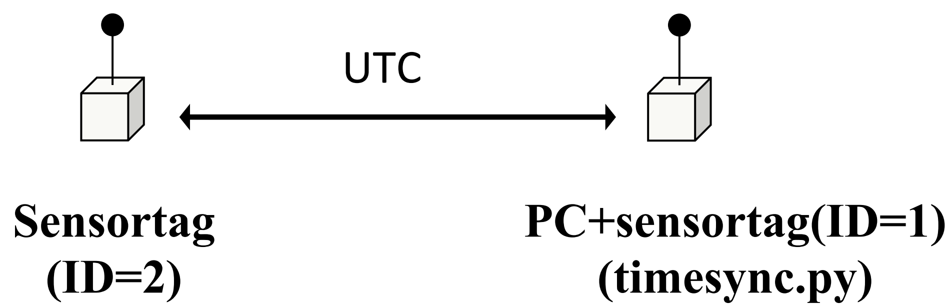
COMP6733 Lab 5:
Time Sync and RF Ranging

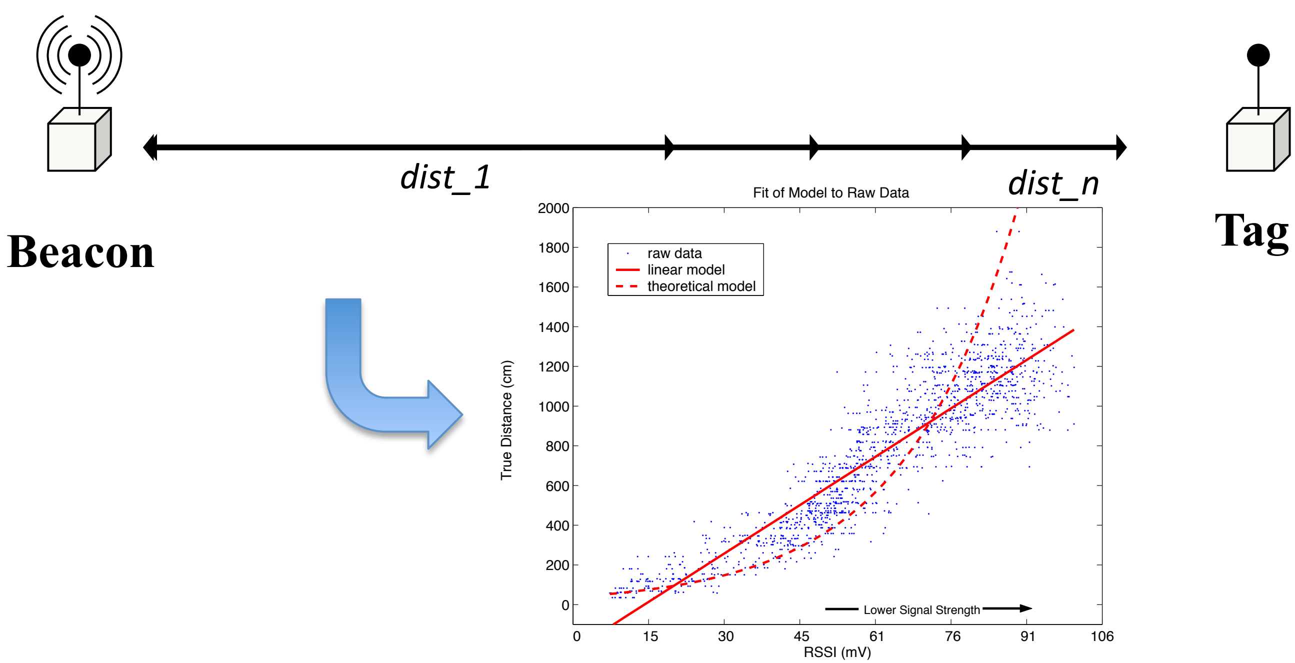
Part 1: UTC Synchronization

1. PC periodically sends packets to sensor tags with UTC time using timesync.py (assumes node ID 2)
2. Nodes 2 periodically synchronize to the UTC time by recording (local time, reference UTC time) pairs
3. Nodes 2 periodically report their UTC times to the PC (UDP).



Part 2: RSSI Ranging

1. Read RSSI tutorial
2. Write a Contiki application
   - SensorTag 1 (CoAP): records the received power (RSSI) for packets from rpl-border-router (which is also topology parent of the the SensorTag because your network has two nodes (SensorTag1 and border router) only; and transmits the latest RSSI to PC (via CoAP protocol) when receives a CoAP RSSI request. Note the RSSI packets will be likely to be the CoAP requests themselves.
3. Write PC application
   - Step 1: Build radio propagation model using at least 10 distance/RSSI pairs
   - Step 2: Use the propagation model to estimate distances between nodes



Understanding RSSI

- Follow RSSI tutorial 7 to understand how to interpret RSSI data
- RSSI depends on transmission power, which is changeable in Contiki
- The resolution of RSSI [dBm] is important

Propagation Model

- What do we measure

  distance **d** (by hand), received power $\mathbf{P_{rx}}$ [in dBm]
- What parameters do we calculate?

  attenuation rate (or path loss exponent) **α**, system losses constant **C**

$$P_{tx} - P_{rx} = \alpha * \log(d) + C$$

$$P_{rx} = -\alpha * \log(d) - C + P_{tx}$$

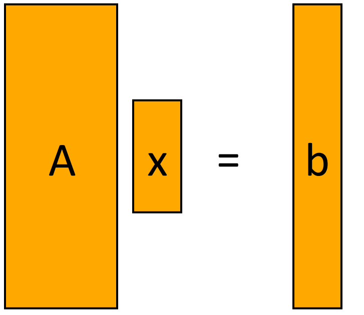
Help with Linear Least Squares

Propagation Model

$$\boxed{\alpha \log(d_i) + C = P_i^{rx}}$$

Linear Least Squares problem formulation for RF propagation model

$$Ax = b$$



$$b = \begin{bmatrix} P_1^{rx} \\ P_2^{rx} \\ \ldots \\ P_k^{rx} \end{bmatrix} \quad A = \begin{bmatrix} \log(d_1) & 1 \\ \log(d_2) & 1 \\ \ldots & \ldots \\ \log(d_k) & 1 \end{bmatrix} \quad x = \begin{bmatrix} \alpha \\ C \end{bmatrix}$$