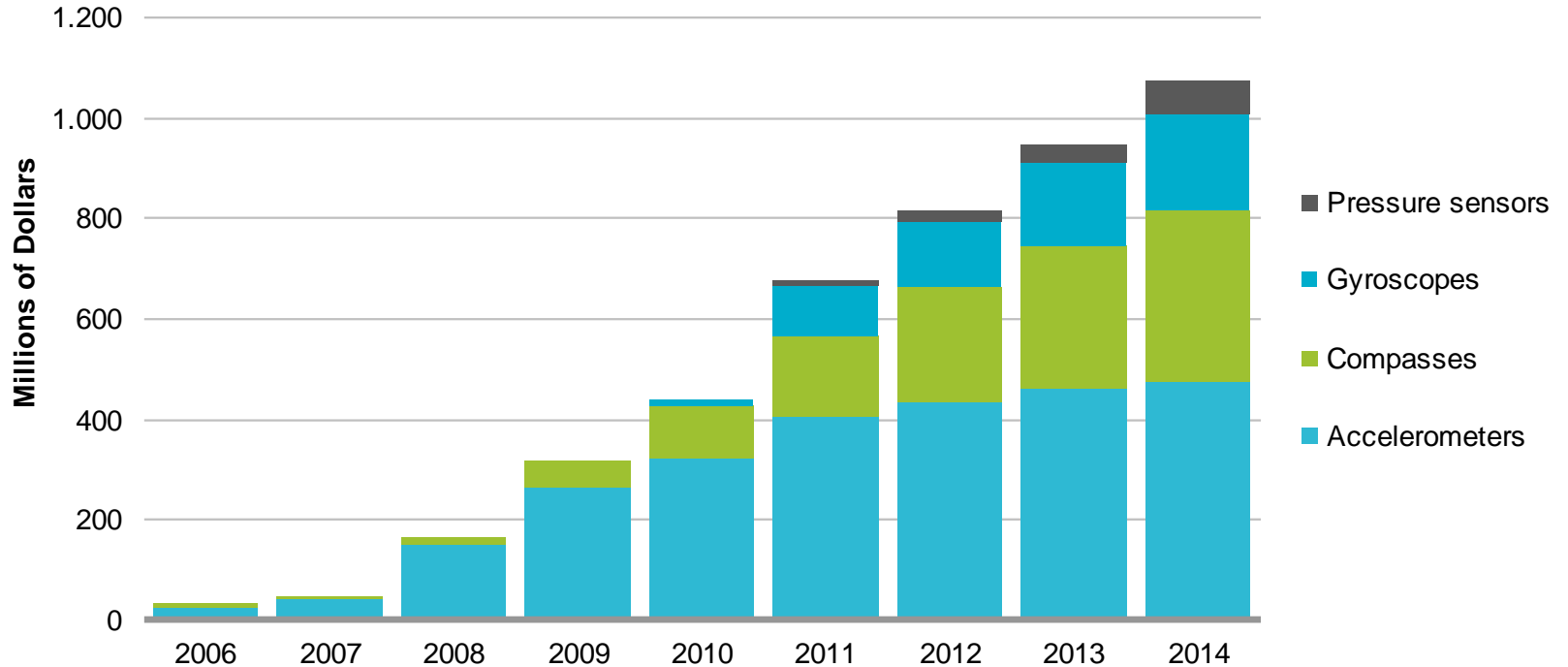


# Ultra low cost monolithic CMOS motion sensors for mass-market consumption

Josep Montanyà i Silvestre  
Chief Technology Officer  
[jmontanya@baolab.com](mailto:jmontanya@baolab.com)

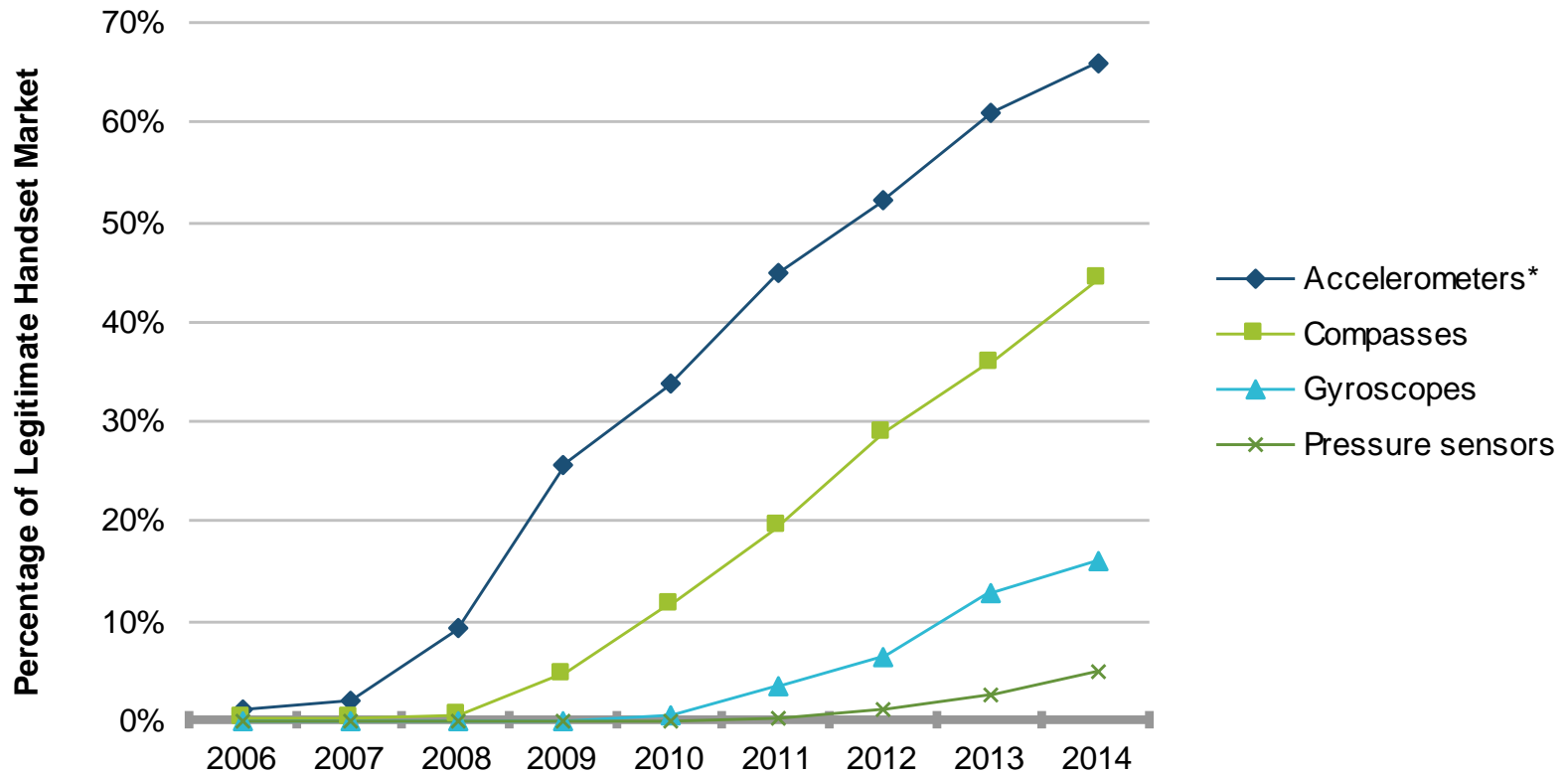
1. Baolab Microsystems
2. Motion sensor market
3. Monolithic MEMS-CMOS integration
4. nanoEMS™
5. Product roadmap

- ◆ **Business:** *Development & commercialization of true “Inside CMOS” monolithic MEMS devices, enabling dramatically lower cost points, with full CMOS integration for the next generation of mass market devices.*
- ◆ **Founded:** July 2003
- ◆ **Investment to date:** \$9.0M (private + VC)
- ◆ **Status:** Development, first revenue’s end 2011
- ◆ **Initial Application:** Cell Phone Handsets
- ◆ **Business Model:** Fabless semiconductor company
- ◆ **Initial Products:** Monolithic motion sensors
- ◆ **Patents:** 18 granted, 9 filed, more in process (process, designs and applications)
- ◆ **Competitive Advantage:** CMOS integration, Size, Cost, Performance, multiple sourcing, volume production capability



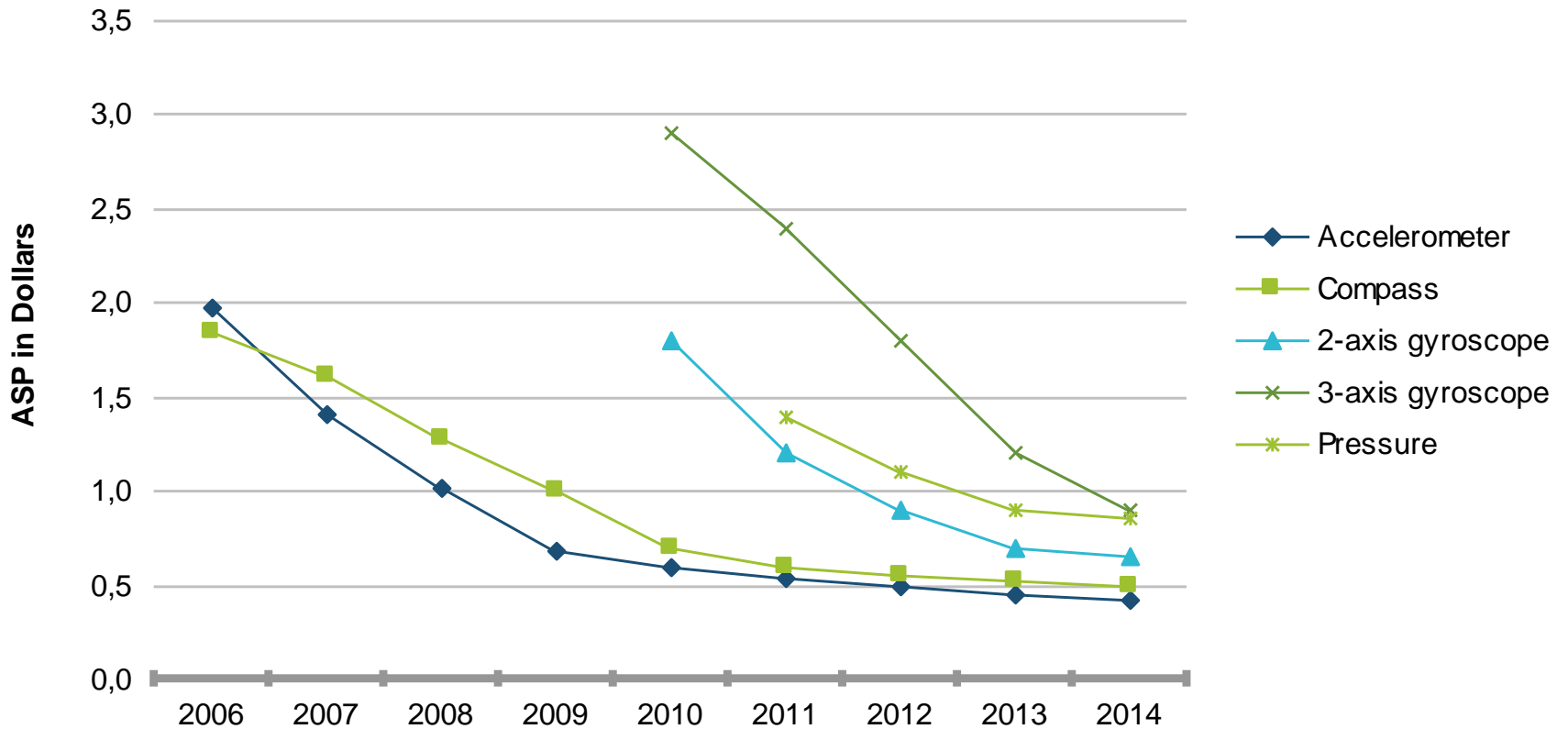
iSupply MEMS H1 2010 Special Report - Motion Sensors in Mobile Handsets

# Penetration of Motion Sensors



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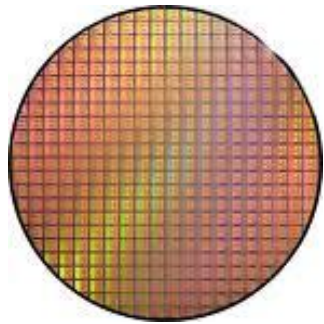
# Price Evolution of Motion Sensors



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# 3D sensor cost breakdown

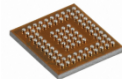
8" wafer (0.18 $\mu$ m): \$1100  
 2.5mm x 2.5mm: 4.668dice  $\rightarrow$  \$0.24  
 1mm x 1mm: 29.199  $\rightarrow$  \$0.04  
 <50% target cost



Test: \$0.05-\$0.10/second  
 10%-50% target cost

Dicing + Tape & Reel: \$0.025  
 10% target cost

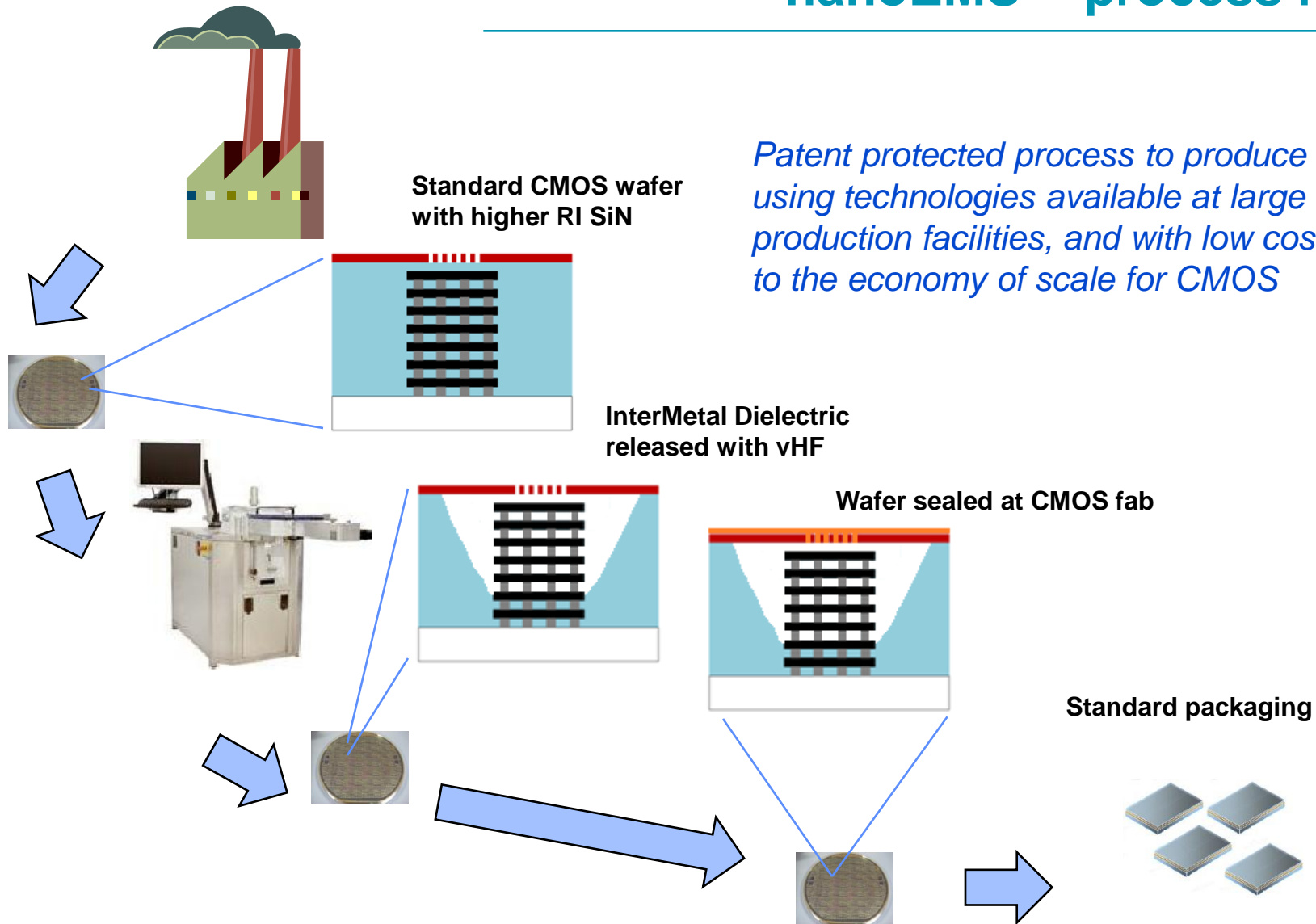
WLCSP: \$0.03-\$0.07  
 20% target cost



**Total monolithic CMOS cost range: \$0.145-\$0.435**  
**Total monolithic CMOS ASP range (with 40% gross margin): \$0.24-\$0.73**  
**Today's MEMS ASP range: \$0.50-\$1.50**



# nanoEMS™ process flow

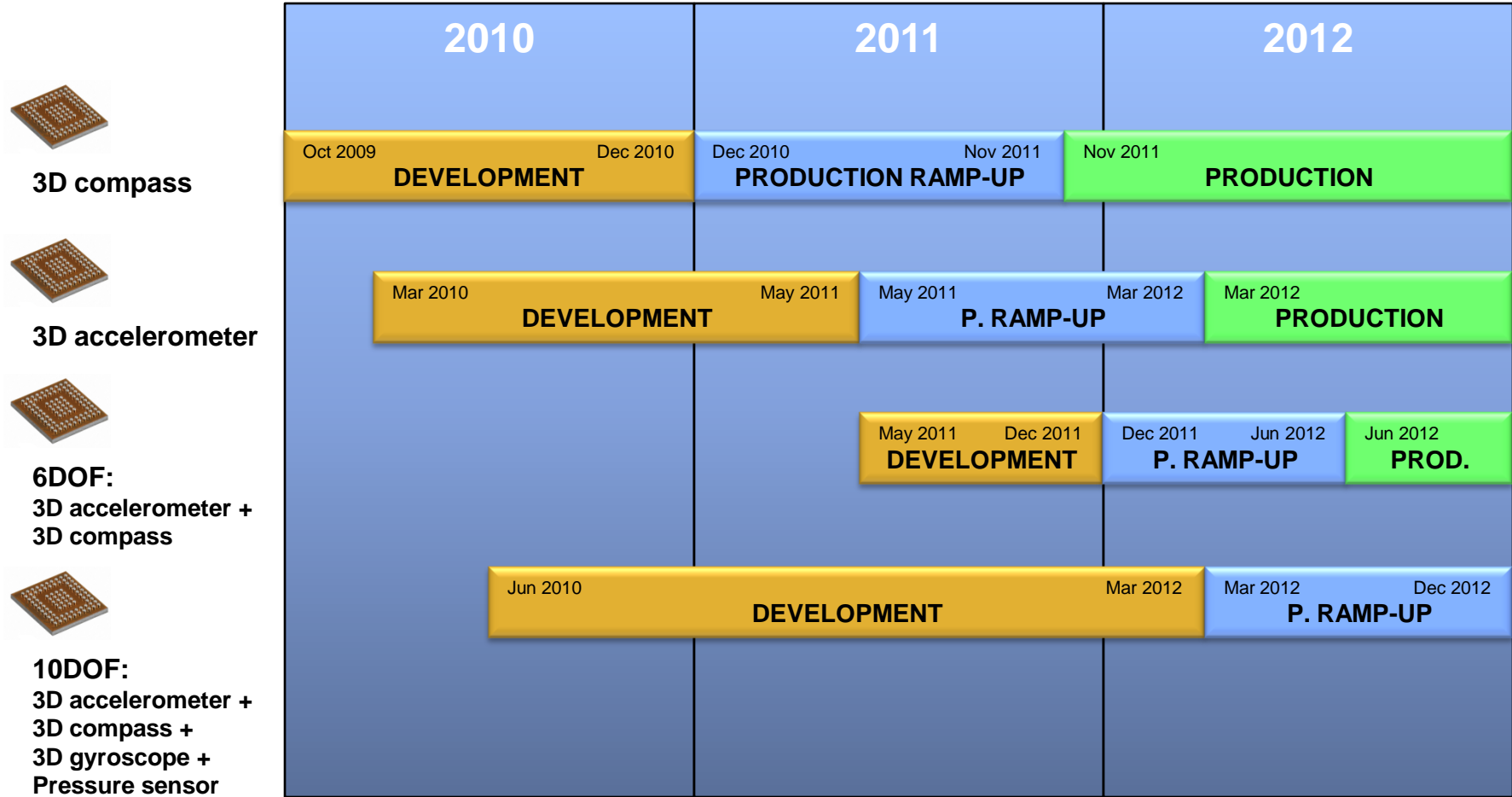


## ◆ Main challenges:

- Etching of passivation → Increase RI of SiN
- Control over the SiO<sub>2</sub> being etched → Design techniques
- Bad mechanical properties of metal layers → Novel detection algorithms  
Autocalibration

## ◆ Patent protection: Entire process; processing tweaks, DRV, design techniques, electronic design, and post-processing.

- ◆ Ultra low cost
- ◆ High volume production capability
- ◆ Multiple sourcing
- ◆ Small size
- ◆ Enhanced functionality
- ◆ Multi-sensor chips
- ◆ Full Integration



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- ◆ nanoEMS™ is the lowest cost approach to build MEMS using standard CMOS process
- ◆ Strong patent portfolio: 18 granted, 9 filed, more in process (process, designs and applications)
- ◆ Partnership with top CMOS foundries, and talking with more
- ◆ Process and designs are easily transferrable to other CMOS fabs
- ◆ 3D compass engineering samples available December 2010

# Thank you!

## Baolab Microsystems

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Josep Montanyà i Silvestre – CTO  
[jmontanya@baolab.com](mailto:jmontanya@baolab.com)