NSF Workshop on Biologically-Enabled Wireless Networks
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Breakout Session on Unifying Themes: Day 2

Nanoscience for Bio-Synthetic Wireless Sensor Networks

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Goals

• Develop ultra-immersive sensing and actuating systems for organisms.

• Requirements:
  – Multiple-scales, i.e., from organism to molecular scale.
  – Two orders of magnitude denser than current technology.
  – New techniques for energy harvesting.
  – Exploit existing body-wide transport systems, e.g., blood, nervous, and lymphoid systems.
Challenges

• Increase sensor density by two orders of magnitude.
• Multi-scale sensors, i.e. from molecular to mm-scale
• Molecular-scale recording of information
• Data collection, data processing and analysis
• Harvest and store energy
  – External
  – Internal, e.g., sugar, ATP, vibration, motion, blood
• Exploit blood, lymphoid, and nervous systems to transport information
• Sensor insertion
• Miniaturization
• Ethics, train the workforce, social acceptance
Applications

• Monitor and respond to lots of “stuff:”
  – Non-invasive medical diagnosis, possibly using multiple sensors, organs, and humans.
  – Detect and respond to toxic chemicals.
• Measuring life experiences of an organism.
• Doing medical trials “without trials,” i.e., crowd-sourced medical trials.
• Applications to social science, psychology, dietary science, political science, homeland security.
• DOD application of critical interest to DARPA: Monitor human soldier in combat at a 100x higher sensor density level.
Recommendations

• Establish a funding program that funds key basic challenges for an ultra-immersive sensing and actuating system for organisms.
• Explore possibilities for joint funding from DARPA and/or NIH.