Passive generation of livestock traceability data

A Canadian Cattle Identification Agency research program review

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Context

- Canadian legislation and regulation for the protection of health of animals is authored and managed by the Canadian Food Inspection Agency (CFIA).
- The CFIA delegates authority over the management of national livestock identification management programs to industry supported non-profit organizations. There are currently four such organizations
- The Canadian Cattle Identification Agency (CCIA) is the largest these organizations and they manage the national animal identification programs for Beef Cattle, Bison, Sheep, Goat and Cervid populations.

Context

- The CFIA has drafted a set of revisions to the Health of Animals Act, with the aim to extend and enhance the quality of Canadian livestock traceability processes and practices
- Industry groups have raised a variety of concerns surrounding the proposed regulation changes citing reasons related to speed of commerce driven by simple limitations of the standard LF RFID transponder technology used in CCIA approved indicators.
- The CCIA with the support of the CFIA and Agriculture Canada have established a research agenda to explore alternative approaches to the generation of livestock traceability data
- This talk will highlight some of this work

Themes

- Identity Management
  - The process of issuing and assigning a unique identification to each animal in the Canadian production livestock species
- Inventory Management
  - The process of establishing animal inventory records for livestock holdings and premises using individual animal identification
- Movement tracking
  - The process of updating and maintaining inventory records as established above
- Producer data privacy and business confidentiality

Approaches

- Passive individual animal sightings events
- Passive batch count sightings events
- Batch count movement events
- Algorithmic processing of sightings into movement records

Research Projects

- Passive generation of inventory control records using network enabled RFID readers
- Batch movement record generation using a digital manifest and conveyance tracking application
- Batch inventory control capture using computer vision processing of video and image data streams
- Multi-source identity to indicator pairing using ERC-721 NFT tokens as a root identification record

Passive generation of individual animal sightings

- Prior research supported the development of three configurations of ghost readers
- We have deployed these readers, (Logger, Pasture and Wide Alley configurations) in feedlot, cow-calf and co-mingling settings to support the passive generation of individual animal sightings records in a variety of settings.
- A sightings record contains at minimum
  - A GPS coordinate pair
  - A date and time stamp
  - An ISO-11784(5) compliant RFID transponder id code

Passive generation of individual animal sightings

- Individual animal sightings records can be used to update or establish inventory records for a premises (via GPS look-up)
- Denote a formal move-in date for premises requiring such reporting (currently feedlots of a certain size in Canada)
- Denote presence at an abattoir or processing site to instantiate the process of tag retirement

Passive generation of individual animal sightings

- Currently we are in the process of deploying ghost readers to support the passive generation of livestock sightings
- Our goal is to deploy readers to cow-calf, market, feedlot and abattoir settings
- In feasibility work, we deployed 8 ghost readers to feedlot settings and 6 cow-calf settings. Over ten months of testing these readers generated 122,000 sightings events.
- 99.1% of these records could be verified as representing an animal movement

Passive generation of animal sightings

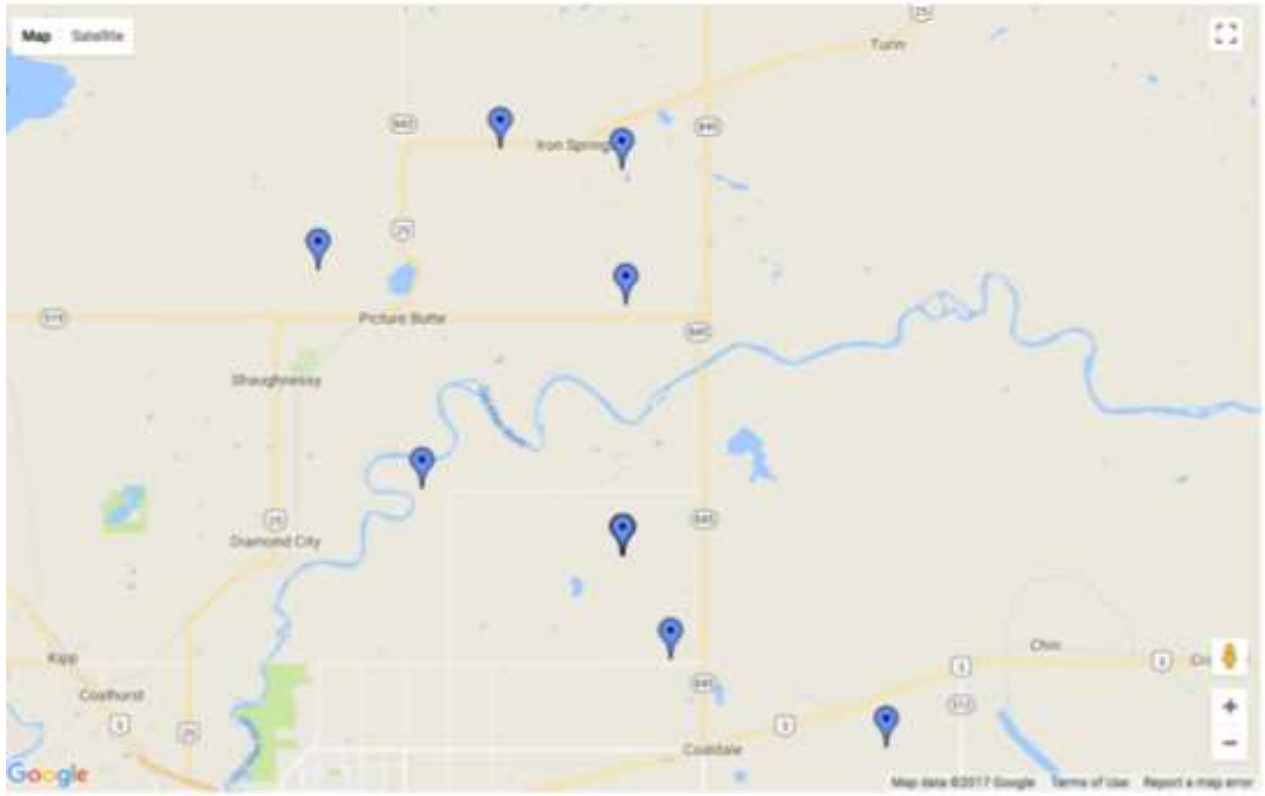

Figure 1: *Current Remote Logger Reader Locations*

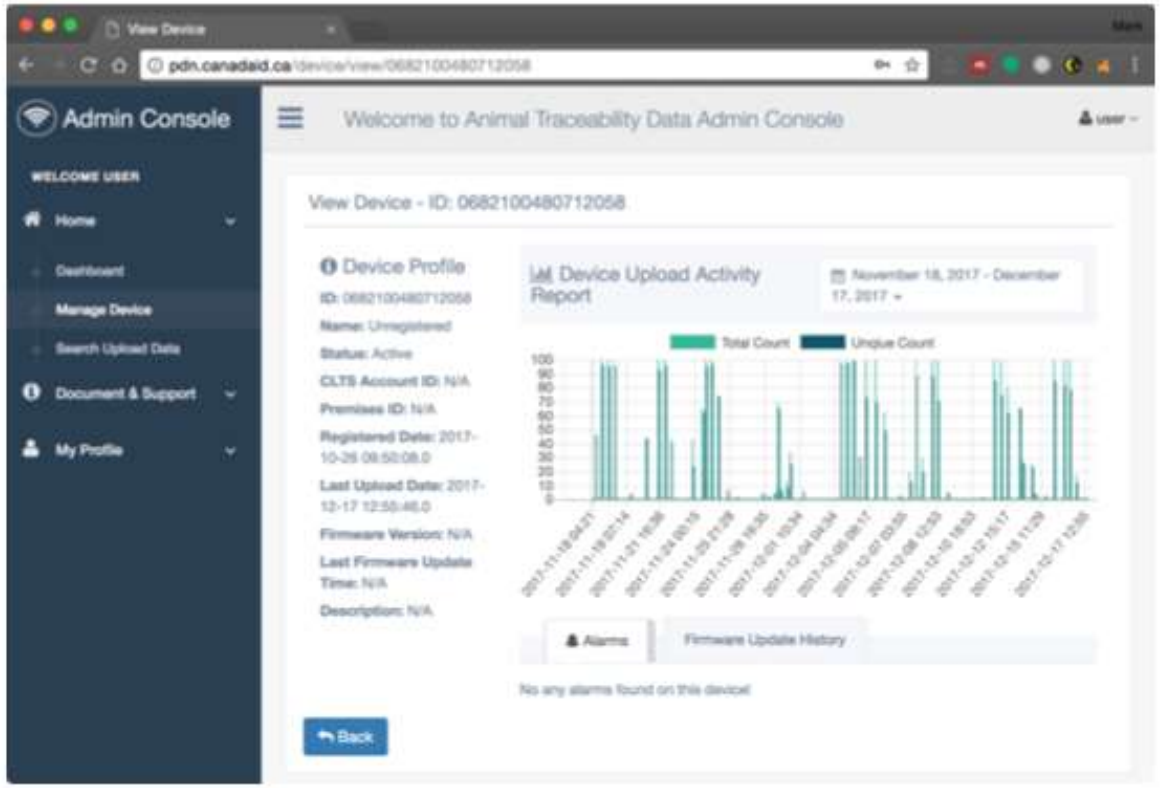

Figure 2: *Remote reader web dashboard*

Batch movement record generation via conveyance tracking

- We are developing a digital manifest application that passively generates batch animal movement records from registered premises to registered premises leveraging cell phone GPS for location
  - We aim to use this to support inventory decrement and increment record generation
  - We believe that this approach could be used to support transport regulation
  - We believe that this approach could be used to identify how route selection could lead to contamination of unconnected premises
  - We like the notion of demonstrating that passive traceability data generation using a tool that is otherwise required (shipment manifest)

Batch inventory control capture using computer vision

- We've developed prototype computer vision models using deep learning to identify and count cattle in group handling situations
- We are testing these algorithms in feedlot loading and unloading situations and hope to extend the list of settings to other high-volume handling events
- Commercial and academic work in this space is ramping up, we have early conversations underway to extend our network of collaborators on this project

Multi-source identity management platform

- Animal indicators (RFID transponders) fail and depending on setting their performance characteristics can be limiting
- Alternative mechanisms of permanent identification (genetic, biometric, visual, etc.) all have challenges
- Multi-source or multi-indicator identification management is challenging as protocols and processes for reconciliation of changing identity vary widely across setting
- We are exploring the feasibility of using distributed ledger technology, and minting non-fungible token smart contract instances as a root identifier to link a variety of identity modalities as token meta-data

Goals

- To support Canadian stakeholders in the development and continuous improvement of national systems for livestock traceability
- To do so in a fashion that does no impede or limit speed of commerce, and that equitably shares cost of participation and operation across all appropriate stakeholders
- To identify opportunities to leverage traceability data to support enhanced husbandry decision making and improve the performance of our national capacity to respond to sanitary events