IEEE Sensors 2013 Industrial Panel: 

Wearable Sensors

The Good, The Bad, and The Alluring ...

Session Goal: To facilitate a discussion between Industry and Academia about the future, challenges and promise of wearable sensor technology.

Panelists
- Ross Alcazar, XM Squared
- Abhi Chavan, Corventis
- Tori Hanna, Under Armour
- Amar Kendale, MC10
- Maurizio Macagno, Heapsylon
- Babak Parviz, Google

Session Co-Chairs
- Andrew DeHennis, Senseonics
- Brian Jamieson, SB Microsystems
The Session Overview

- Panelist Opening Statements (5min each)
- Planned Discussion and Questions
- Questions from the Floor
- Closing Statements
## The Metrics

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Readiness: Launch Target</strong></td>
<td>5 yrs</td>
<td>3 yrs</td>
<td>1 yr</td>
<td>Imminent</td>
<td>On the Market</td>
</tr>
<tr>
<td><strong>Measurement Complexity</strong></td>
<td>none</td>
<td>Qualitative Activity</td>
<td>Quantitative Activity</td>
<td>External Bioinformatics</td>
<td>External and Internal bioinformatics</td>
</tr>
<tr>
<td><strong>Internet Connectivity</strong></td>
<td>none</td>
<td></td>
<td></td>
<td></td>
<td>Wifi + Cellular</td>
</tr>
<tr>
<td><strong>Social Connectivity</strong></td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>Information Sharing</td>
</tr>
<tr>
<td><strong>Visual Output Complexity</strong></td>
<td>no display</td>
<td></td>
<td></td>
<td></td>
<td>HD Video</td>
</tr>
</tbody>
</table>

### Diagram: Samsung Smartwatch

- **Technology Readiness**: 5 yrs
- **Measurement Complexity**: 3 yrs
- **Subtleness of Form Factor**: 1 yr
- **Data Storage**: Imminent
- **Power Source Complexity**: On the Market
- **Battery Life**: External and Internal bioinformatics
- **Visual Output Complexity**: Wifi + Cellular
- **Social Connectivity**: Information Sharing
- **Internet Connectivity**: HD Video
- **Multimedia Connectivity**: No
- **Web Community**: Self-Organization
- **Qualitative Activity**: Self-Organization
- **Quantitative Activity**: Self-Organization
- **External Bioinformatics**: Self-Organization
- **Internal Bioinformatics**: Self-Organization
- **None**: Self-Organization
# The Metrics

<table>
<thead>
<tr>
<th>Factor</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery Life</strong></td>
<td>~8 hrs</td>
<td>~1 day</td>
<td>~3 days</td>
<td>~1 week</td>
<td>~1 month</td>
</tr>
<tr>
<td><strong>Power source complexity</strong></td>
<td>Single cell</td>
<td>Rechargable</td>
<td></td>
<td></td>
<td>Energy Harvesting</td>
</tr>
<tr>
<td><strong>Data storage</strong></td>
<td>KB or less range</td>
<td></td>
<td></td>
<td>Cloud + On Device</td>
<td></td>
</tr>
<tr>
<td><strong>Subtleness of Form Factor</strong></td>
<td>Attention Getter</td>
<td>Obvious accessory</td>
<td>Part of Attire</td>
<td>Non-obvious under clothes</td>
<td>Undetectable</td>
</tr>
<tr>
<td><strong>Attachment Method</strong></td>
<td>Adhesive</td>
<td>Accessory</td>
<td></td>
<td></td>
<td>Part of clothes</td>
</tr>
</tbody>
</table>
The Panelists
Ross Alcazar
XM-Squared – Founder/CEO

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- Founder/CEO
XM-Squared
Abhi Chavan
Corventis – Vice-President of R &D

- Actionable Medical Data
- Discrete
- High Compliance
- Easy to Use
ARMOUR39 Performance Heart-Rate Monitor

- Built for interval training
- Watch OR iOS BLE enabled device
- 4 Key metrics (HR, R-T Intensity, Calories, WILLpower)
- Armour39 Future Show
Amar Kendale
MC10- VP of Marketing
Maurizio Macagno
Heapsylon – VP of Development

- Connected Smart Garments
- Heart rate, GSR, Force/Pressure...
- Do not disrupt consumer workflow
Babak Parviz
Creator of Google Glass and Director at Google X

+ Evolution of computing
+ Evolution of access to information
+ Evolution of modes of communication
+ Unique aspects of wearables:
  device awareness of the users, co-presence, displays
The Panel Questions
The Bad

Power, and the available of energy dense power sources in general, remains a critical issue of the design of practical wearable devices. Is the cavalry on the way, and if so what do you think is the most promising technology to fix this bottleneck?
The Good

Complete turnkey machine-to-machine cell phone modems (such as this multi-tech iCell with IPstack) left, or ConnectBlue’s low power bluetooth module (right) speed time to market

What are some of the key potential sub-modules that can (or could if they existed) enable streamlined Wearable Sensor development?
How can we better incorporate Industrial Design in early stages of Wearable Sensor Development?
The Desirable

What wearable device do you most wish you could buy and use right now?
The Market

Who are your most important early customers, and what are you doing to identify and get the attention of early adopters?
The Difference

What differentiates your technology / approach / application from what is currently on the market? Or do you see yourselves as first-to-market, solving an existing and unanswered need?
The tipping point for cell phones came in the late 1990's, when cell phone use expanded at an astronomical rate and passed 50% penetration worldwide. When do you think the tipping point for wearables will come, and what device do you guess might lead the charge?
The Language

Example of a Wireless Connectivity for Embedded Devices (WICED) device and developing standard

What role will communication standards play in connecting wearable devices?
The Recent Benefits

Photographic example of University run labs that train students on various cleanroom technologies

What recent changes have you seen from academic programs (students or technology) that have made an impact in your development?
The Talent

What is your biggest technical problem area in terms of recruiting and harnessing engineering horsepower. In other words, "I wish we could find more people who are excellent at __________"?
The Open Questions

Audience ???