

K2: A system for campaign deployments of wireless sensor networks

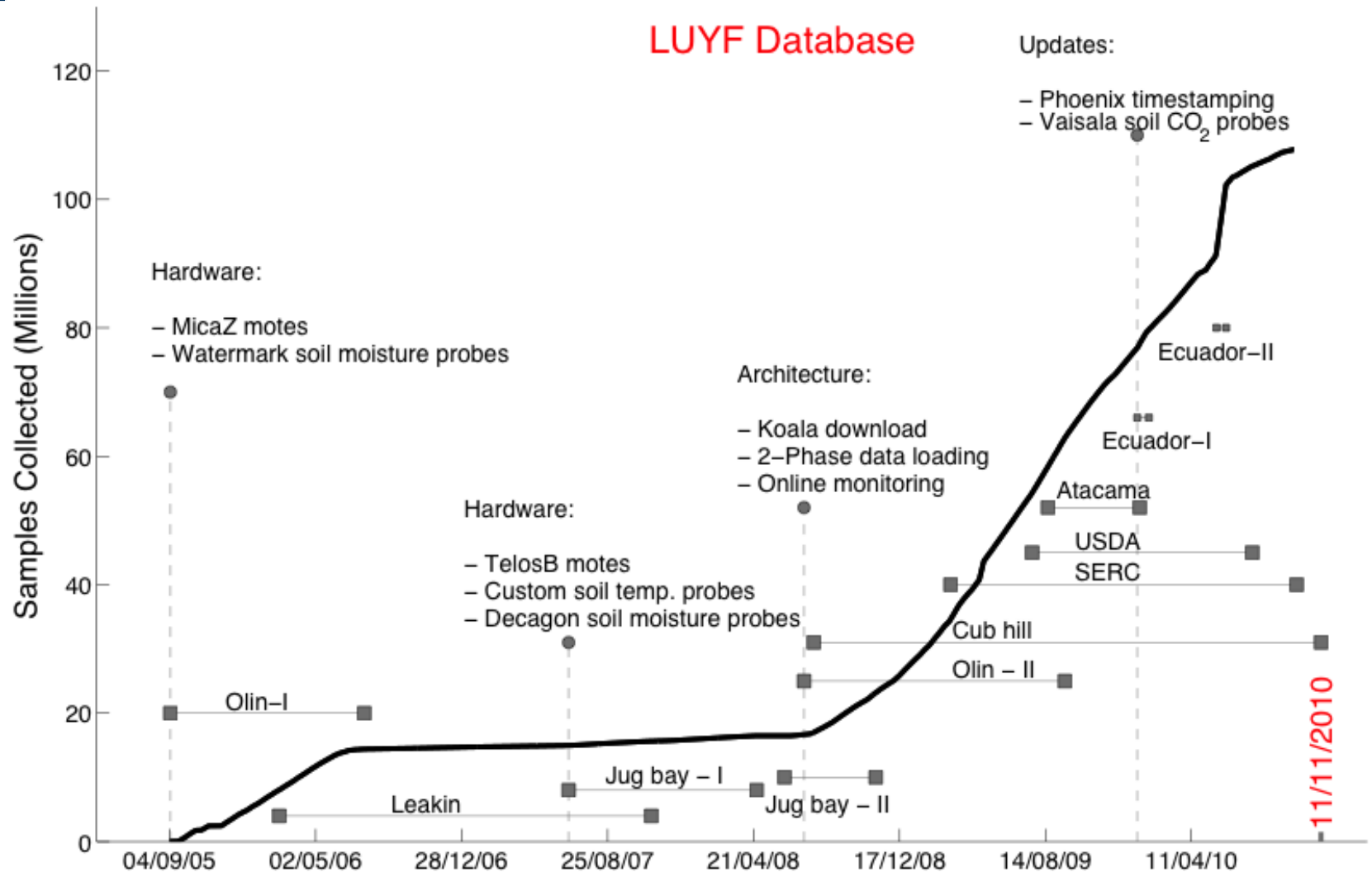
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Outline

- ▶ Background on Life Under Your Feet (LUYF)
- ▶ System K2
- ▶ Results from Santa Virginia Deployment
- ▶ Ongoing Work

Life Under Your Feet



System-K2

- ▶ An end-to-end wireless sensing system for environmental monitoring
 - ▶ Disconnection tolerance
 - ▶ Scientifically-usable data
 - ▶ High Data Recovery Rates
- ▶ Three components
 - ▶ Sensing nodes: collect measurements (and relay data)
 - ▶ Gateway(s): reliably extract data from network of sensing nodes
 - ▶ Data Processing and Persistence Layer: Transform raw data to “science-ready” data

Sensing Nodes

- ▶ Periodically sample their sensors
 - ▶ Onboard and external sensors
 - ▶ Operation metadata
- ▶ Compress measurements and save to local flash
 - ▶ Variant of delta encoding
- ▶ Send periodic radio probes
 - ▶ If no acknowledgement, go back to sleep else stay up to receive further instructions
 - ▶ In the absence of any activity go back to sleep

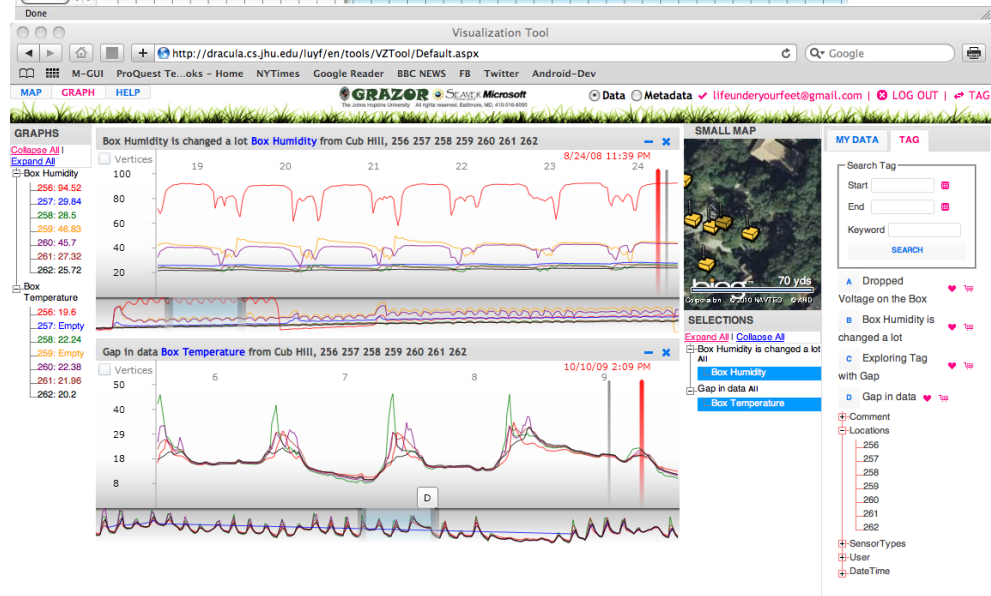
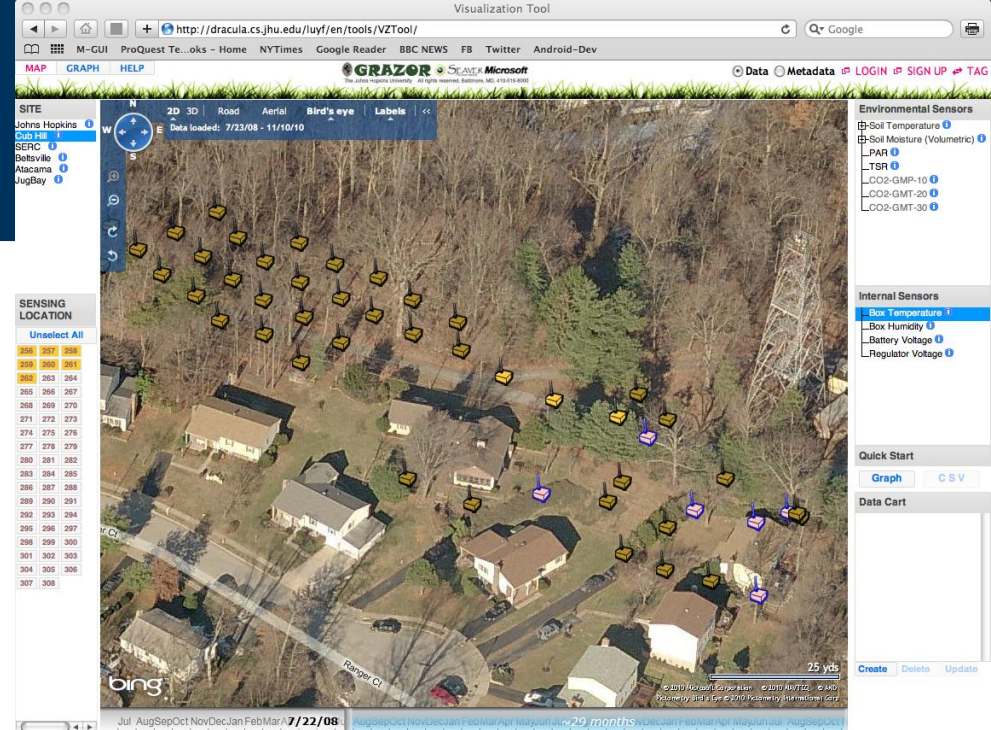
Gateway

- ▶ Periodically wakes up the whole network
- ▶ Collects reachability information
- ▶ Decides multi-hop paths that will be used to retrieve the nodes' data
- ▶ Transmits collect data to database back-end

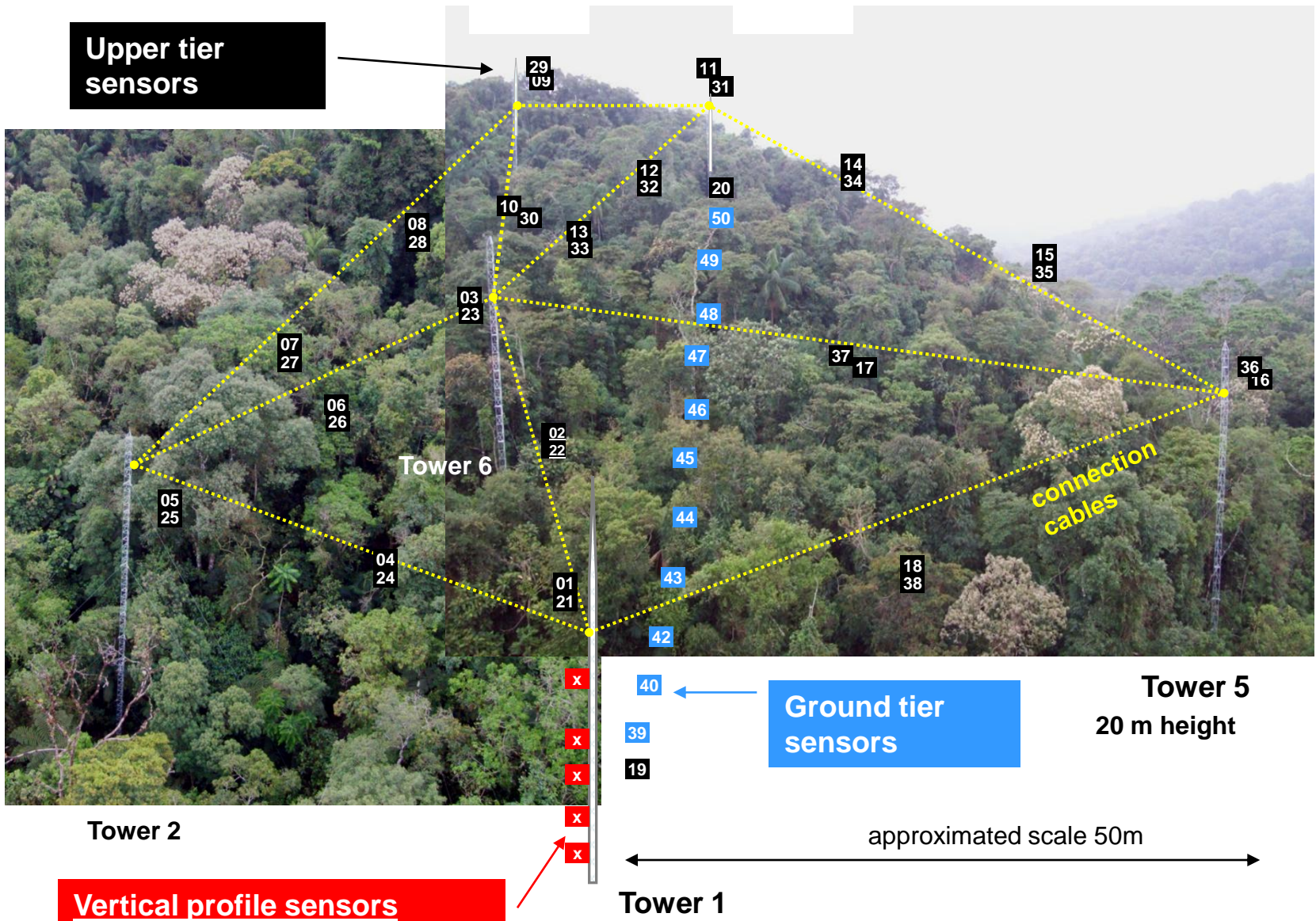


Database

- ▶ Move from physical devices to abstract locations
- ▶ Translate raw data to scientific units
- ▶ Detect obvious sensor faults
- ▶ Assign global timestamps
- ▶ Drive visualization front-ends



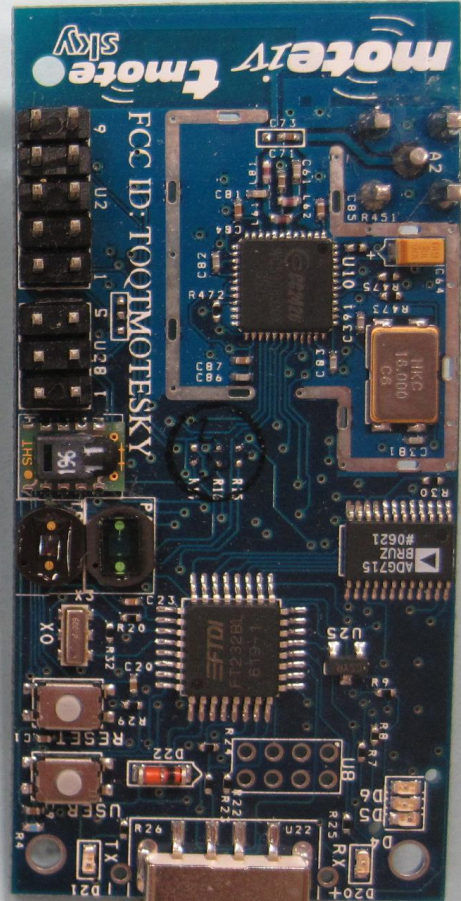
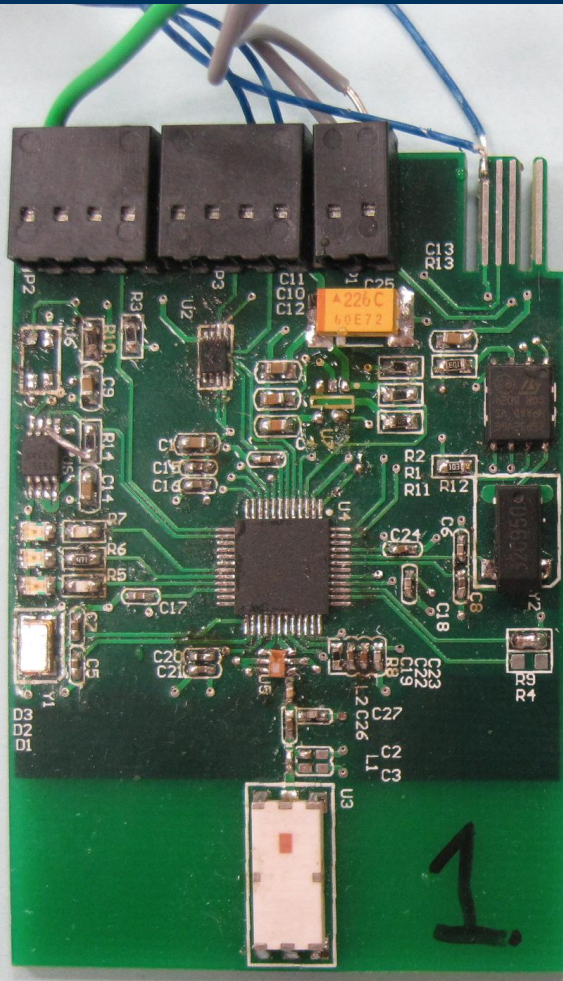
(Image courtesy of Humberto Rocha)



Performance Statistics

- ▶ Dates: 11/17/09-12/18/10
- ▶ Samples Collected and Time-stamped : 5,418,074
- ▶ Overall Yield (collected/expected) : **99.2%**
- ▶ Timestamp Yield (time-stamped/collected) : **99.7%**
- ▶ Median variance of the residuals of used fit paths : **10 ms**
- ▶ Median node duty cycle: **3%**
- ▶ Median network path length: **3%**
- ▶ Median estimated node lifetime: **~1,000 days**
- ▶ Median number of days required to fill up flash: **103**

Ongoing work: hardware



Ongoing work: software

- ▶ Mote side
 - ▶ Self-identifying sensors
 - ▶ Sensor chains
 - ▶ Fine-grain power metering
- ▶ Network-side
 - ▶ Support for
 - ▶ Lower data delivery latency
 - ▶ Larger networks
 - ▶ Higher sampling rates
 - ▶ Node reprogramming
- ▶ What else?

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Questions ?

