

Near Zero Power Sensor Operations (N-ZERO)



National Need: Pervasive Sensing Capabilities for the Warfighter

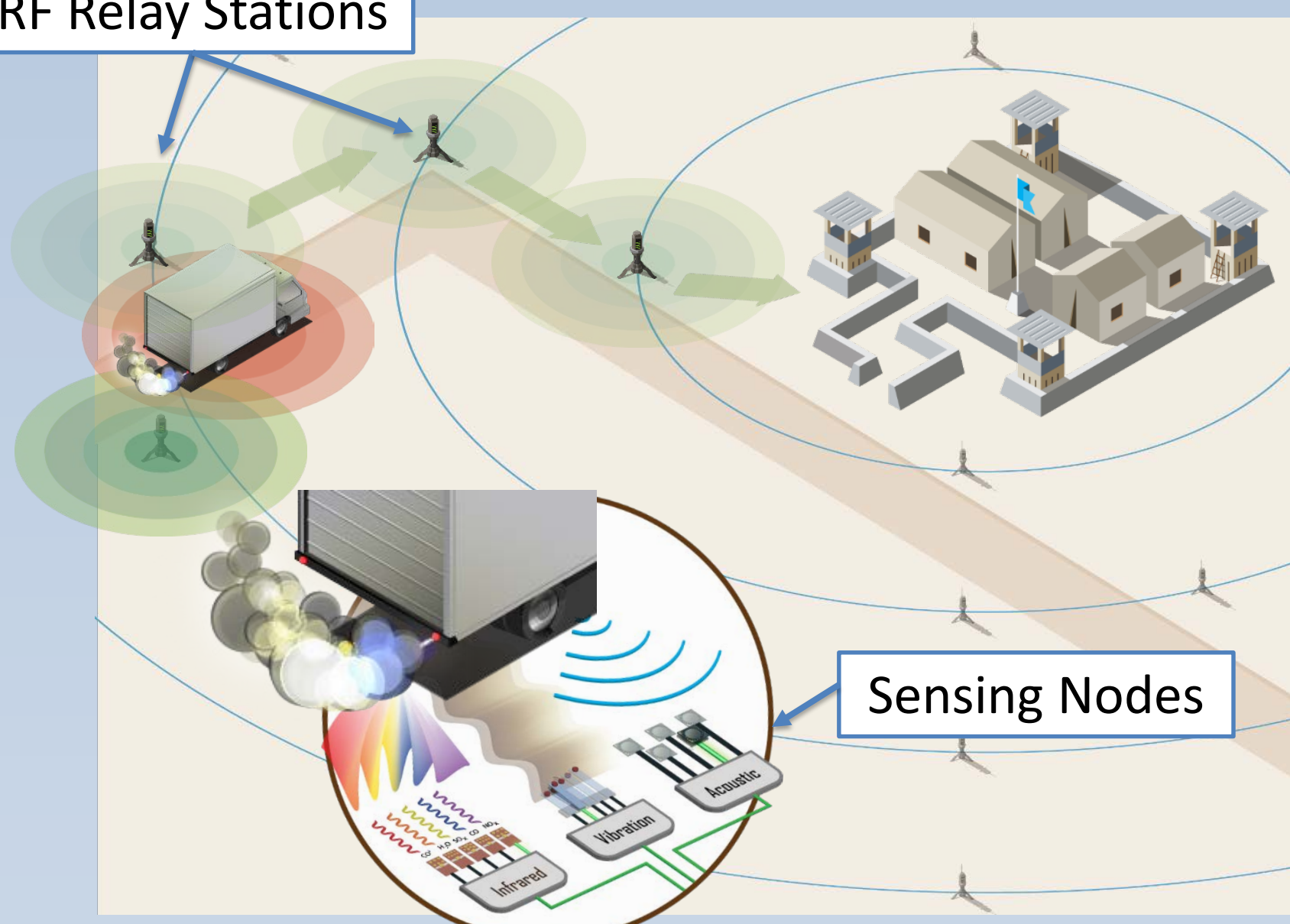
Heterogeneous Integration

Next Generation Solutions

N-ZERO Seeks to Enable Persistent Sensing for the DoD



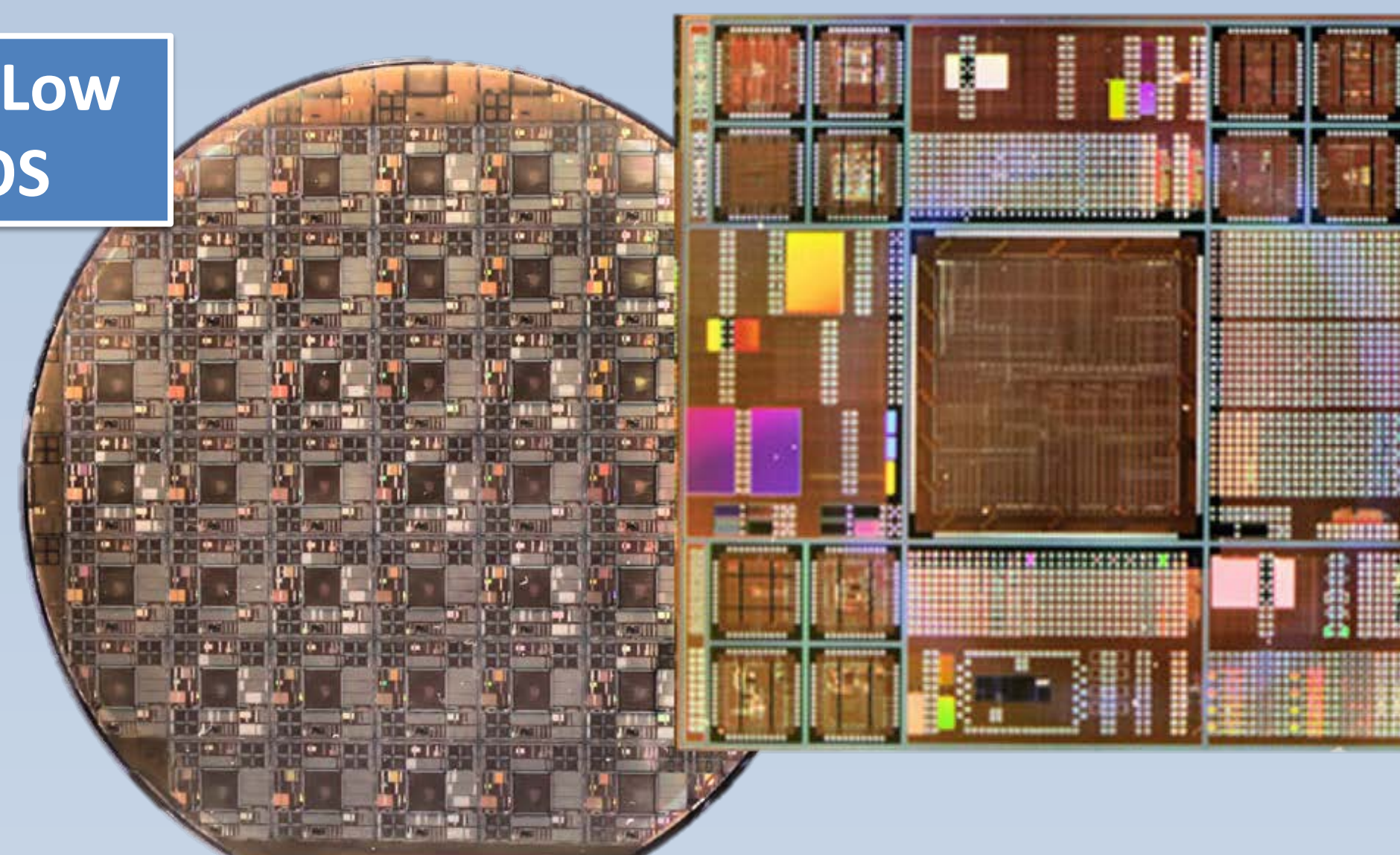
RF Relay Stations



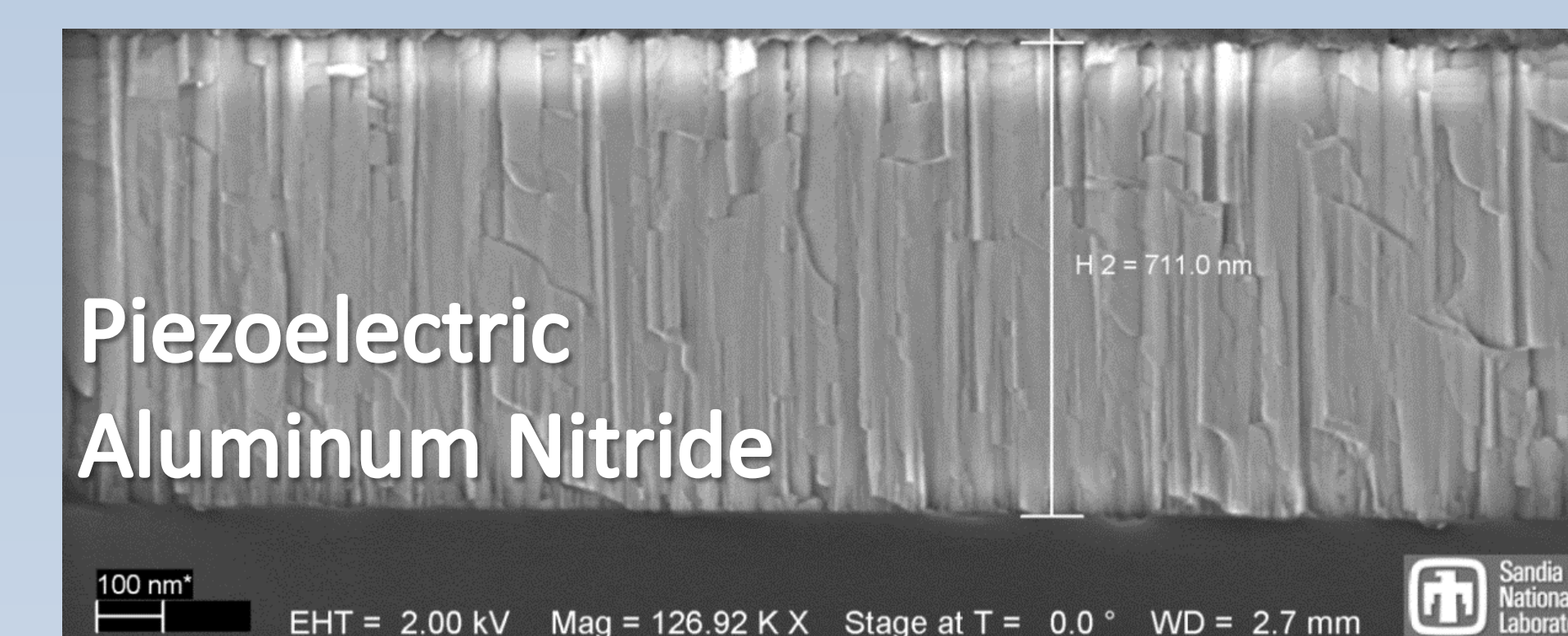
- Saturate the perimeter with low-cost, wireless sensors with greatly reduced battery usage
- Employ continuously aware sensors with high Probability of Detect and low False Alarm Rate
- Relay the detected event wirelessly back to a central location through the sensor network nodes

Sensing Nodes

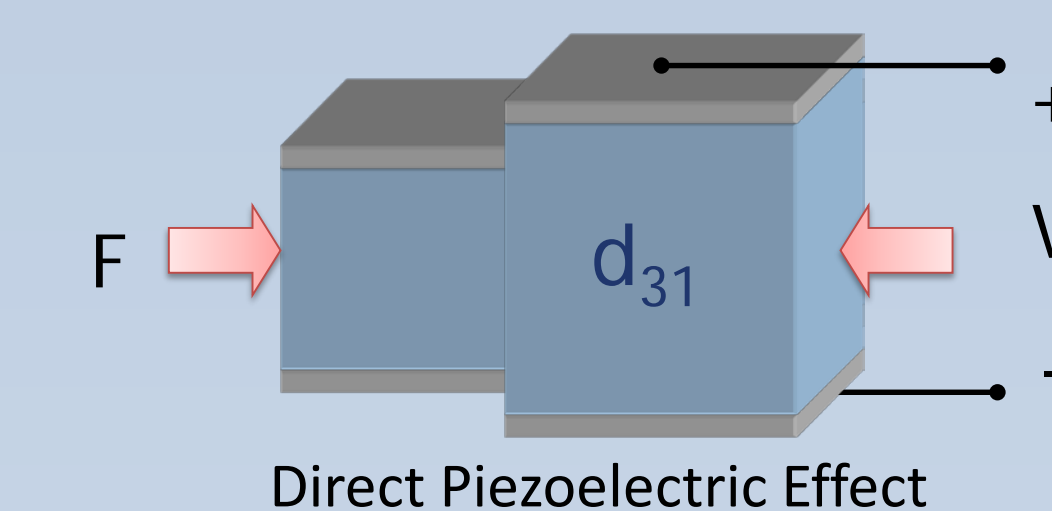
SiFab CMOS7 Low Power CMOS



Aluminum Nitride Piezoelectric Material and Device Expertise

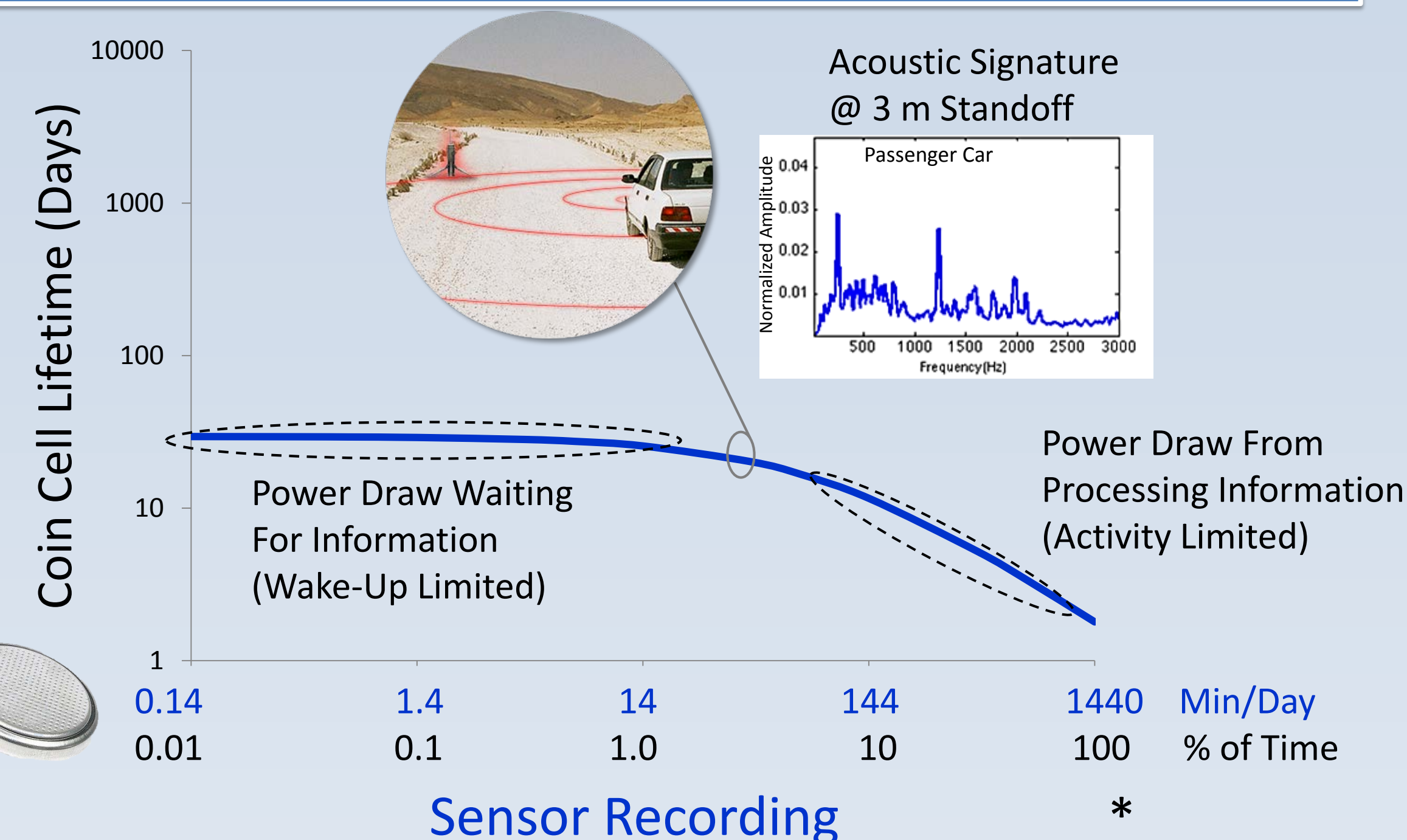


Electromechanical Transduction

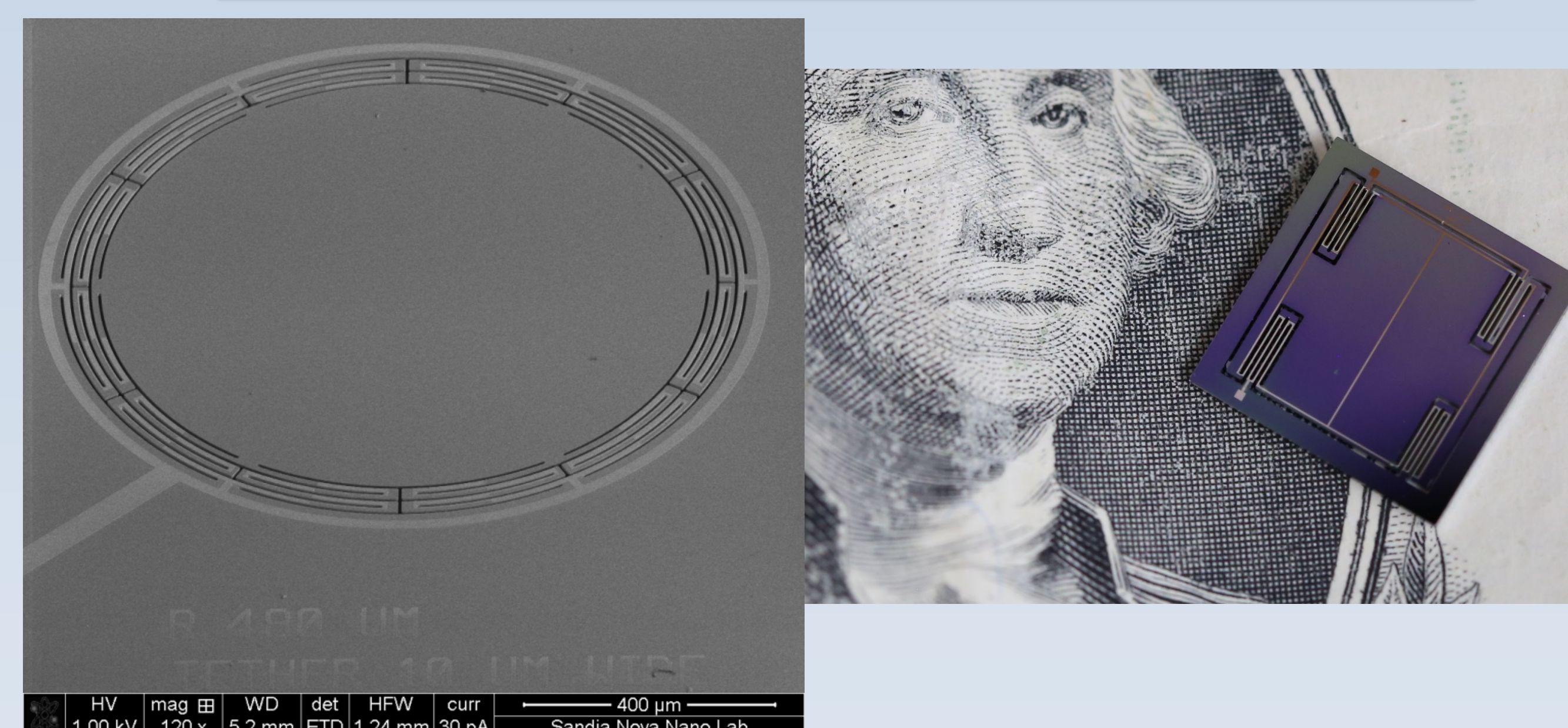


Direct Piezoelectric Effect

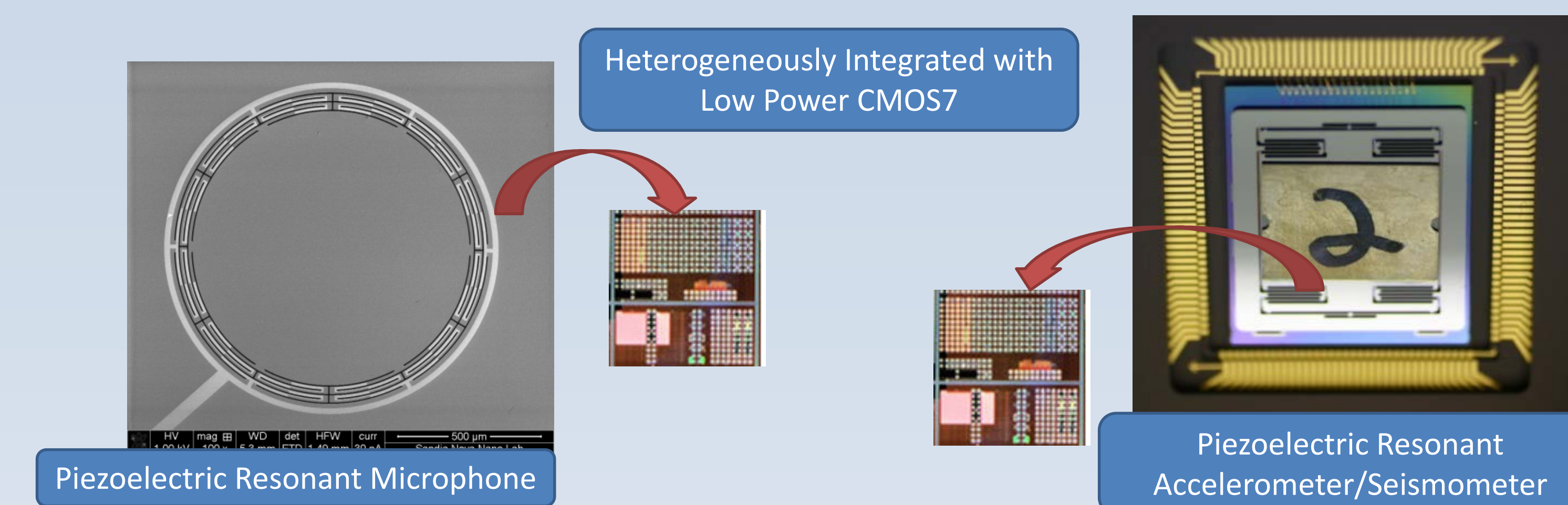
Before N-ZERO: Awaiting Activity Constrains Mission Life



μFab Enabled III/V Microelectromechanical Sensors

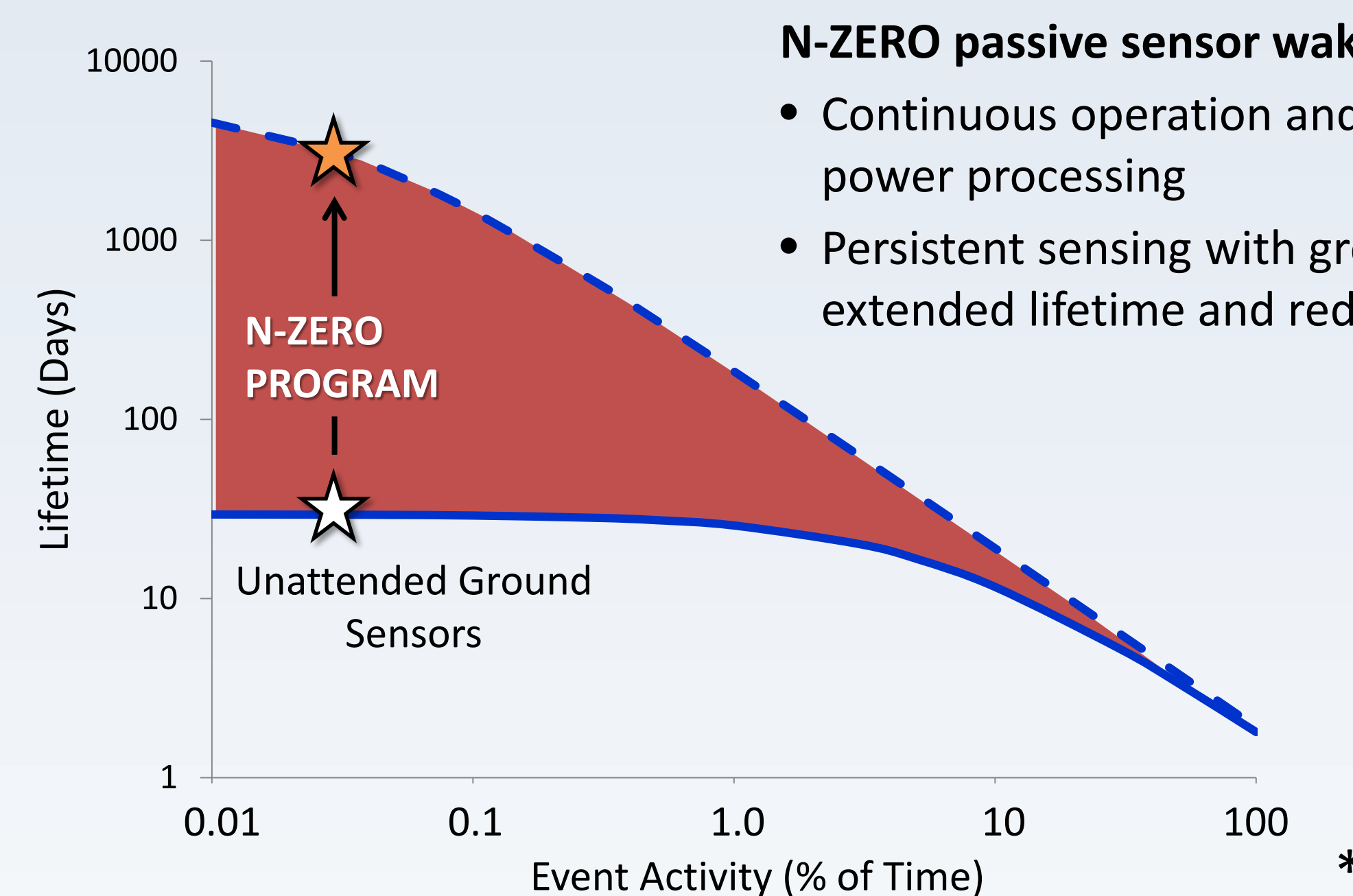


Physical Wakeup Sensors

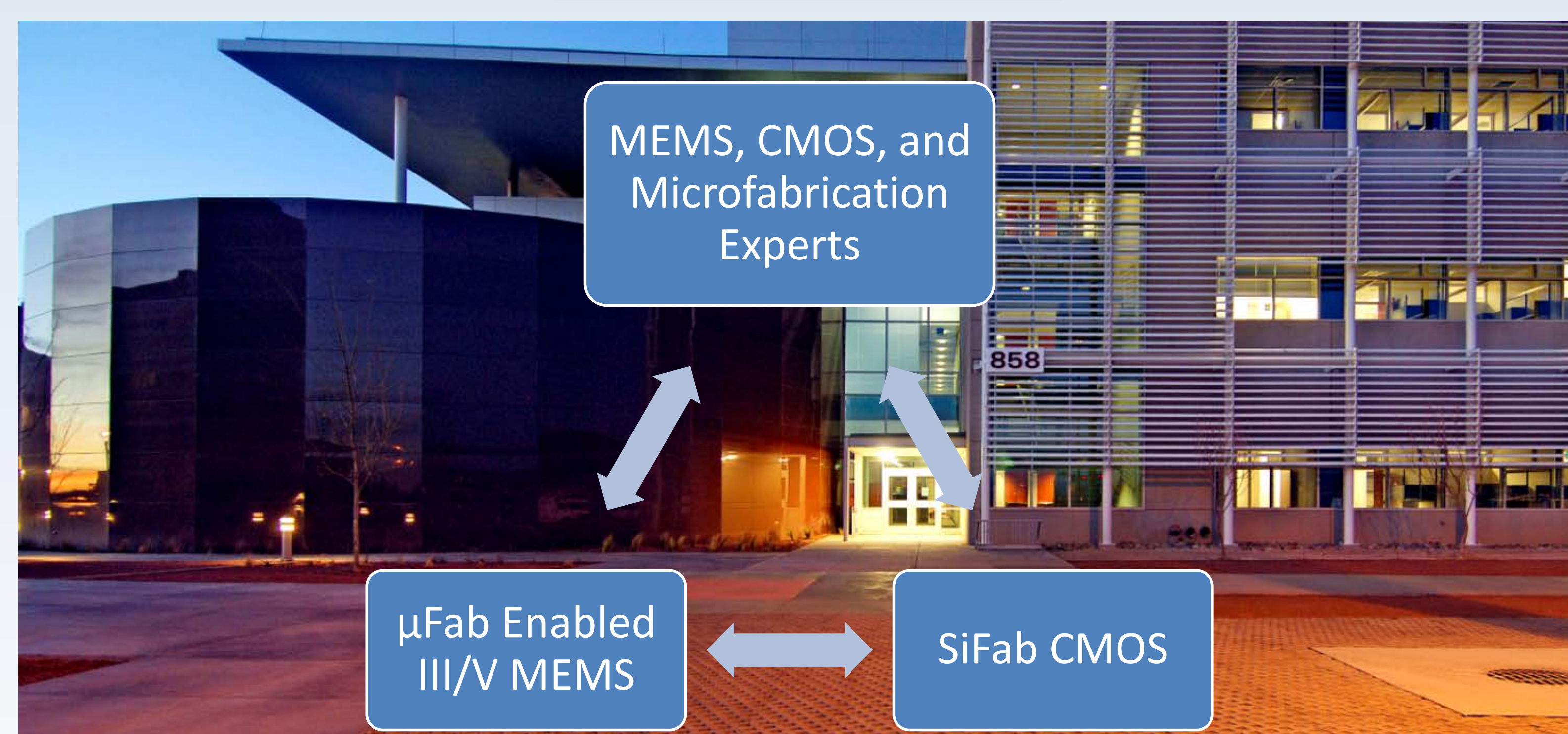


- Phase 1 demonstration of 5 nW vibration wakeup system [1]
 - Targeted vibration signature of a generator
 - 100% probability of detection with 0 false alarms
- Multi-frequency physical filters enabled by batch microfabrication techniques
- Frequency selectivity plus zero power piezoelectric generation of wakeup signal enables near zero power solution

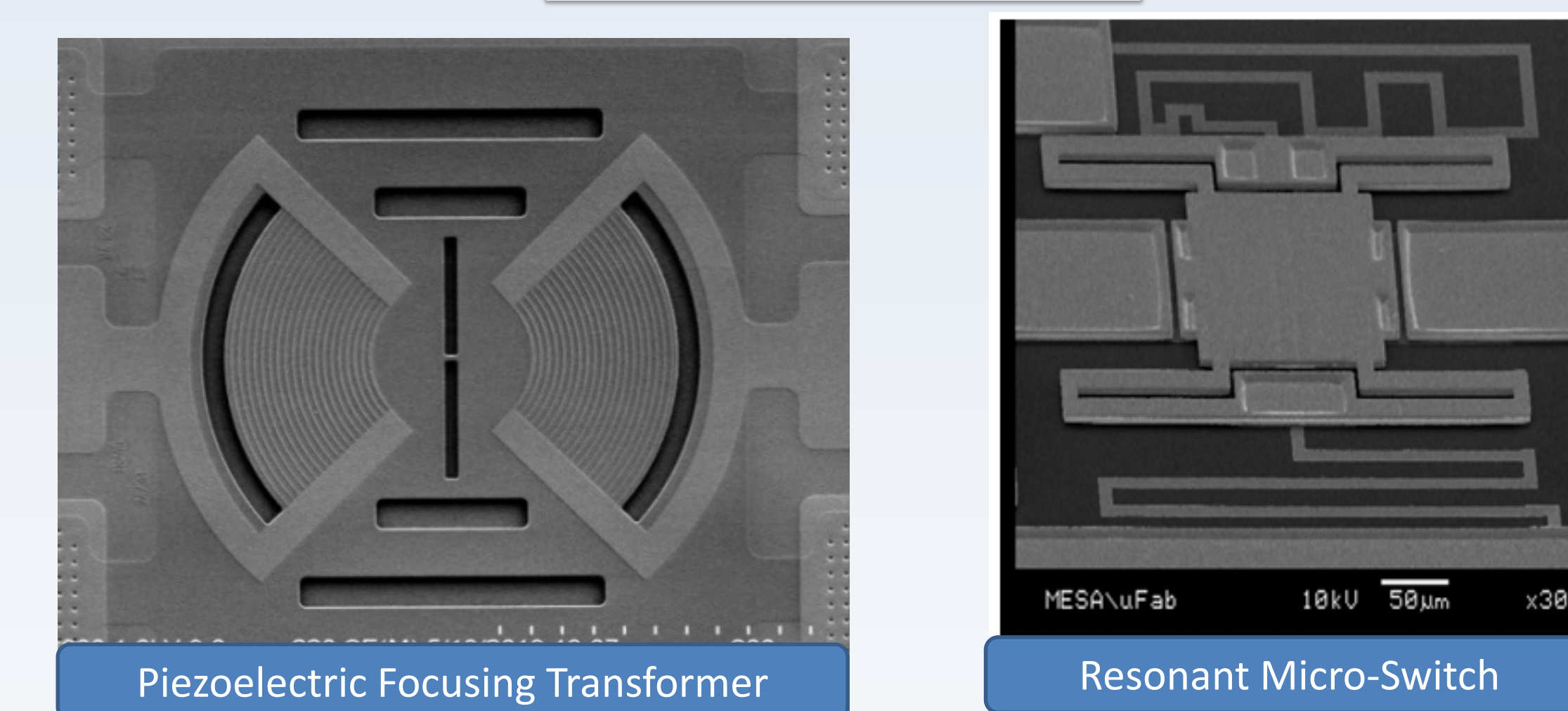
After N-ZERO: Devices are OFF (Zero Power Consumption) Yet Continually ALERT!



MESA Complex



RF Wakeup Sensor



Goal: 10 nW continuous standby power consumption