Protecting Livestock Using Network Biosecurity Technology

Executive Summary

This project, undertaken by Farm Health Guardian, was to test and validate trailer tracking technologies in agricultural environments for the purposes of livestock disease control and mitigation. Five different technologies were tested for a minimum of six months each. The technologies tested were:

- Battery powered Global Position System (GPS) devices, some augmented by solar power
- Wired or powered GPS devices
- Bluetooth Low Energy (BLE) devices
- Medium Range RFID devices
- Long-Range Local Area Network (LoRa LAN), tested in Saskatchewan and Manitoba

We had a total of 350 farm or agri-business properties in Saskatchewan, Manitoba, Ontario and Quebec participating in the trial, as well as several farm service providers and commodity groups.

Devices were purchased from independent suppliers with the exception of the Radio Frequency Identification (RFID) system which was developed in-house. Each technology/device was given a unique identifier based on the user, the company, and vehicle carrying the device, for ease of recognition in the field.

Some vehicles were equipped with multiple device types to enable comparison. Some devices were mounted externally on trailers, and some were placed in the truck cab. Externally mounted devices were placed to ensure they received the most extreme treatment likely to be experienced in the field. For example, they were subjected to:

- Hot and cold high pressure washing
- Thermal Assisted Drying and Decontamination (TADD) at >75^{o}C for 15 minutes, and;
- Being mounted on the exterior of trailers in northern Canada during winter they were also subjected to temperatures below -40^{o}C and probably lower than -50^{o}C with the windchill factor.

For GPS devices, accurate signal reception requires that battery devices have a clear ‘view’ of the sky and therefore need to be mounted externally on the trailer. This did not seem to be such an issue for powered GPS devices.

Vehicle movements were recorded in the Farm Health Guardian software system as well as the digital dashboards of the device supplier. This allowed for comparison and a detailed analysis of times of entry and departure from premises recorded on both systems and the accuracy of those measurements in the Farm Health Guardian system. When possible, these records were also compared to the project participants records of entry and exit from properties by vehicles carrying devices. When participant records of dates of movement were available, it was generally only possible to get approximate entry and exit times so these data were not used in our final analysis.

Findings on sensor devices:

- **Device Performance**: Of the technologies tested, three GPS devices (two wired or powered, and one fully battery powered) showed reliable performance in and were unaffected by harsh cold winters. They proved reliable in daily operations related to livestock production and sanitation, with no significant impact on battery life.
- Manufacturers recommendations are not always the best guide for identifying devices that are suitable for farm and livestock trailer transport use. For example, some devices with IP ratings of IP67 (no ingress of dust and full immersion in water up to 30 mins at a depth of 1 meter) will not keep water out if subjected to pressure washing. Likewise, any devices rated as "water resistant" are not sufficiently sealed to withstand normal farm vehicle operations.
- **Cellular Coverage**: The devices demonstrated reliable usability even in regions with limited cellular coverage, ensuring satisfactory performance in such areas.
- **LoRa**: LoRa technology showed promise but requires more development and refinement to reduce the size of the devices to scale up for this use.
- **Installation**: All devices were straightforward to install especially the battery powered devices and manufacturers instructions on installation were also clear.
- **Battery Life**: Signal (ping) frequency significantly affects battery life. All devices had the ability to increase or decrease the number of times the device reported movement to the system (pings). They could also be set to only report starts and stops.

Overall findings and recommendations:

- When selecting sensors, it's important to be aware that none of the devices currently on the market are designed specifically for use in a livestock trailer tracking capacity.
- The relationship between battery life and signal frequency: There is a trade-off between battery life and the degree to which position accuracy and timeliness of data are required. For epidemiological purposes, it is important to know when a vehicle enters and leaves farms and associated livestock premises. We recommend selecting systems that allow the user to adjust signal timing from the device to the central database, or with settings that only record vehicle stops and starts.
- Devices must be able to withstand cleaning and disinfecting procedures, including hot and cold high pressure washing and resistance to cleaning and disinfecting agents.
- The device supplier's Application Programming Interface (API) must enable the movement data to be transferred.
- To keep transport data secure, the system must encrypt data being transmitted and the supplier must agree that the data will never be sold.
- Movements of livestock trailers should be recorded in a confidential database using sensor devices to significantly reduce track and trace time in the event of a disease outbreak. This information is kept confidential unless it is needed for a disease investigation. Having movement data readily accessible and easy to share in a database enables rapid disease response.
- We encourage governments to accelerate adoption of suitable track and trace devices by supporting investment in sensor technologies, in order to reduce costs of disease response and recovery.

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