Canary is a small, inexpensive sensing and communications device. It provides light, IR, infrasound, sound, ultrasound, magnetometer, accelerometer, temperature, pressure, humidity, and GPS sensing. For communications, it includes a nearby mesh and a long range radio, which can also mesh. Canary was part of the SEBATT project, which sought to integrate systems across Labs, and then an element of the ‘incubator,’ a section of the LUNARCAT venture.

LUNARCAT at its core was a novel mission which required, and requires, a novel way of thinking. The short history of remote sensing is about finding places, physical locations where proliferation-relevant activities might be taking place, and then scanning for confirming evidence. LUNARCAT shifted this fundamental perspective, to making the relationships bet2ween places central.

Each succeeding stage of the nuclear fuel cycle is more difficult to locate (from a distance) than the preceding. It’s hard to hide the mining of ore, but enrichment and reprocessing can be done in bland, undistinguished industrial buildings or in underground facilities. To find the latter, the networks connecting it to the former become focus of search. Those networks represent the relationships at the core of LUNARCAT.

To find them we need to identify the earlier-stage facility and use our knowledge of the NFC practicalities to sense when a shipment is likely to be leaving. We then need to track the shipment to a destination. (Note that the material is the concern, not necessarily the vehicle on which it is carried.) When that can be done with adequate reliability, the patterns or relationship will tell us where to focus our attention. In that way, the long investment in place-centered remote sensing can be brought to bear.

Canary was built to support this mission in three ways. First, as a ‘vehicle’ to support other, higher-sensitivity/selectivity sensors. Second, as a source of tips and cues to high-value sensors. Third, as a capable, stealthy stand-alone device.

In the first role Canary provides both straightforward extensibility via the I2C daughtercard connector and by providing general context and communications services, allowing the sensor developer to focus on his or her topic. ‘Context’ might comprise, for example, the temperature, pressure, and humidity needed by a chemical sensor.

<insert pin map of I2C connector>

The second role for Canary is as a source of tips and cues. (‘Tips’ are informational notifications, ‘cues’ are specific directives.) For example, Canaries on a roadway can cue the high-resolution Humble Oracle system, another element of the LUNARCAT Incubator, that a potentially high-value target is approaching, and its current distance and speed.

The third role for Canary is as an independent device, or rather, network of devices. Canaries self-organize in meshes, and as a network self-heal by automatically regenerating the mesh when devices come online or go offline. The combination of sensors on individual Canaries may be adequate to uniquely identify vehicles; if the probabilistic reliability of the id is lower than we’d like, classification into categories should be achievable. This, using the LoRa long-range mesh, we can potentially follow vehicle routes for hundred of kilometers.

This last role is speculative; funding expired prior to field testing. However, even a lesser role could still be of value to the mission, e.g., by transmitting vehicle signatures and estimated transit times to Canaries emplaced near roads leading to ‘enigma’ facilities to report matches.

<Some bland text>

<Insert sample code>

<insert annotated image of board>

<Wrap-up paragraph, emphasizing mission and need for heterogeneous sensing.>