

NC STATE UNIVERSITY

Little Sensors to solve **BIG PROBLEMS**

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**Feed 9B people in
~2050**



**Restore and
Improve Urban
Infrastructure**



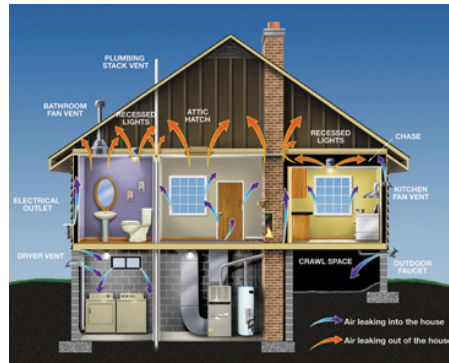
**Improve Efficiency
and Efficacy of
Health Care &
Disease
Prevention**



**Provide Clean
Water**



**Manage the
Nitrogen Cycle**



**Improve Energy
Efficiency**



Provide National Security₂

Research Challenges

**Autonomic
Action**

**Node
Functionality**

**Security &
Privacy**

**Energy
Management**

Autonomic Action via an Open Platform

- ▷ **Collective Programming & Data Management**
 - ◆ Self-installing, self-configuring Swarm OS
 - ◆ SQL like queries to sensor network
 - ◆ Getting useful answers from noisy data
 - ◆ Collective intelligent processing within the network
 - ◆ Data management, not data crunch
- ▷ **Robustness & Resilience**
 - ◆ Achieving high QOS despite poor links
 - ◆ For 4G LTE as well as sensor-specific radios
- ▷ **Coupling with self-actuation**
- ▷ **Coupling with natural UIs**

Sensor Functionality

- ▷ **Robust field deployable sensors**
 - ◆ Gas, bio, chem sensor sub-system operating at a mW, in a ml, and for a long time
 - ◆ Particulate matter
- ▷ **Maximizing external sensing of internal body functions**
- ▷ **Position location to 1 m accuracy**
 - ◆ Indoors

Security and Privacy

- ▷ **Data security**
 - ◆ Keep valuable data proprietary
- ▷ **Intrusion prevention**
- ▷ **Privacy protection**
 - ◆ Prevent identity hijacking, etc.
 - ◆ Keeping others data private

Energy Management

- ▷ **Give appearance of continuous operation despite much of the system being much of the time**
- ▷ **Maximizing data utility while minimizing data communications**
 - ◆ High energy cost of RF communications
- ▷ **Achieve useful “mission” lifetimes**
 - ◆ Through battery management, energy harvesting, ultra-low power electronics and sensors sub-systems