

Brainstorming on M2M Data Analysis

Prof. Shou-de Lin

CSIE/GINM, NTU

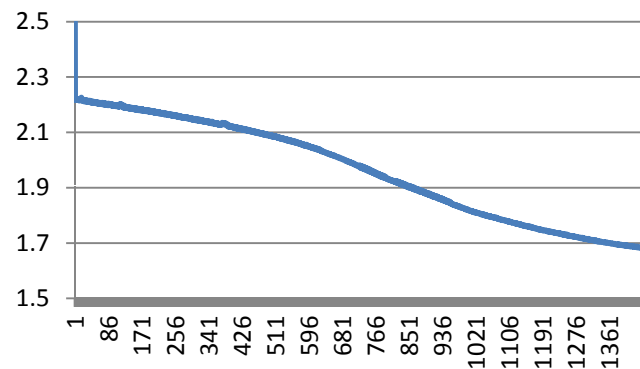
sdlin@csie.ntu.edu.tw

Q1: Can you come up with some potentially useful and interesting M2M analysis tasks ?

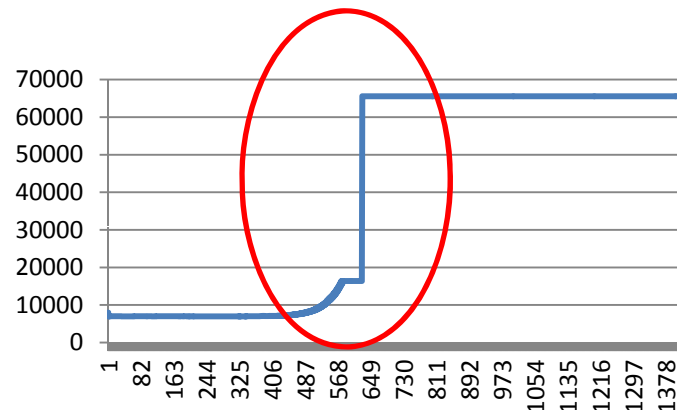
- Example: inferring battery status from sensor data.
- Motivation
 - we would like to know in advance “before” a sensor runs out of battery
 - We would like to calibrate the sensor values affected by low battery

Battery Depletion Scenario

- When battery power begins at full and is draining until the radio stops transmitting, we have discovered the collected data exhibit certain interesting patterns and properties
- The humidity data is seriously affected when the battery power is low



Voltage

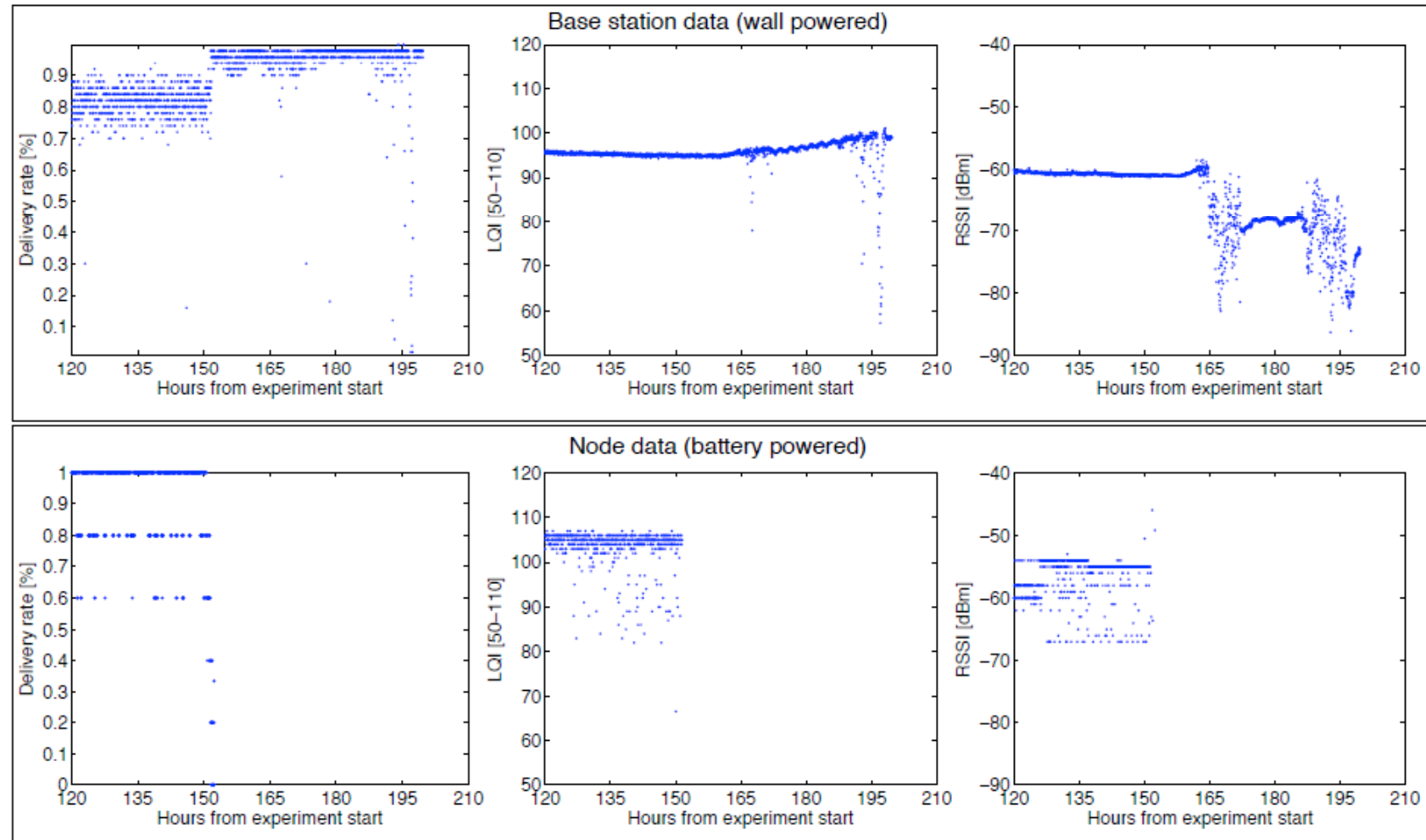


Humidity

Battery Depletion Scenario II

- Sensors degrade and lose functionality one at a time:
 - Temperature -> Humidity -> Ambient light
- Before specific sensor die, its data have observed drifts before it lose functionality
 - Packets 487-649 in previous slide
 - Operation outside designed voltage spec yields detectable data faults

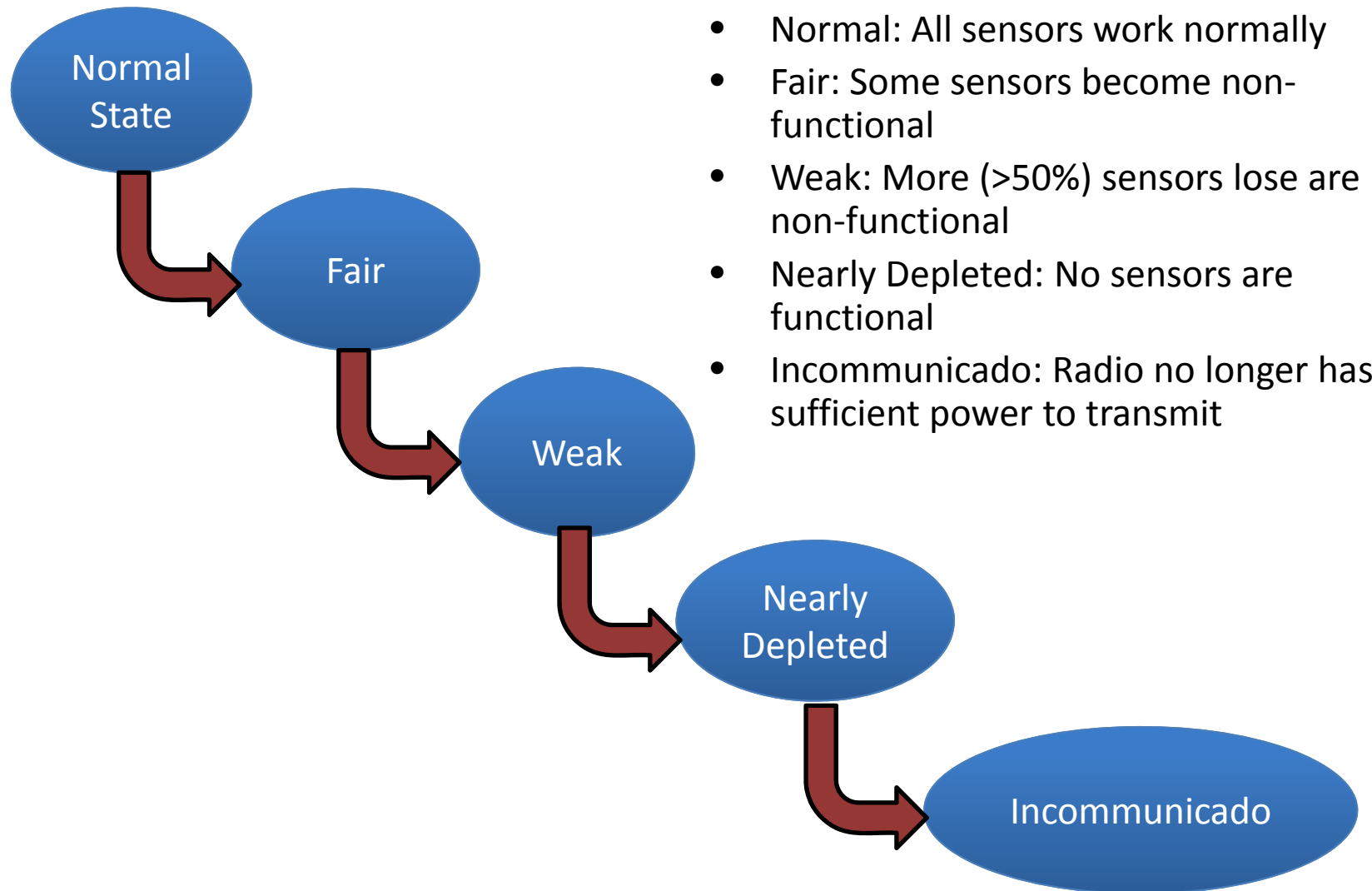
Sensor Node Lifetime Study



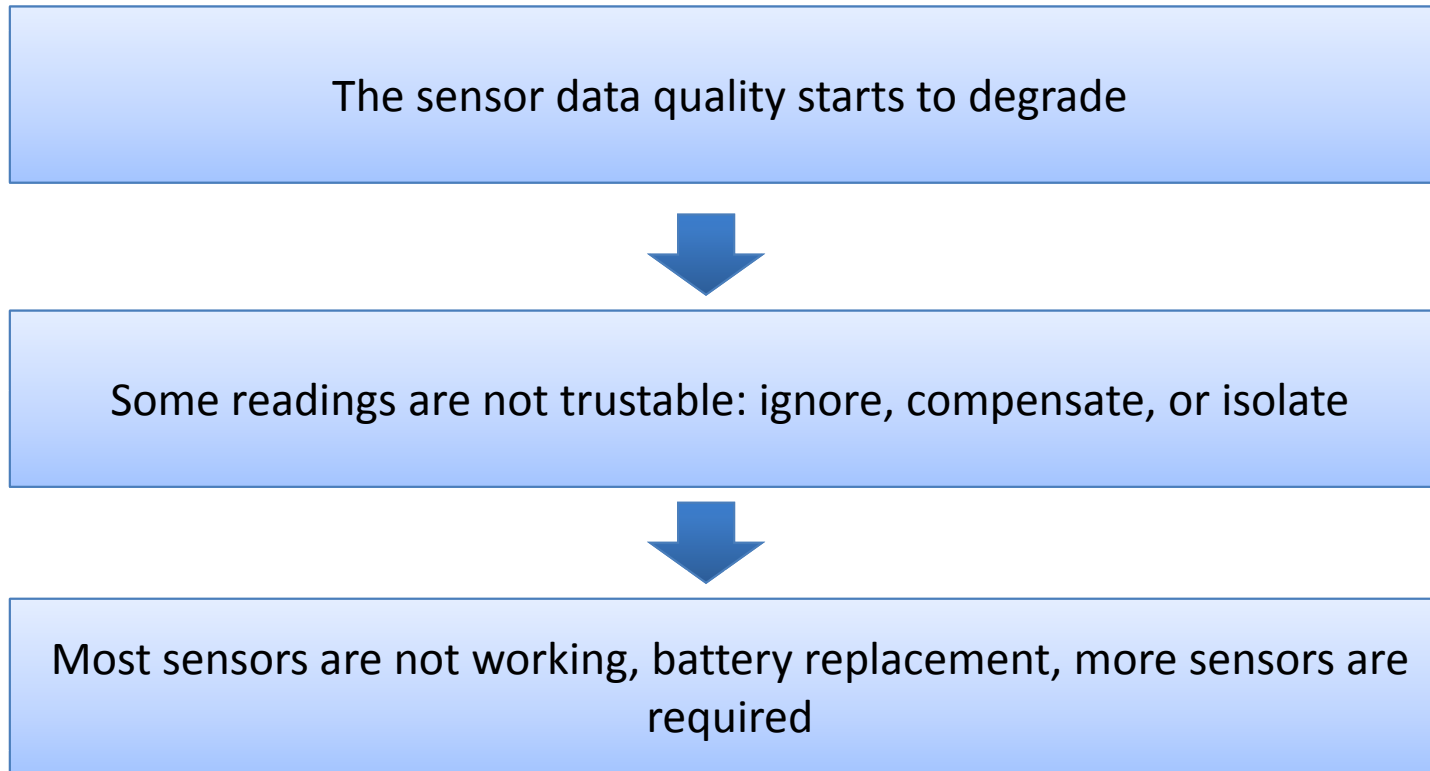
Insights from Discovered Faults

- Given many different environment scenarios:
 - Bathroom, Freezer, Balcony, Kitchen...
- We can test multiple combinations of sensors readings.
 - Ex: On the outdoor balcony, when battery power is no longer sufficient for temperature sensing, the light ambient sensor may still be functional with some drift.

Proposed Battery States (tentative)



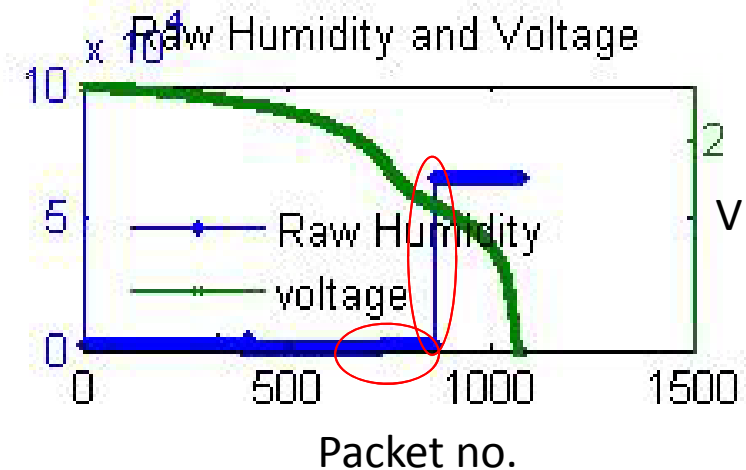
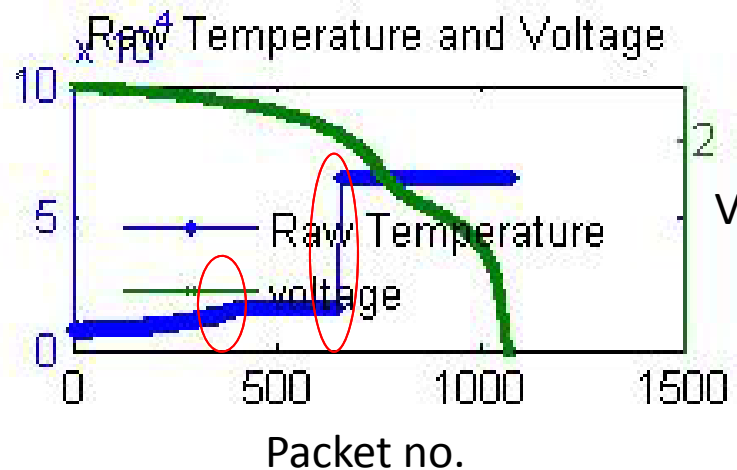
Using Battery State For Diagnosis



Battery State Goal

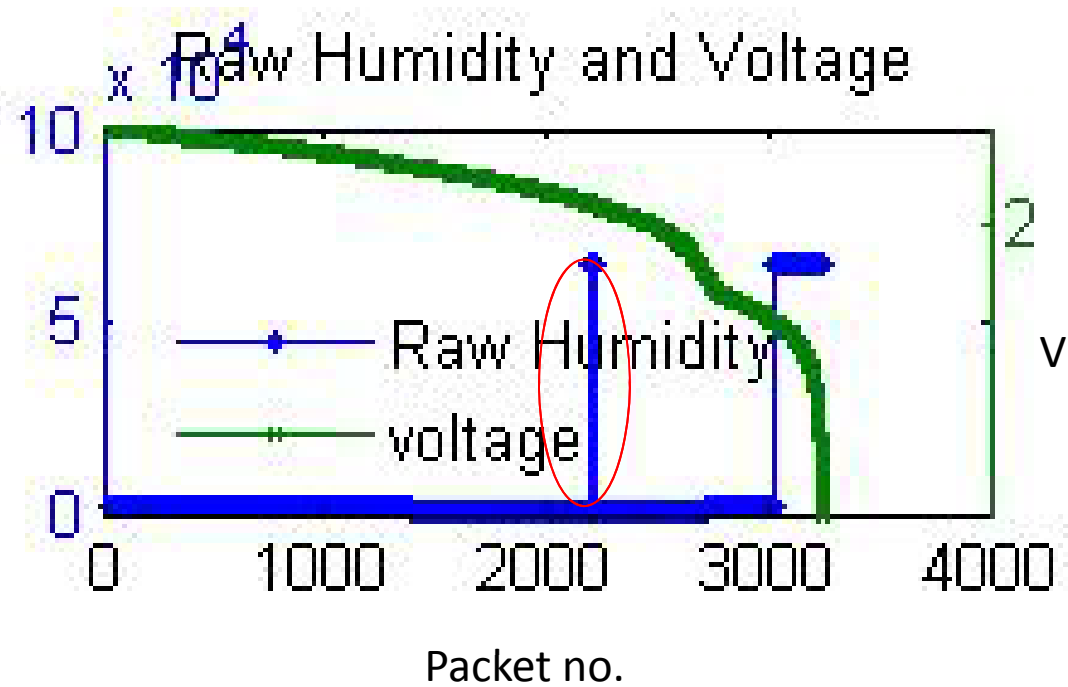
- Implement a suitable battery state classification algorithm given sensor data
 - Lower the computing burden at the sensor level
 - Fast and online detection

Adverse effects of low-power on temp/humidity sensor data



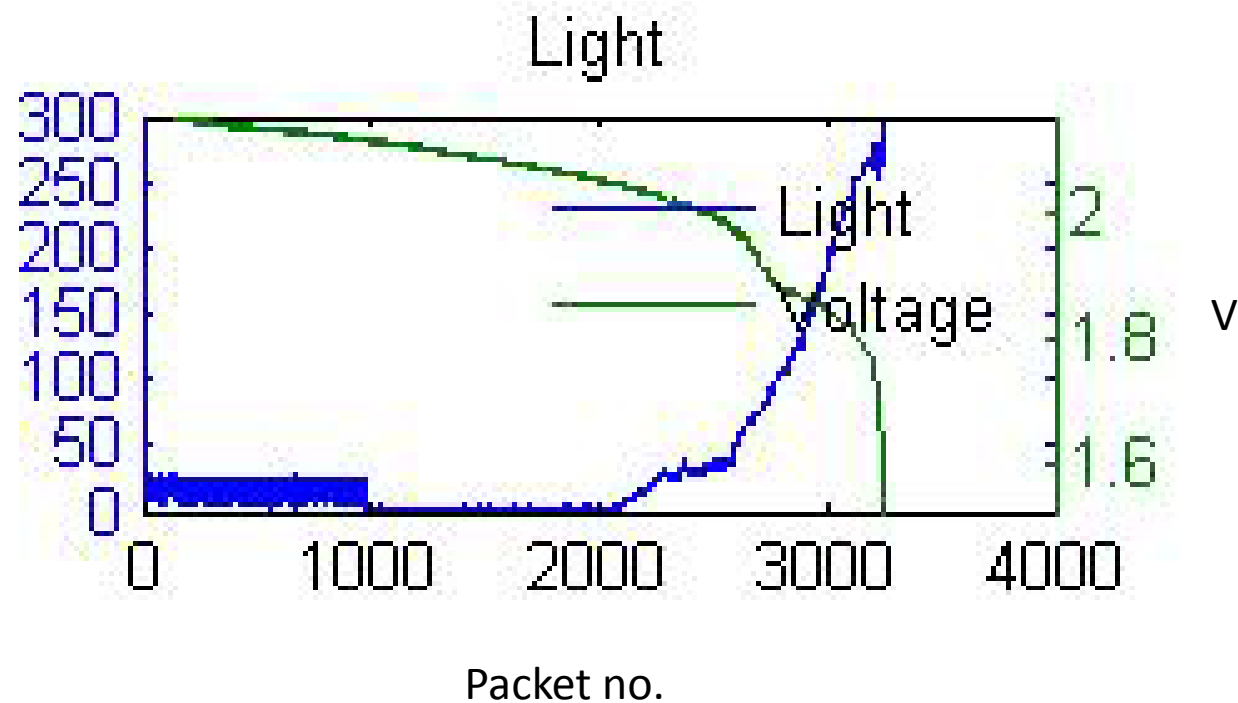
Sensor readings drift with lower voltage, then fail

Point anomaly example



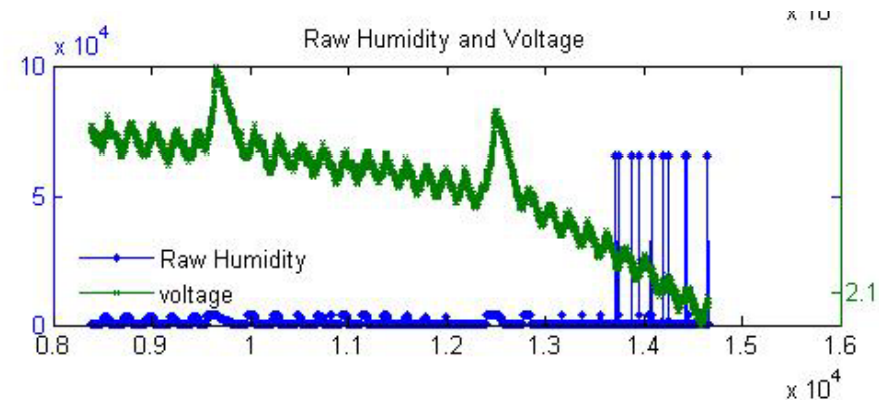
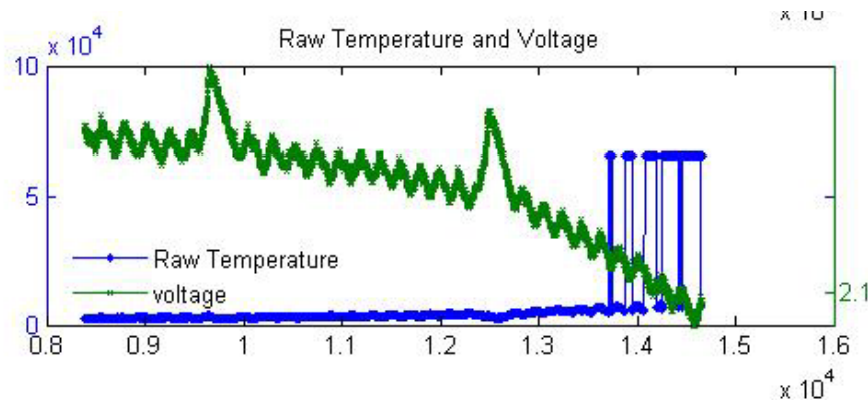
An initial anomaly may “recover”

Light sensor vs. Voltage



Light sensor readings drift with lower voltage

Freezer Example



Cyclic voltage readings, winding down to sensor failure in the freezer!

Other Ideas

- It's time to showcase your creativity.

Q2: what do you think is the main difference from the sensor data from other types of data?

Insights from YK

1. There is a real-time requirement on data processing.
2. It is nature for sensor data to be processed in a hierarchical and distributed fashion
3. Sensor data might process large amount of redundancy and require some sort of *reduction or summarization* process.
4. The existence of temporal and spatial dependency among data
5. Data quality might not be good (separation of noise and anomaly could be challenging).
6. The ultimate goal for sensor data analysis is to allow the users or machines to perform certain action in response to the current status.