TerraSwarm

Monjolo: An Energy-Harvesting Energy Meter Architecture

Brad Campbell, Sam DeBruin, Meghan Clark, Prabal Dutta
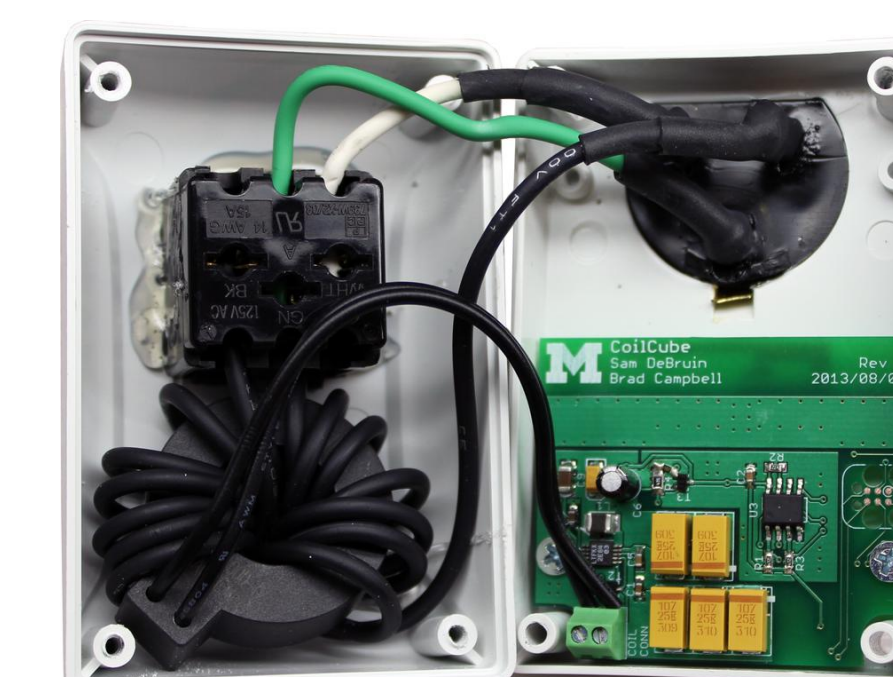
University of Michigan

November 5, 2013

Energy sources we wish to meter
{indoor lighting, AC loads, heat}
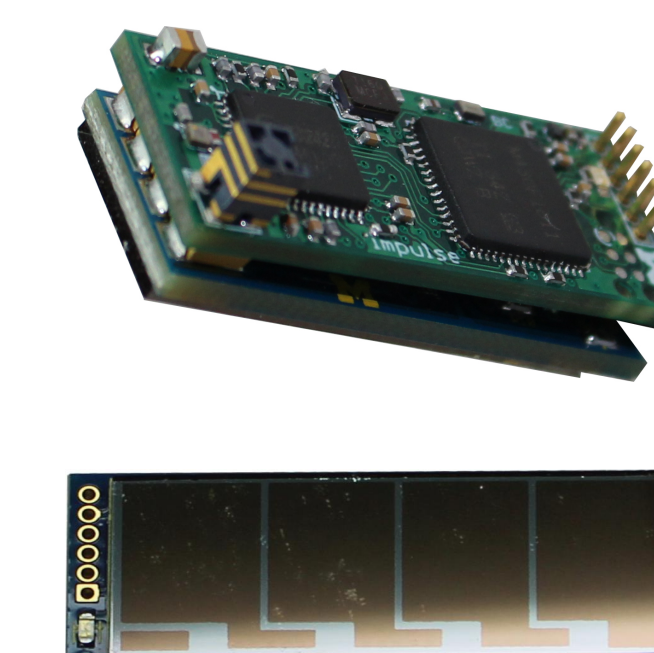
emit side channels of harvestable energy
{light, electromagnetic fields, temperature gradients}

MONJOLO NODES

Plug load   Splitcore   Light
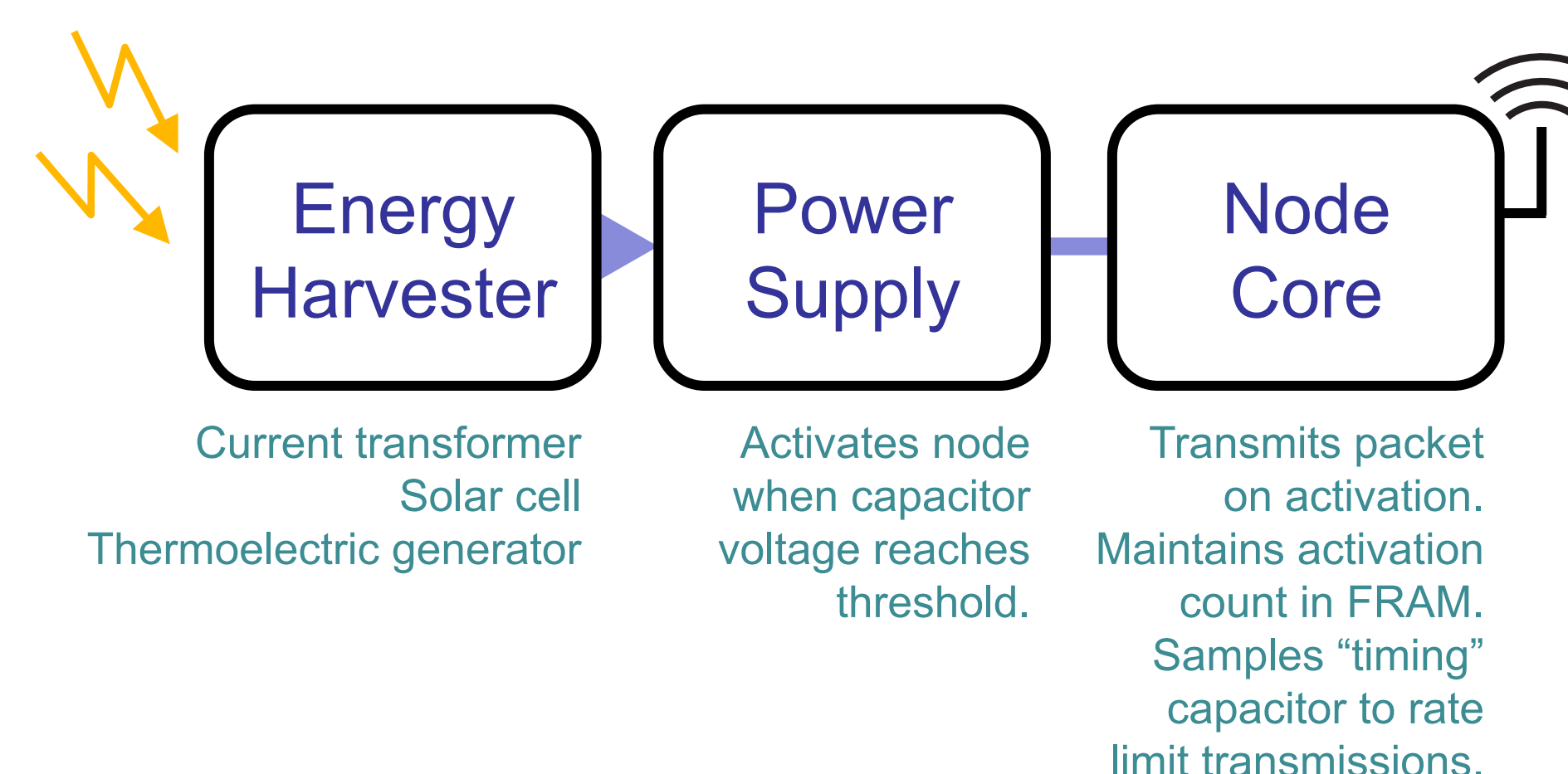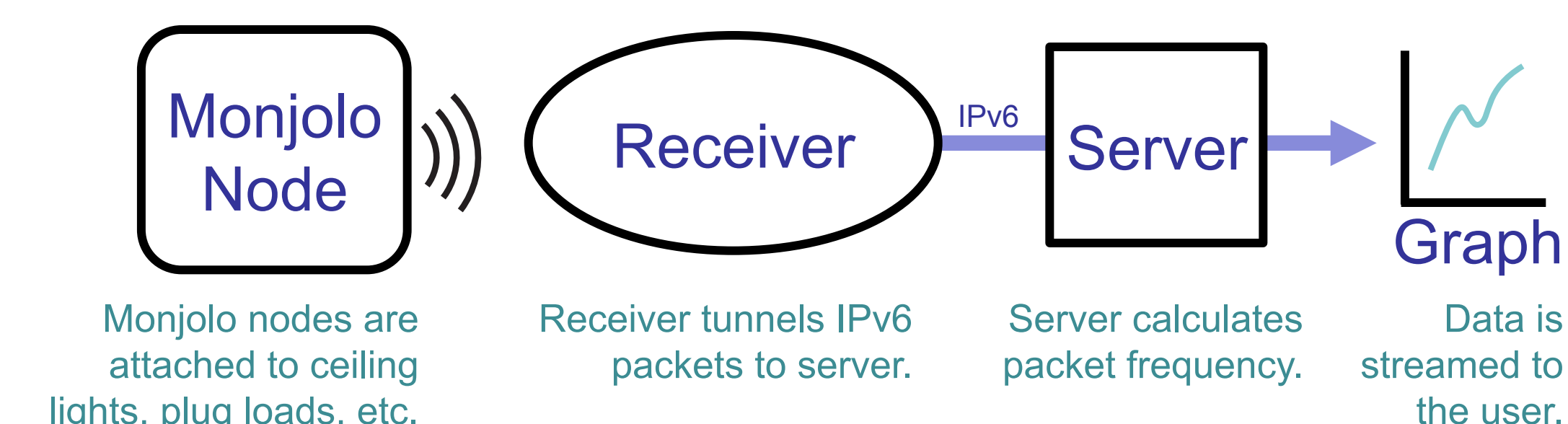
We use these side channels and an energy-harvesting power supply to *intermittently* power a sensor node.

Hypothesis: the rate of node activations increases monotonically with the power draw of the energy source.

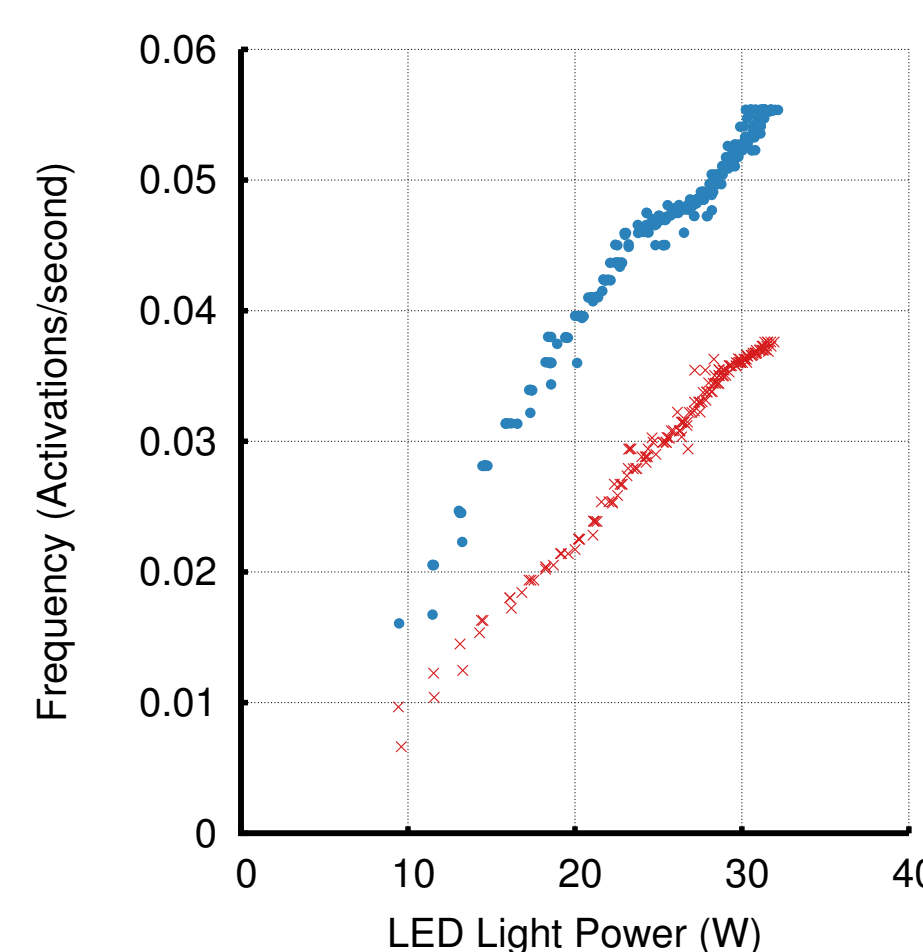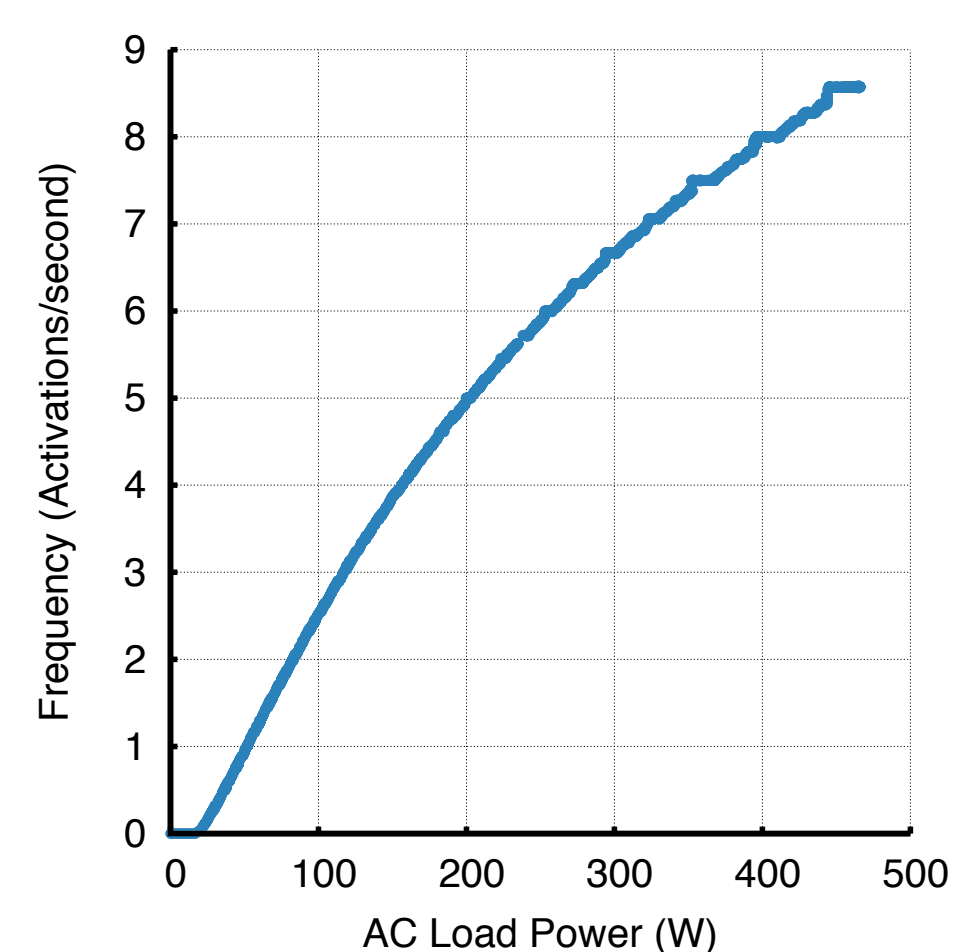Activations of a power meter and light sensor across a range of AC loads. As the load power increases, so does the activation rate.

Monjolo Operation

Energy Harvester → Power Supply → Node Core

Current transformer
Solar cell
Thermoelectric generator

Activates node when capacitor voltage reaches threshold.

Transmits packet on activation. Maintains activation count in FRAM. Samples "timing" capacitor to rate limit transmissions.

Monjolo AC Power Meter

RESISTIVE

REACTIVE

End-to-end System

Monjolo Node))) Receiver —IPv6→ Server → Graph

Monjolo nodes are attached to ceiling lights, plug loads, etc.

Receiver tunnels IPv6 packets to server.

Server calculates packet frequency.

Data is streamed to the user.

Load Disaggregation

Our current work aims to provide submetering with uncalibrated Monjolo nodes and a ground truth aggregate value.