

Ultra-High Radio Frequency Identification Demonstration Project Summary and State Reports



August 2016



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Acronym List

ADT	Animal Disease Traceability
AHFSS	Animal Health & Food Safety Services
AIMS	Animal Identification Management System
AIN	Animal Identification Number
APHIS	Animal and Plant Health Inspection Service
CDFA	California Department of Food and Agriculture
CVI	Certificate of Veterinary Inspection
CVM	College of Veterinary Medicine
DATCP	(WI) Department of Agriculture, Trade & Consumer Protection
EID	Electronic ID
ET	Emerging Threats
ICVI	Interstate Certificate of Veterinary Inspection
LF	Low Frequency
MDOL	Montana Department of Livestock
MIM	Mobile Information Management
NUES	National Uniform Eartagging System
ODAFF	Oklahoma Department of Food and Forestry
POE	Power over Ethernet
POS	Point of Sale
RFID	Radio Frequency Identification
TDS	Tag Data Standard
UHF	Ultra-High Frequency
USDA	United States Department of Agriculture



Ultra-High Radio Frequency Identification Demonstration Project Summary

Introduction

Radio frequency identification (RFID) technology has been available in the livestock industry for many years. Low frequency identification devices that operate at 134.2 kHz are the most commonly used RFID on the market. More recently, RFID devices have become available that utilize ultra-high frequency (UHF) technology operating in the 902 MHz – 928 MHz frequency range.

In FY 2014, USDA APHIS VS provided limited funds to support UHF demonstration projects through the administration of 8 cooperative agreements with the States of California/Hawaii (joint agreement), Colorado, Florida, Michigan, Montana, Oklahoma, Tennessee and Wisconsin. The objective of these demonstration projects was to evaluate UHF technology to document its potential merit for the collection of official livestock identification and animal health information to support disease traceability and animal disease control programs. The expectation was that use of UHF technology would increase the efficiency and accuracy of collecting animal identification and animal health information by integrating electronic data capture solutions.

Funding was awarded to projects that included cattle as the primary focus, targeting areas in the cattle industry that are most common or frequently practiced so that the outcomes would have the potential to impact a significant portion of the industry. Projects that spanned multiple states and multiple sectors of the cattle industry were encouraged and were required to support one or more of the activities listed below:

- Collecting official identification and movement records required through Federal, State, Tribal traceability and animal program disease regulations.
- Integrating Mobile Information Management (MIM) devices with the Animal Identification Management System (AIMS) and/or other animal health information systems used by the cooperator.
- Automating the preparation of Interstate Certificates of Veterinary Inspection (ICVIs) through the integration of electronic ICVI solutions.
- Integrating UHF technology in various sectors; in particular, marketing channels.
- Integration of UHF technology in slaughter plants to maintain animal identification/carcass cross reference through final inspection and the retirement of official identification numbers.

- Collecting data on groups of animals and recording additional group level data (e.g., age, sex, lot/group number, species, etc.).
- Providing the opportunity for industry to participate in the evaluation of UHF identification technology for their purposes (management, marketing, etc.).

Cooperative Agreement Awards

Funding was awarded to applicants as listed below:

Applicant	APHIS VS District	Award Amount
California (with Hawaii)	6	\$83,477
Colorado	6	\$92,755
Florida (participating in TN Project)	2	\$30,680
Michigan (with MI State University)	3	\$38,517
Montana	5	\$110,000
Oklahoma	4	\$80,510
Tennessee	2	\$98,938
Wisconsin (Market and Tribe)	3	\$58,523
Total		\$593,400

UHF Equipment

USDA acquired official UHF ear tags from three manufacturers. Due to cost and final delivery of the ear tags, the majority of the tags used in the project were from Hana Micron America, Milpitas, CA. Initially, 118mm (length of tag) blank panel UHF tags were purchased for the projects in bulk from HANA Micron. Project participants requested that a smaller tag also be made available for calves in particular. Subsequently, USDA purchased 77mm tags from HANA Micron for use in younger animals or as preferred by the producers or participants.



Unfortunately, issues with the male button portion of the HANA Micron UHF tag occurred at the beginning of the UHF project period. This resulted in numerous tags not being properly applied early on in a few projects. Replacement male button tags provided by HANA Micron in December 2014 were field tested to ensure compatibility with the tagger before they were distributed in January 2015. It was reported that the amount of force needed to apply the tags was significant and as a result an alternative tagger was recommended.

UHF Readers utilized by project participants included both stationary and handheld models. Stationary reader configurations included single, dual and quad antenna systems. Handheld devices consisted of two basic configurations; a dedicated or separate UHF reader that transmits tag data wirelessly to the handheld PC (similar concept to a LF wand reader), or a handheld PC with the UHF reader contained in the same device (referred to as a built-in UHF reader in this report).

Findings and Lessons Learned

Readability

The project coordinators were asked to report on tag readability to reflect the ability to capture the animal's official identification number contained in the UHF tag. Readability of both the 118mm and 77mm tags provided to participants in the project was excellent. The majority of participants reported 100% readability of tags when equipment was installed in the correct position and functioning properly. For the cooperators that received both tag sizes there was no report of size having a significant effect on readability of tags. Often the read distance had to be adjusted down to capture only the animal(s) of interest as the readers would pick up UHF identification in animals from other pens. There were a small number of tags that were not able to be read (confirmed via a handheld or running the animal

past a stationary antenna a second time) presumably due to tag malfunction. Some participants scanned the UHF tag to ensure that the tag was functioning properly before applying it to the animal. In one project, the participant reported highly variable read rates for UHF tags, but it was indicated that the failure of the tags to read was likely an issue with reader equipment rather than tag failure.

Handheld devices with built-in UHF readers achieved 100% readability in most cases with a read distance of 2-6 feet depending on the area where the tags were read. A few cooperators reported that wire or pipe fencing and alleys interfered with readability or read distance of UHF tags. The read range of the dedicated handheld reader was reported at 100% at 10 – 12 feet. Some participants indicated that the ability to scan and record groups of animals with the dedicated handheld reader and mobile PC was a substantial benefit of this configuration, whereas the handheld device with the built-in UHF reader and its associated software requires users to save information between each animal scanned. In actuality, both reader configurations offer the ability to scan and record groups of identification. However, when the handheld device with the built-in UHF reader is paired with USDA's MIM PDA software it will currently only work with one individual animal record at a time. One disadvantage reported when using the dedicated handheld reader and the portable PC is that the Bluetooth pairing would disconnect when the unit was idle for a long period of time between reading groups of cattle. This is a feature on many portable wireless devices intended to extend the battery life of these units when not in use, and is typically user adjustable in the power settings. Multiple participants recommended that the read distance for the handheld readers needs to be drastically improved, particularly for the handheld device with the built-in UHF reader, in order to be useful.

There was also a clear preference among some for the ease in maneuverability of the handheld to capture all identification quickly versus having to move cattle around to be read by the stationary antenna. It is important to ensure that users select the correct equipment based on their needs. Different handheld readers are designed for different purposes, for example some are more suited for working with groups of animals and others are designed for individual animal situations. End users need to work with company representatives to determine which device configurations will provide the appropriate read ranges for the intended use.

Stationary antenna were reported to have readability up to 100% when equipment was installed in the proper location and large numbers of cattle were not bunched together while being read. Multiple cooperators with dairies, cow/calf and livestock market participants indicated that 'line of site' is imperative for the antenna to read UHF tags at 100%. This becomes an issue not only when cattle run past the antenna as a closely bunched group but also when attempting to read large numbers confined in a space such as pile feeding or on a scale. A solution some participants used for reading a large group of cattle on a truck, pile feeding or on the scale, was to move the animals around so the antenna could capture each tag.

While not ideal, this step did not generally result in substantially increased times for capturing identification. Wide alleys and large livestock market sale rings were also reported to cause a decrease in read rate necessitating that cattle be run through again closer to the antenna to capture all identification. This issue may have been mitigated by installation of additional antenna or a shift in the placement of antenna. When installed in the proper locations and with clear line of site stationary antenna had a reported read range of up to 20 feet.

Multiple cooperators experienced issues with use of a reader and antenna combination in an environment where no wireless local area network (Wi-Fi) connection was available. This problem was encountered because the cooperator purchased an antenna and reader combination that requires a Wi-Fi connection. There are readers and antenna designed for use in environments without a Wi-Fi connection. It is again important to stress the need for end users to communicate with company representatives to determine which device configurations are appropriate for the intended use and setting.

Weather was not considered to be a significant issue with readability of UHF tags except when temperatures dropped below 30° F and specifically with the handheld device with the built-in UHF reader. Freezing temperatures appeared to affect the battery life of the unit which automatically shut off when battery levels reach 50-60%. The cooperator was able to mitigate this issue by storing the unit on a charger next to a heater when not in use between groups of cattle. The automatic shut off when battery levels reach a certain percentage is likely another setting that can be adjusted to the desired level. When using many handhelds in cold climates it is highly recommended to store the unit near a heater or attach a hand warmer to the device to help maintain battery warmth and processor speed.



Retention

Retention of both the 118mm and 77mm tags provided to participants in the project did not appear to be an issue. As was expected, retention for UHF tags was reported to be similar to other visually read panel tags. While some participants only assessed retention over a few days to a few months' time, others documented excellent retention (100%) in cattle from 6 months to 1.5 years post tagging. Retention in pasture and feedlot conditions were both reported as excellent, although it was suggested that more tags were lost in confinement conditions where cattle could rub or get caught on fencing or equipment. Multiple participants expressed concern over retention of the larger sized tags when placed in younger cattle. These concerns did not appear to be realized over the course of the agreement period as only a few tags were reported lost by each cooperator.

Software

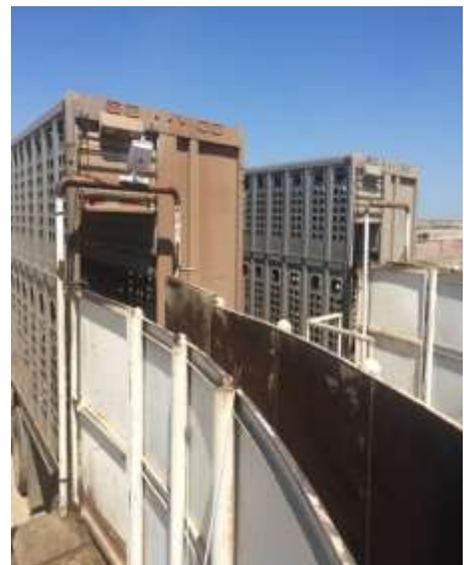
Some participants experienced issues with third party software that was not capable of performing a desired functionality while using UHF technology. In some cases the issues stemmed from attempting to integrate the data collected by the UHF readers into existing software as in the case of livestock markets, whereas software purchased for use with UHF technology functioned well once properly installed and updated as needed.

Additionally there was a significant difference in the user experience when merging data from multiple mobile devices based on the mobile software used. A few cooperators reported that XML/CSV file outputs generated from some mobile software were easily shared with other states and uploaded into databases, while other participants reported that it was difficult to generate an eCVI or herd management record with the amount of data manipulation that was required with the provided software. Other available software applications may solve this problem.

Efficiency

The greatest increase in efficiency observed using UHF technology in these projects related to a reduction in time and personnel needed when processing cattle post-sale at livestock markets. Specifically, applying UHF tags pre-sale and reading of the identification as the animals left the ring and were sorted allowed for increased efficiency in generating movement documentation for animals to be exported post sale. Livestock market personnel reported countless hours saved generating movement documents without having to handle cattle an additional time to record identification.

Some producers that participated in the project reported benefits and increased efficiency in data capture during weaning, pregnancy checks, sorting and shipping cattle, including recording weights, pen assignments, vaccination status, pregnancy status, when generating movement documents for shipping animals and for reading identification in the field. Capturing this data electronically at the time the tags were read eliminated the need for additional data entry and handwritten records, and significantly reduced errors in the data captured.



Tag Customization

Tag manufactures provide tag customization options for the UHF tags similar to those provided for visual only tags. However, USDA purchased the UHF tags for the demonstration projects in bulk which prohibited the participants from choosing color, management number, different tag sizes and other customization options. One cooperator had the producer's management numbers laser printed on the UHF tags in order to eliminate the need for a second management tag. The concerns expressed about limited tag colors, size, and omission of herd management numbers, etc. will likely be resolved when producers obtain their tags directly from the retailer.

The panel tag style of the UHF tags are more similar to the widely used visual herd management tags than most official identification tags, in particular the small metal "Brite Tag" and button 840 LF RFID tags. It is common for producers to remove any management tags present on purchased animals and to apply tags that fit well with their management systems. The larger UHF panel tag, even if customized by the initial breeder, may not be desired by the next owner and was a noted issue of concern in some projects.

Obstacles to UHF integration

It is important to acknowledge that UHF tags and readers are relatively new in the marketplace when considering the following observed obstacles to integration. Some issues will be resolved, or minimized, as more experience with the technology is achieved, and as more UHF products become available and are integrated.

Cooperators and project participants listed 2 major obstacles to integration of UHF technology within the cattle industry, cost and ease of using the equipment while maintaining the speed of commerce.

Over half of the participants, regardless of the type of production unit, suggested that the cost of tags, equipment and software is the biggest impediment to use and integration of UHF technology into their businesses. Specific examples included the cost of tags, the need for separate readers to capture both UHF and LF RFID (or lack of cross-compatibility of equipment), and the cost of the software. Some participants indicated that they were reluctant to commit the funds to purchase equipment that may quickly become obsolete and to which enhancements are currently needed for maximum efficiency. The need for a dual UHF/LF RFID tag was also mentioned.

Working with company representatives, and when appropriate, knowledgeable local regulatory personnel to ensure acquisition, configuration and use of the proper equipment and software is imperative to realize the benefits of UHF

technology. There is a learning curve for individuals utilizing the equipment to maximize its full potential while sustaining operations at the speed of commerce. Depending on the issues encountered when utilizing UHF technology there is the potential that efficiency will be greatly reduced. For example, having to rerun cattle past the reader to capture official animal identification numbers on tags that were not read on the first pass, non-functional tags that may need to be replaced or problems with Bluetooth connectivity, etc. These issues proved to be a deterrent to some project participants that subsequently do not wish to incorporate UHF technology into their businesses at this time. For those participants that have realized significant efficiency with UHF technology and worked with company representatives and local regulatory personnel when issues did arise, the overall benefit of the technology has outweighed the few problems encountered.

For participants that did not fully integrate UHF technology into their businesses, there would likely be no perceived benefit to the cost of the equipment and tags. Integration with the correct software for business type is imperative for industry to realize the maximum efficiency of this technology. As mentioned previously, significant benefit and efficiency realized with UHF technology occurred for livestock markets and producers using software that captured data at weaning, pregnancy checks, sorting and shipping cattle, including recording weights, pen assignments, vaccination status, pregnancy status, and when generating movement documents to capture identification without slowing the operation down or handling cattle a second time. Greater use of UHF technology in slaughter plants would also provide added benefit for producers looking to capture and monitor information related to carcass data.

Another common concern regarding integration that was reported by cooperators was related to the size and color of UHF tags distributed for this project. As mentioned previously the tags were purchased in bulk from HANA Micron and therefore were not customized for project participants. Individuals ordering UHF tags directly have the ability to choose from available sizes and colors to match their management needs.

Current and Future Related Issues

Tag Size and Tag Options

As noted earlier, there is a strong interest in tag customization, in particular, customization of the panel type UHF tags. In addition to the concerns expressed about limited tag colors and omission of herd management numbers, project participants expressed interest in significantly smaller tags that are able to maintain read distance. It is expected that these types of changes would advance the use of the UHF tags for both management and official identification purposes.

Standardization

Low frequency identification devices that operate at 134.2 kHz are the most commonly used RFID in the livestock industry. Standards for LF RFID devices used for animals were established in the 1990's through a Working Group of the International Organization for Standardization (ISO/TC23/SC19/WG3). Two primary standards were defined; one standard on the code structure in the transponder and one on the technology for the communication between reader and transponder. These standards are referenced below:

- ISO 11784. Agricultural Electronics—Radio Frequency Identification of Animals—Code Structure. International Organization for Standardization.
- ISO 11785. Radio Frequency Identification of Animals—Technical Concept. International Organization for Standardization.

USDA has required conformance to these standards for official identification devices that utilize LF RFID technology.

Since radio frequency identification devices for livestock using UHF technology have become available in the market, USDA has approved several ear tags that incorporate UHF technology based on EPC Gen 2 (v1.2.0) ISO/IEC 18000-6C operating in the 902 MHz – 928 MHz range. While this standard addresses the communication protocol between the reader and the UHF tag, there is no standard for a common encoding scheme, or Tag Data Standard (TDS), for translating USDA animal numbering systems in UHF identification devices. A global standard is needed and highly preferred by USDA. However as of this date, no TDS has been defined and one does not appear to be on the horizon anytime soon.

To compensate for of the lack of an established global standard for the encoding of animal numbers in the UHF tags, USDA has defined an interim standard that will achieve uniformity across manufacturers that are authorized to encode USDA animal numbers into identification devices

(<https://www.aphis.usda.gov/traceability/downloads/uhf-interim-tag-data-standard.pdf>).

This action is warranted to ensure compatibility of this technical issue is achieved as soon as possible across manufacturers providing USDA identification devices that utilize UHF technology.

Regardless of the standards adopted at this time by USDA, transition to a global standard(s) is anticipated in the future. Therefore, USDA acknowledges that the interim standard currently being defined will be followed until a global standard evolves. When such standards are available, USDA will work with approved manufacturers of official identification devices to establish a timeline to transition to the recognized global standard.

Dual Technology RFID Tag

Low frequency RFID tags have been used for several years. However, the industry has numerous needs and no one single technology is likely to be established in the immediate future. The marketplace, therefore, could be well served with a dual technology RFID tag that has both LF and UHF. This would allow producers to purchase animals identified with such tags and maintain their existing reader infrastructure. Such an option would provide a “bridge” for both technologies to be used successfully until an overall technology is determined.

Availability of Official Identification Tags

USDA will continue to support the advancement and utilization of UHF technology, as has been done with LF, by approving such devices that meet the requirements for official identification while letting the marketplace determine the preferred solutions. USDA may also consider procuring dual RFID tags for the administration of disease program work if they become available in the future.

Conclusion

The demonstration projects indicated that the UHF technology has certain advantages over LF RFID tags, in particular the read rate and read distance increase the potential of reading the animals’ official identification numbers at the speed of commerce. However, no RFID technology appears to be perfect for capturing animal identification information in all livestock environments. In certain cattle handling situations (working cattle in lockups or chutes, dairy parlors, etc.) UHF may have minimal, if any, advantages over LF technology. However, in management environments that require longer read distances, reading multiple animals at one time, etc., UHF technology has significant advantages, as the read distance for UHF technology is able to be adjusted to decrease read distance, whereas LF technology cannot be adjusted to significantly increase read distance.

Overall the UHF tags and technology worked very well and as expected. Impediments to successful integration included utilizing the improper equipment for the production setting or environment, unfamiliarity with the equipment to ensure continued function at the speed of commerce, and lack of incorporation of appropriate software to achieve maximum benefit and efficiency of UHF technology. It is apparent that successful utilization of UHF tags will be driven by the industry for management and marketing purposes. The utilization of UHF technology is likely to advance and grow as more fine-tuning of the equipment and tags is achieved. Continued use of the technology by 14 of the 32 (44%) participants, two of which already used LF, is a good indicator that investment in UHF technology is feasible in some environments.

Table 1. Project Participation by State

	Accredited Vet	Backgrounder	Bull evaluation center	Cow/Calf Operation	Dairy	Feedlot	Livestock Market	Total number tags applied	Total number participants continuing to utilize UHF
CA							3	4139	2
CO				4			2	7500	3
FL	1				1			1304	1
HI				2				527	1
MI			1	1		1		147	2
MT						1	2	30000	1
OK	1	1			1	2		1080	0
TN					2		3	19718	3
WI	1			1			1	1600	1
TOTAL	3	1	1	8	4	4	11	66015	14

Table 2. Livestock Market Participation Summary

State		Readability*	Tag Size	Reader	Market Software Integration	eCVI	Efficiency	Continued use of UHF post project
CA	Cattlemens	100%	118 77	Stationary Antenna	Yes, with existing software	No (use printout of ID attached to ICVI)	Maintained speed of commerce and generation of ICVI much quicker	Yes
	Market B	100%	77	Stationary Antenna	Yes, with existing software	No (use printout of ID attached to ICVI)	Speed of commerce maintained/improved; time to create ICVI greatly reduced	Yes
	Market C	0-100%	118	Stationary Antenna	Yes, with existing software	No (use printout of ID attached to ICVI)	When the system worked correctly saved a lot of time and made issuing ICVI easy	No
CO	Northeastern CO market	99%	118 77	Dedicated UHF reader and handheld PC with built-in UHF reader	No	Yes	Shorter time for buyers at load out, reduced handling of cattle	Yes
	Western CO market	100%	118	Dedicated UHF reader and handheld PC with built-in UHF reader	No	Yes	Market and vet both struggled with buy in and did not fully utilize the technology	No
MT	Billings Livestock	100%	118	Stationary Antenna	Yes	Yes	Reduction of 6 hours and 3 people post sale.	Yes
	PAYS Livestock	100%	118	Stationary Antenna	No	Yes	Reduction of 17 hours and 6 people post sale largely due to eCVI	No
TN	Market 1	100%	118 77	Dedicated UHF reader, handheld PC with built-in UHF reader and stationary antenna	Yes, updated existing software	No	Reduction in personnel needed and hours	Yes
	Market 2	100%	118 77	Handheld PC with built-in UHF reader and stationary antenna	No	No	None, returned to LF RFID tags	No
	Market 3	100%	118 77	Dedicated UHF reader and handheld PC with built-in UHF reader	No	No	None, returned to using NUES tags (only has two steer sales per year)	No
WI	Equity Livestock	100%	118	Dedicated UHF reader and stationary antenna	No	Yes	None	No

* Readability represents the number of animals read during sales. In some instances cattle needed to be run past the antenna a second time or scanned with a handheld device for the tag to read.

Animal Disease Traceability UHF Cooperative Agreement Demonstration Project Report

Cooperator: California Department of Food and Agriculture
1220 N St
Sacramento, CA 95814

Project Coordinator: Rachelle Kennedy

APHIS VS ADODR: Dr. Larry Rawson

Start Date of Project: September 30, 2014

End Date of Project: March 31, 2016

Project Participation Summary

Participants: Hawaii Department of Agriculture (See HI final report)
Cattlemen's Livestock Market Galt, CA
Market B, CA
Market C, CA

Number and Type of Operation(s)/Business(es)

3 Livestock Markets

Summary of Number and Type of Livestock Identified with UHF Eartags:

Cattlemen's Livestock Market: 1,104 head of adult beef female cattle in 15 sales were tagged with the large (118 mm) Hana Micron UHF Tags, and 110 head of adult beef female cattle in 1 sale were tagged with the small (77 mm) Hana Micron UHF Tags.

Market C: 1,308 head of adult beef female cattle in 16 sales were tagged with the large (118 mm) Hana Micron UHF Tags.

Market B: 1,927 head of beef female and male cattle ranging from 4 months to 12 years old in 36 sales were recorded through the market but tagged by producers at various times using the small (77 mm) Hana Micron UHF Tags bought by the market.

Totals: 2,412 head of adult beef female cattle, 1,927 head of mixed age beef steers, heifers, and cows

Summary of UHF Readers Used in the Project:

Two (2) antenna “AniTrace” system set up at the scale

Two (2) antenna system set up at the exit gate and scale after the sale ring

Two (2) antennas set up at the entrance of the sale ring

Overall Project Objectives and Activity Areas**1. Use UHF tags in heifers applying at brucellosis calfhod vaccination in Hawaii**

- A. Evaluate the application, retention, readability and durability of UHF-RFID applied to heifers moving interstate between Hawaii and California
- B. Evaluate the ability of UHF-RFIDs to enhance interstate movement and brucellosis calfhod vaccination identification compliance and accuracy of lot identification.
- C. Evaluate the physical and function integrity of UHF-RFIDs in grassfed heifers harvested at local slaughter plants in Hawaii. Assess and allocate personnel time to achieve data transfer of information collected from animal movement documentation, inspection and disease surveillance activities.

2. Use UHF tags in heifers moving from Hawaii

- A. Identify the differences of readability of UHF tags in dry and moist environmental conditions.
- B. Evaluate the use of UHF reader devices with existing software such as USDA's Mobile Information Management (MIM) system, CDFA's animal movement permitting Apple iPad and integration of the tags into the existing Animal Health & Food Safety Services (AHFSS) Emerging Threats (ET) database.
- C. Evaluate the use of UHF tags in heifers moving interstate. Application of the tags at vaccination in lieu of vaccination NUES tags. Tracking the movement of heifers from shipping state, scanning at origin and at arrival.
- D. Evaluate the use of the UHF tags in heifers in feedlots. Use of the tags for tracking heifers in the feedlot including lot placement, weight, and any medical treatment.
- E. Evaluate tag retention in a feedlot environment.
- F. Evaluate collection of information at terminal points by scanning of animals at slaughter.
- G. Evaluate the use of this type of technology at speed of commerce across all sectors.

3. Use of UHF tags for cattle moving through Livestock Markets

- A. Identify the differences of readability of UHF tags in dry and moist environmental conditions.
- B. Evaluate the use of UHF reader devices with existing software such as USDA's MIM, CDFA's animal movement permitting Apple iPad and integration of the tags into the existing AHFSS ET database.
- C. Evaluate the use of UHF tags through livestock markets.
- D. If available, evaluate the use of UHF backtags, including interference with UHF eartags and other RFID tags.
- E. Evaluate Approved Tagging Sites use of UHF tags on out of state cattle, including but not limited to cattle from Oregon and Nevada.
- F. Evaluate collection of information at terminal points by scanning animals at slaughter.
- G. Evaluate the use of this type of technology at speed of commerce.

Outcomes of Each Target Area

1. Use UHF tags in heifers applying at brucellosis calthood vaccination in Hawaii

See HI Department of Agriculture's report

2. Use UHF tags in heifers moving from Hawaii

Due to the low volume of UHF tagged cattle moving from HI to CA and lack of interest from CA receivers we were unable to fully assess the use of UHF tags for this objective. One markets picked up 80 head UHF tagged cattle from Hawaii in 3 sales. See Summary Table A Below.

Table A: HI Tagged Cattle Scanned in CA							
Type of Animal	Date Tagged	Total # Animals Tagged in HI	Date of Sale in CA	# Scanned @ CA Market	Tag Type	~ Age	# of Retention Days
Beef Feeder	7/23/15	21	8/19/15	19	118 mm	6 to 9 mo.	27
Beef Feeder	7/23/15	21	9/2/15	1	118 mm	6 to 9 mo.	44
Beef Feeder	10/19/15	72	11/11/15	60	118 mm	6 to 9 mo.	23

3. Use of UHF tags for cattle moving through Livestock Markets

- A. Identify the differences of readability of UHF tags in dry and moist environmental conditions.

Throughout the project, the markets were able to evaluate the use of the tags in various environmental conditions, including dry/hot, and cool/rainy. All tags worked the same regardless of the environmental conditions. Most tags were applied within a few days of when they were read. The conditions were the same or similar when they were tagged and read. One market did have the producers tag the cattle prior to their arrival at the market. The environmental conditions at tagging for those are unknown. This market read the animals when they were presented for sale and all tags read regardless of the conditions. The readability of the tag did not seem to be affected by being in the cattle longer before being recorded.

- B. Evaluate the use of UHF reader devices with existing software such as USDA's MIM, CDFA's animal movement permitting Apple iPad and integration of the tags into the existing AHFSS ET database.

Not much was done to evaluate existing software. Readers at the markets were integrated into existing saleyard software. Exports of tag information can be gathered from the saleyard software and uploaded to our systems if needed.

- C. Evaluate the use of UHF tags through livestock markets.

Between the three markets in the project, we were able to evaluate more than 4,300 UHF tagged beef cattle moving through markets. Each market utilized the tags in a different way, so we were able to see a variety of uses. The markets were able to use both size tags. Based off feedback, the large tags seemed be more useful for adult cattle, while the smaller tags were useful in any size cattle, especially smaller feeder cattle. The markets reported that the tags worked great. Producers commented that the tags were big and ugly. Some refused to let their cattle be tagged with them, while others wanted to cut them out after they bought the cattle. Two of the markets had issues with the readers and the software used to capture the information. Overall, when everything worked correctly, all three markets loved using the tags and believed the technology will save time. See comments on speed of commerce (G).

Cattlemen’s Livestock Market had an overall good experience with the project. After resolving some issues with the backs and taggers, they saw 100% retention of the tags applied. They applied tags to adult beef cows, particularly for their bred cow sales. They liked using the large tags for the bred cow sales and out of state cattle. They were able to evaluate the smaller tags in one sale and did not have a problem with those either. The readers at the market worked well. They did have some issues with the integration of the software to produce a CVI on a Mac, so they were not able to evaluate. Print-outs from the system show the tag number, seller ID, date scanned, and buyer. The market did scan cattle not tagged at their market in multiple sales. This included 3 sales with cattle tagged in HI and 3 sales with cattle tagged at another market. Overall they commented that they liked the project, tagging cattle was easier, and the recording of information was quicker and more efficient. See Summary Table B below.



Table B: Cattlemen’s UHF Tags Applied & Read

Type of Animal	Date	# Animals Tagged	# Scanned (Not Tagged at Market)*	Tag Type	~ Age	Type of Reader	# Tags Read with UHF Reader	% Read
Beef Cows	5/5/15	40		118 mm	2-10 yrs.	Antenna	40	100
Beef Cows	6/10/15	64		118 mm	1-10 yrs.	Antenna	64	100
Beef Cows	6/24/15	180		118 mm	1-10 yrs.	Antenna	180	100
Beef Cows	8/19/15	68		118 mm	1-10 yrs.	Antenna	68	100
Beef Cows	8/19/15	7		118 mm	1-10 yrs.	Antenna	7	100
Beef Feeder	8/19/15		19 (HI)	118 mm	6 to 9 mo.	Antenna	19	100
Beef Feeder	9/2/15		1 (HI)	118 mm	6 to 9 mo.	Antenna	1	100
Beef Cattle	9/2/15		4 (Mkt B)	77 mm	?	Antenna	4	100
Beef Cows	9/22/15	24		118 mm	1-10 yrs.	Antenna	24	100
Beef Cows	11/6/15	221		118 mm	1-10 yrs.	Antenna	221	100
Beef Cows	11/6/15		11 (Mkt C)	118 mm	1-10 yrs.	Antenna	11	100
Beef Feeder	11/11/15		60 (HI)	118 mm	6 to 9 mo.	Antenna	60	100
Beef Cow	11/11/15		1 (Mkt C)	118 mm	1-10 yrs.	Antenna	1	100
Beef Cows	3/2/16	110		77 mm	20-48 mo.	Antenna	110	100

**Noted next to number where animal was tagged, if known*

Market C had valuable feedback for the project. They had several issues regarding the tags including producer thoughts regarding the tags, and initial issues with both backs provided by USDA. Some producers would not allow the market to tag their cattle with the large tags as they

said the tags were big and ugly. Another issue encountered was with buyers utilizing BLM allotments, if the color did not match the producer's tag color, this led to the cutting out of official ID. Although this issue could potentially be solved by the producer buying and applying the tags in the correct color, it does limit the market's ability to apply the tags and market the tagged cattle. The market had various reader and software issues throughout the project. Approximately half the sales had problems with the reader or software and anywhere from one to all the head in those sales did not read. When all the tags did not read, it was a software issue. When one to a few head did not read, the market was unable to determine whether the issue was related to the tags or the reader. Unfortunately, this market continued to have issues with the software leading to them to stop applying tags for the project. Overall when everything worked correctly for them, the market liked the technology and it did save them time. This was especially true for cattle leaving CA. The market supports the continued development of the technology and can see the value throughout the production chain, particularly if the cattle were tagged by the producer prior to arrival at the market. See Summary Table C Below.

Table C: Market C's UHF Tags Applied & Read

Type of Animal	Date	# Animals Tagged	Tag Type	~ Age	Type of Reader	# Tags Read with UHF Reader	% Read
Beef Cows	4/24/15	47	118 mm	2-10 yrs.	Antenna	46	97.8
Beef Cows	5/1/15	204	118 mm	2-10 yrs.	Antenna	200	98
Beef Cows	5/8/15	142	118 mm	2-10 yrs.	Antenna	142	100
Beef Cows	5/15/15	129	118 mm	2-12 yrs.	Antenna	129	100
Beef Cows	5/22/15	81	118 mm	2-12 yrs.	Antenna	0	0
Beef Cows	5/29/15	1	118 mm	4-8 yrs.	Antenna	1	100
Beef Cows	6/5/15	222	118 mm	2-10 yrs.	Antenna	218	98.2
Beef Cows	6/12/15	259	118 mm	2-10 yrs.	Antenna	251	92.9
Beef Cows	6/19/15	18	118 mm	2-10 yrs.	Antenna	18	100
Beef Cows	6/26/15	57	118 mm	2-10 yrs.	Antenna	56	98.3
Beef Cows	7/10/15	20	118 mm	2-10 yrs.	Antenna	18	90
Beef Cows	7/17/15	14	118 mm	2-12 yrs.	Antenna	13	92.9
Beef Cows	8/7/15	18	118 mm	2-13 yrs.	Antenna	18	100
Beef Cows	8/14/15	5	118 mm	2-13 yrs.	Antenna	3	60
Beef Cows	8/27/15	23	118 mm	2-13 yrs.	Antenna	0	0
Beef Cows	Sept 2015	68	118 mm	18 mo.-13 yrs.	Antenna	0	0

Market B operates a little differently than the other markets. They began using Low Frequency Tags in the year 2000 and switched to using UHF in the last couple years. The market distributed the tags including Hana Micron Large Tags from the project, “900” series Hana Micron small tags, and more recently “840” series Hana Micron

small tags. Owners of the animals tag the cattle. Primarily feeder cattle receive the tags as part of the Age/Source Verification Program.

The market has found that the large tags from USDA are only useful for cows. Feedback on the USDA tags is that both tag backs received did not work with the tags and the market began using different tag backs successfully. There were no issues scanning the tags with 100%



reading. The animals presented for sale could have been tagged anytime between 2012 and time of sale. The tag information is scanned directly into the software that the market uses. This market also uses software to scan the animals into the market at the chute. Animal information is uploaded by the market on behalf of the consigner including age, source, and vaccination information. This information appears on a screen to the potential buyers when the first animal from that owner enters the ring. The market is working towards an online database where the producer has access to update information regarding the cattle that will end up at the market. The overall use of UHF tags at Market B has saved countless hours according to the owner. Although the producers do the tagging, the time to record the information has decreased greatly. See Summary Table D Below.

Table D: Market B’s UHF Tags Read

Type of Animal	Sale Date	# Animals Scanned	Tag Type	~ Age	Type of Reader	# Tags Read with UHF Reader	% Read
Beef Feeders/Cows	7/7/15	9	77 mm	3 mo.-12 yrs.	Antenna	9	100
Beef Feeders/Cows	7/14/15	245	77 mm	3 mo.-12 yrs.	Antenna	245	100
Beef Feeders/Cows	7/21/15	17	77 mm	3 mo.-12 yrs.	Antenna	17	100
Beef Feeders/Cows	8/4/15	24	77 mm	3 mo.-12 yrs.	Antenna	24	100
Beef Feeders/Cows	8/11/15	3	77 mm	3 mos-12 yrs.	Antenna	3	100
Beef Feeders/Cows	Sept 2015	205	77 mm	3 mos-12 yrs.	Antenna	205	100
Beef Feeders/Cows	10/13/15	22	77 mm	3 mos-12 yrs.	Antenna	22	100
Beef Feeders/Cows	10/20/15	25	77 mm	3 mos-12 yrs.	Antenna	25	100

Beef Feeders/Cows	10/27/15	39	77 mm	3 mos-12 yrs.	Antenna	39	100
Beef Feeders/Cows	11/10/15	8	77 mm	3 mos-12 yrs.	Antenna	8	100
Beef Feeders/Cows	11/17/15	85	77 mm	3 mos-12 yrs.	Antenna	85	100
Beef Feeders/Cows	12/8/15	35	77 mm	3 mos-12 yrs.	Antenna	35	100
Beef Feeders/Cows	12/16/15	353	77 mm	3 mos-12 yrs.	Antenna	353	100
Beef Feeders/Cows	1/5/16	4	77 mm	3 mos-12 yrs.	Antenna	4	100
Beef Feeders/Cows	1/12/16	16	77 mm	3 mos-12 yrs.	Antenna	16	100
Beef Feeders/Cows	1/19/16	40	77 mm	3 mos-12 yrs.	Antenna	40	100
Beef Feeders/Cows	1/26/16	3	77 mm	3 mos-12 yrs.	Antenna	3	100
Beef Feeders/Cows	2/2/16	18	77 mm	3 mos-12 yrs.	Antenna	18	100
Beef Feeders/Cows	2/9/16	12	77 mm	3 mos-12 yrs.	Antenna	12	100
Beef Feeders/Cows	2/16/16	17	77 mm	3 mos-12 yrs.	Antenna	17	100
Beef Feeders/Cows	2/23/16	43	77 mm	3 mos-12 yrs.	Antenna	43	100
Beef Feeders/Cows	3/1/16	23	77 mm	3 mos-12 yrs.	Antenna	23	100
Beef Feeders/Cows	3/15/16	8	77 mm	3 mos-12 yrs.	Antenna	8	100

- D. If available, evaluate the use of UHF backtags, including interference with UHF eartags and other RFID tags.

We did not acquire any UHF backtags.

- E. Evaluate Approved Tagging Sites use of UHF tags on out of state cattle, including but not limited to cattle from Oregon and Nevada.

All three markets involved are Approved Tagging Sites. Cattlemen's Livestock Market utilized the UHF tags to tag a few loads of out-of-state cattle as an Approved Tagging Site. The market found the larger UHF tags useful when applying to adult beef cows from NV and OR. It was easy to record the UHF tags for the records as an Approved Tagging Site.

- F. Evaluate collection of information at terminal points by scanning of animals at slaughter.

Most of the animals tagged were animals not going to slaughter. No evaluation was done at slaughter plants. CDFA supports the further evaluation of the collection of this type of ID at slaughter.

- G. Evaluate the use of this type of technology at speed of commerce.

This was one of the most important objectives to evaluate with this project. When the equipment and software were working properly, the speed of commerce was not impacted. For all three markets, the reader equipment was in or near the sale ring. This allowed for all three to evaluate the use during the normal course of the sale.

Cattlemen's Livestock Market did not have any problems with their software or hardware. All lots of cattle they tagged read 100%. The market commented that using the UHF tags maintained the speed of commerce and that they thought the system worked great. When animals did move out of state, the official ID for the CVI was much quicker to produce than previous methods.

Market C had several problems throughout the project, mostly involving issues with the software, but they believe a few may have been the hardware. When the system worked correctly, the market reported that it saved a lot of time and made issuing the CVI super easy. When the system did not work correctly, it greatly slowed the process and required extra time for working the cattle back through the chute to see which animal was missed.

Market B has the most experience using UHF tags. Animals arrive at the market already tagged. The market saves time by the cattle being tagged by the producers. They also utilize the tags to record information regarding the cattle. This information is displayed in the auction ring when the cattle are scanned. The market has found that speed of commerce is maintained and even improved. The information about that animal stays on the tag. That information can then be transferred easily to the buyer, saving time. If a CVI is needed, the time to produce the document has been greatly decreased.

Conclusion

Overall, CDFA found the use of UHF tags and technology could be a great asset to animal agriculture and further efforts in Animal Disease Traceability, particular for use in beef cattle. Although there is still the need to develop more compatible software and hardware, the existing systems worked well for the project and the integration into existing software has mostly worked.

The UHF tags worked well. After some initial issues with the tag backs and taggers, the application was easy and retention of the tags was good. With a few exceptions, all the tags scanned properly. We are unsure whether the tag read error that occurred was due to the tags or the reader. The biggest issue with the USDA provided tag was the size and color. We had many complaints from producers regarding how "ugly" the tag was. We even had buyers cut out the tags. The large tags were also difficult to use in smaller/younger cattle, but were useful for cow sales. The smaller tags later provided were more favorable with producers and the markets. The size of the tag did not affect the readability.

The three markets in the project used antenna readers integrated into their existing saleyard software. Two of the markets had no issues with the readers or software. One of the markets was able to pick up and report to us cattle tagged at two other markets, and in HI. The 3rd market had issues with the software throughout the project. Unfortunately they were unable to solve the

problems or continue evaluating the technology. There should be continued development of software and/or modifications to existing software.

CDFA supports and encourages the development of dual tags combining Low Frequency and Ultra High Frequency. This would allow for more use throughout the system depending on the management and existing systems of a facility, especially for cattle that start at a calf ranch and move through to feedlots. For facilities looking into the use of technology, the creation of a dual reader would also be useful as we will likely see the continued use of both technologies.

CDFA appreciated the opportunity to be a part of the project. The three markets thought the project was great when things worked correctly it saved them a lot of time. Two markets plan to continue to use the tags and technology even though the project is over.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Colorado Department of Agriculture, Animal Health Division
 305 Interlocken Parkway
 Broomfield, CO 80021
 Cooperative Agreement #14-9708-2249-CA

Project Coordinator: Alex K. Turner, DVM

APHIS VS ADODR: Don Beckett, DVM, MPH

Start Date of Project: September 29, 2014

End Date of Project: June 30, 2016

Project Participation Summary

Participants:

- Western Colorado Livestock Market
- Northeastern Colorado Livestock Market
- Southern Colorado Livestock Market
- Western Colorado Rancher
- Central Colorado Mountain Rancher
- Northeastern Colorado/Nebraska Rancher #1
- Northeastern Colorado Rancher #2
- Southeastern Colorado Feedlot #1
- Failed Last Minute Southeastern Colorado Livestock Market, turned into Southeastern Colorado Feedlot #2

Number and Type of Operation(s)/Business(es):

3 Livestock Markets
 4 Cow/Calf beef producers
 1/2 Feedlot producers

Summary of Number and Type of Livestock Identified with UHF Eartags:

6,000 Beef Cows (bred cow sales at markets)

- 1,500 cows tagged at Western Colorado Livestock Market
- 1,000 tags distributed for use of the newest Southern Colorado Livestock Market. Intended to tag animals more this fall
- 3,500 cows tagged at Northeastern Colorado Livestock Market, mostly bred cows, but anything that needs official ID that came through the chute at this market was done using UHF ear tags. This is the market that continued to use the technology at their own expense.

2,500 Beef Calves (steers or heifers)

- 3 of the original producers also use a Livestock Market project site to sell their cattle. All 3 of these producers continue to use UHF tags in their herd management on a day to day basis.
- 4th producer (Central Colorado Mountain Rancher) also invested in the technology for use in all of their cattle, as well as their own bison.

2,000 Feedlot Cattle

- Most recent project additions currently have 1,000 tags that they are placing now through the fall. Both new members of the project will be selling through the newest Southern Colorado Livestock Market this year and having animals tagged there for them.

10,400 tags placed/allocated to producers/markets during the project.

7,700 tags currently in inventory (leftover project tags, also following late request of surplus tags at end of project to facilitate continued Colorado UHF efforts)

Summary of UHF Readers Used in the Project:

TSL 1128 Bluetooth UHF RFID Reader

- Used in Ranch settings, as well as at the markets for CVI generation
- About a 10 foot or so read range, line of sight, and unobstructed.

Hanna Micron/Fort Supply “AnniTrace” Stationary panel reader

- Used at All markets, feedlots, scales and some alleyways for load out.
- Could be positioned in a pen or alley way with multiple panel readers and then bluetoothed to the PDA to capture animals as they went by without having to put them in a squeeze chute.
- Also used some of the panels to assist an elk producer in the State with their inventory using their own supplied UHF tags. The panels worked well for this use.

Trimble Juno T41 PDA w/ reader

- Most recent addition to the project, but did have the chance to see it used by a field ADT to capture IDs in a livestock market setting.
- Using the UHF tag reader resulted in a very short battery life for the reader, which has it’s own separate reader.
- This could be used to aid a dedicated reader, or for short times during testing procedures, but this would not suffice as a stand alone day to day reader in most settings.

Overall Project Objectives and Activity Areas:

The primary objective of the UHF project in Colorado had 2 main target areas, with a 3rd aspect that came out of the original 2 objectives. Originally Colorado wanted to focus on the livestock markets as a target area, but within that objective, also saw that there was the opportunity to see producer tagging for producers that sold their cattle at the original two target livestock markets. The hope was that by integrating with market software and the market veterinarian that we would see a benefit to the speed of commerce at the markets.

The second original target area was to focus on the feedlot aspect of having UHF ear tags present. We had hoped to test reading groups of cattle in that scenario, as well as seeing how tag retention was in different feedlot environments, as well as how the tags could help to generate management documents. Lastly in this target area was the processing and weighing processes of the cattle with UHF tags.

The parameters of success for CDA were set to be providing an analysis of the benefits and drawbacks to utilizing UHF ear tag technology for Animal Disease Traceability (ADT) in a format that is easy to adopt and also useful for regulatory purposes.

Outcomes of Each Target Area and Conclusion:

Overall in Colorado the UHF Pilot Project has had successes and failures. For the most part the technology of the ear tags works as advertised. The read rate is high, the tag retention is also high, and the distance that the tags can be read from is also as advertised. The panel readers are able to read an ear tag moving past them at a run from 20 feet away, and can be placed in such a way as to give excellent coverage in an alley, on a scale, or especially in a chute/narrow alley. The hand readers can pick up an ear tag from 10 feet or so at speed in most environments. There is also a UHF reader attached to a PDA (the Juno from Juniper systems) that is able to read a UHF ear tag from about 6 feet away. There were instances where all of the cattle in a group that were passing through an alley or a gate or onto a scale were not read properly. This was a known feature of the tags as they require “line of sight” from the reader to the tag and are not able to penetrate through the head of the cow, or past another cow in between the reader and the tag. Another area where the technology seems to still need improvement is in the ability of the software to get the ID numbers to a useful stage for CVI generation or herd management. Fort Supply has newer software that is still in testing and approval phase here in Colorado called FastCVI for veterinarians. Using the software and UHF tags to generate fast and easy CVIs without all of the data manipulation that was required throughout this project timeframe would help to aid the uptake of veterinarians with the project, long term. The tags seemed to have a high retention rate out in the pastures represented here in Colorado. Everything from heavy mountain timber, to sage brush grazing to some of the grasslands of NE Colorado showed a retention rate that was equal to or better than what was seen with existing ranch tags. Many of these calves and cows tagged on Colorado pasture kept this high retention rate for the entire project period (1 ½ years). We did see some of the feedlot cattle have the ability to reduce the retention rate and suspect that this is due to more areas in a feedlot for rubbing a tag out (feeders, waterers, fences, bunks, especially wire protected posts!). The tag failure rate also seemed to be low, regularly being around 1 per 500 to 1 per 1,000 from the reports of those that were placing tags for the project.

Some of the failures that the project had were in part to a lack of buy in from market owners and veterinarians. Many could not see where the long term cost of the ear tags (currently around \$3.25/tag) would come from beyond the end of the project.

However, there were also examples of good buy in from producers and veterinarians who were willing to work through the learning process. One market has adopted the UHF ear tags as the version that they use in their market. This has resulted in a shorter time for their buyers at load out, and reduced the amount of handling that cattle require for out of State shipments. In the long term, they expect this to also reduce shrinkage for their customers. There are also two producers who have adopted the technology and actually purchased their own ear tags and equipment to supplement what the project introduced them to. They see benefit in sorting animals, getting ID while out in the field, and in shipping their animals as well. Colorado plans to continue with the UHF pilot project as an effort to increase the amount of electronic official animal ID that is in use in the State as well as the chance to continue to increase the amount of electronic CVI that we receive from market veterinarians. Both of these efforts are in line with the mission of advancing ADT in Colorado.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Department of Agriculture and Consumer Services, Division of Animal Industry 407 S. Calhoun St., Room 330, Tallahassee, FL 32399-0800

Project Coordinator: Dr. Michael A. Short, State Veterinarian/Director, 407 South Calhoun Street, (850) 410-0914 Michael.Short@FreshFromFlorida.com

APHIS VS ADODR: Dr. Cristopher A. Young, DVM, MPH, Diplomate ACVPM, Assistant Director District 2 for Florida and Georgia, APHIS VS, 1506 Klondike RD SW STE 300, Conyers, GA 30094, Office: 770-761-5421, Mobile: 770-330-8300

Start Date of Project: October 1, 2014

End Date of Project: March 31, 2016 (project will continue past end date to determine UHF tags retention overtime)

Project Participation Summary

Participants:

- 1 Dairy located in Zolfo Springs, FL
- 1 Accredited Veterinarian located in Summerfield, FL
- 1 Calf Broker/ Raiser in Fayetteville, TN
- 1 Hill Cattle Co/ Hauler of TN

Number and Type of Operation(s)/Business(es)

- 1 FL Dairy
- 1 TN Dairy Calf Broker
- 1 FL Accredited Veterinarian
- 1 FL/TN Cattle Hauler Co.

Federal/ State Participation:

- 6 USDA VS AHTs Florida
- 1 USDA VS AIC Florida
- 1 USDA VS AIC Tennessee
- 1 FL State Bovine Program Manager
- 1 FL State OPS/ Data Entry

Summary of Number and Type of Livestock Identified with UHF Eartags:

Total number of calves IDed and shipped to TN is 801

Total number of calves IDed and inventoried at dairy in FL is 1304

Total number of IDed and scanned calf loads from FL to TN is 7

Summary of UHF Readers Used in the Project:

6 Trimble Juno T41 CLR-TYW-00 (PDA with UHF scanner build into device)

All equipment used was owned by USDA D2 FL

Overall Project Objectives and Activity Areas

- Evaluate the use of UHF devices in the tracking of dairy calves originating in the Southeast
- Capture of interstate movement data by the use of UHF RFID ear tags and reader technology
- Collect official identification and movement records required through Federal, State, traceability and animal health program disease regulations to test the use of UHF devices that will provide official identification for animals involved in one or more **interstate** movement events.
- Use Mobile Information Management (MIM) devices integrated into the project along with the Animal Identification Management System (AIMS) and/or other animal health information systems used by the cooperator to generate electronic movement documents and records.
- Use UHF devices to capture animal identification that will be distributed and entered into AIMS linked to the Premises where devices are applied to demonstrate the value of electronic automation and preparation of ICVIs through the integration of electronic ICVI solutions.
- This project will continue until we have used all UHF tags issued to FL. We will continue to tag and inventory calves at this dairy as well as scan tags at load out for TN. We will also be continuing this project to scan the tags upon return to Florida. The calves sent to TN will return as springers. We will be able to obtain a lot more information about tag retention when these calves return to FL. We plan to stay involved until we have good data quality on the retention of the UHF tags applied.

Outcomes of Each Target Area

- UHF tags applied to dairy calves have demonstrated a 99% retention in those who tags were applied
- Zero errors were observed in the capture of UHF identification using UHF technology. Although at times the scanners seemed to want to pick up ear tags in calves in the next stall. This was corrected by changing the read distance in the PDA. No issues to report after that change was made.
- The collection on identification for calves being moved from FL to TN was very successful. The use of this type of technology improved the process by allowing data to be emailed and imported into a database to generate electronic records to capture inventories and movements of those animals involved in the activity.
- The use of MIM made it much easier to create electronic files and share specific file types that could be generated by MIM applications.
- XML and CSV files were easily generated in the field and shared with state officials. State personnel were able to take the files generated in the field and upload them into other key databases used by both federal and state officials.
- Out of the 1304 tags applied, only 2 have been observed or reported as “loss of tag” in three months.
- Gains include time spent at load out at about half the time spent when UHF RFID tags were used. Also less than half of the people were needed to work the load out. This was primarily due to scanning the tags instead of catching each calve and reading a NUES tag when loading the trucks.
- The equipment was tested in weather ranging from 50 degrees to 95 degrees. Often it was muddy and wet due to rain. Once we adjusted the read range based on the location where we were scanning, we did not have any issues with scanning tags. The only issue we had was when scanning the youngest calves in small close knit pens. We sometimes picked up the ID on the calf in the next pen. After we adjusted the read range to <2, we no longer had that problem.
- FDACS personnel uploaded the data using StateVet.com which dumps into Core One. The data was also shared with TN each time a shipment was sent.
- The Dairy will continue to use this technology for 2 reasons. They accomplish multiple function with this one tag. They can use it as a visual tag in addition to the UHF RFID. They also like that you can change the read range and find that beneficial. They really want to see how the tags are retained upon return to FL. They have had issues in the past questioning if they actually get the exact calves back that they sent to TN. The dairy expressed how much they feel this will help with accountability when their bred heifers return to FL. The real test of the equipment will be determined upon return to FL when longer term retention can be assessed.

- Movements were captured in SCS Core One via StateVet.com. The generated electronic files were given to the producer and were shared with his veterinarian who was writing the ICVI's. The veterinarian attached the printed animal inventory for each load. The ICVI and electronically generated inventory print out accompanied the load in route to TN.

Conclusion

In conclusion, the RFID/ UHF technology demonstrated by this projects supports the use of UHF technology in the future for the following reasons:

1. To improve the accuracy of identification collected in the field.
2. Lesson the likelihood of human error while performing data entry or transcribing hand written documents.
3. The ability to rapidly capture data associated with livestock moving in interstate commerce and for animal disease testing purposes.
4. The ability to quickly share data among those not in close proximity.
5. Electronic capture of activity data can be quickly uploaded into most databases used by federal, state and producer management systems.
6. The ability to use one device that can capture data as well as scan identification in the field. This decreases the amount for troubleshooting in the field by not having multiple devices that need to be paired and connected.
7. The ability to changed read distance on the UHF devices allows for adjustment to the specific needs and set up of the premises where the activity being performed.
8. The dairy really likes the tags we use because they can use one tag to serve the purpose of two tags they were previously using. Instead of using a management (visual) ID and a RFID, the dairy used only the UHF/ RFID issued by VS because it has a space for them to write their farm management ID on the UHF tags supplied.
9. UHF tags and PDA worked well (able to scan/ read 100%) of the tags while scanning in head catches, pens and alleys.
10. The Allflex Total Tagger worked best with the UHF tags used (Hanna Micron 77mm tags).

Negatives:

1. Other taggers did not work well with the Hanna Micron tags:
 - They were difficult for individuals with smaller hands to use based on design.
 - When tagging, the pin misaligned and pushed off to the side piercing the tag at the wrong spot for affixing in the ear.
 - The pins were often not strong/ sturdy enough to actually pierce the tag.

2. Additional training for the use of UHF tags and scanner needs to be provided to those who already use MIM. Individuals would need training on the set up and use of the UHF devices to ensure they are aware of how to change read/ scan distances as well as how to use the device without the need of a paired wand/ scanner/ reader.

Overall, this technology was found to be very valuable and can be used to improve the speed and accuracy of data captured in the field as well as allow for quicker, more accurate capturing and sharing of such data.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Hawaii Dept. of Agriculture
1428 S. King Street
Honolulu, HI 96814

Project Coordinator: Raquel Wong, DVM

APHIS VS ADODR: Larry Rawson, DVM

Start Date of Project: September 1, 2015

End Date of Project: March 31, 2016

Project Participation Summary- 1

Number and Type of Operation(s)/Business(es)

(1) Cow/calf operation

Summary of Number and Type of Livestock Identified with UHF Eartags:

December 5, 2015 (139 calves at branding)

December 5, 2015 (147 weaned calves)

March 28, 2016 (169 calves at branding)

Summary of UHF Readers Used in the Project:

Attempted to use hand held reader at branding and weaning but could not pair up the reader and the archer. When assistance requested a wifi connection was required and no wifi was available at the remote corral where activities were occurring.

Weaned calves were shipped on 1/13/16. Tag retention from tag placed on 12/5/2015 was 100%. Readability with hand held was 100%. Readability with stationary reader was between 98-99%. Pairing of reader to archer was again an issue but was resolvable with wifi connection available at the loading site.

Overall Project Objectives and Activity Areas

- 1) Evaluate the application, retention, readability and durability of UHF-RFID applied to heifers moving interstate between Hawaii and California
- 2) Evaluation the ability of UHF-RFIDs to enhance interstate movement and brucellosis calf hood vaccination identification compliance and accuracy of lot identification.

Outcomes of Each Target Area

Evaluate the application, retention, readability and durability of UHF-RFID

In use with the cattle shipping operation it was found that hand held readers were accurate and easy to use. Stationary readers worked quickly and well when they read 100% of a load. At times however the stationary readers required shuffling of the cattle in the weight box where the readers were installed in order to read 100% of the tags.

Evaluation the ability of UHF-RFIDs to enhance interstate movement and brucellosis calf hood vaccination identification compliance and accuracy of lot identification.

In the cattle shipping operation it was found that vaccination data was entered at the time the animals were identified and individual records were created. This eliminated the second the data entry step. The benefit was realized when travel ICVI documents were created when it was time to ship the animals.

Conclusion

The UHF tags appear to have good retention and durability in the field for 30-45 days. It is too early to determine retention and durability beyond that period as calves tagged at branding have not yet been shipped. The need to repeat pairing of the readers and the archer was problematic and caused reading of the tag to be abandoned when wifi was not available. Without continuous use of the archer the need for partial retraining was also problematic.

Project Participation Summary - 2

Number and Type of Operation(s)/Business(es)

Cattle shipping operation

Summary of Number and Type of Livestock Identified with UHF Eartags:

October 19, 2015 (72 feeder cattle)

Summary of UHF Readers Used in the Project:

Hand held reader read at 100%

Stationary readers read between 98-99%

One tag could not be read

Overall Project Objectives and Activity Areas

- 1) Evaluate the application, retention, readability and durability of UHF-RFID applied to heifers moving interstate between Hawaii and California
- 2) Evaluation the ability of UHF-RFIDs to enhance interstate movement and brucellosis calf hood vaccination identification compliance and accuracy of lot identification.

Outcomes of Each Target Area

Evaluate the application, retention, readability and durability of UHF-RFID

In the application to calves it was found that attempts to use hand held reader at branding and weaning but could not pair up the reader and the archer due to lack of wifi at the remote corral where activities were occurring.

Weaned calves were shipped on 1/13/16. Tag retention from tag placed on 12/5/2015 was 100%. Readability with hand held was 100%. Readability with stationary reader was between 98-99%. Pairing of reader to archer was again an issue but was resolvable with wifi connection available at the loading site.

Evaluation the ability of UHF-RFIDs to enhance interstate movement and brucellosis calf hood vaccination identification compliance and accuracy of lot identification.

The tags applied at the calf operation also had good durability. The creation of individual records sped up the processing of the calves at the time of weaning and transport. The data was available to attach to the travel documents (DC-44 Certificate of Livestock Movement). The larger issue was that of the lack of connectivity in remote locations which made verification of information transfer impossible.

Conclusion

Hand held readers were accurate and easy to use. Stationary readers worked quickly and well when they read 100% of a load. At times however the stationary readers required shuffling of the cattle in the weight box where the readers were installed in order to read 100% of the tags. The stationary reader installed to read tags at the squeeze chute would read tags that were not applied resulting in lost data. To resolve the issue the sensitivity of the read was lowered and the tags that were not yet applied had to be moved away from the chute area which resulted in more walking and time required to apply the tags. When assistance was required wifi was available and Fort Supply staff were available, helpful and very willing. Some retraining was required because there was time lapse in-between the initial training and use of the equipment.

Animal Disease Traceability UHF Cooperative Agreement Demonstration Project Report

Cooperator: James Averill, D.V.M., Ph.D.
State Veterinarian of Michigan, Animal Industry Division Director
Michigan Dept. of Agriculture and Rural Development
525 West Allegan Street
PO Box 30017
Lansing, MI 48933

Project Coordinator: Daniel Buskirk, Ph.D., P.A.S., Dept. of
Animal Science, Michigan State University

APHIS VS ADODR: Reed Macarty, D.V.M (retired)

Start Date of Project: October 1, 2014

End Date of Project: March 31, 2016

Project Participation Summary

Number and Type of Operation(s)/Business(es) 1

Beef Feedlot

1 Beef Cow/Calf Operation

1 Beef Bull Evaluation Station

Summary of Number and Type of Livestock Identified with UHF Eartags: 35

Dairy Heifers

41 Beef Cows

71 Beef Bulls

Summary of UHF Readers Used in the Project:

Alien Technology Corp. – ALR-9650 Gen 2 stationary reader

Hana Micron America Inc. – AniMonitor stationary readers (AC and solar powered)

USE OF UHF RFID FOR CONTINUOUS MONITORING OF CATTLE HEALTH AND INVENTORY

OVERALL PROJECT OBJECTIVES AND ACTIVITY AREAS

PROJECT OBJECTIVE:

The project objective was to demonstrate ultra high frequency radio frequency identification (**UHF RFID**; 902-928 MHz, ISO 18000-6C, EPC Gen 2 compliance) in a basic system which would monitor cattle attendance at water sources. The specific aim of this project was to develop an on-farm UHF RFID-based system that could be used to monitor cattle health, cattle inventory, and water source status. Because water is an essential nutrient, and access is often a point source, gathering data on attendance at water sources would allow for near real-time monitoring of cattle inventories, cattle health, and water source viability.

ACTIVITY AREAS:

The reading systems were developed for two cattle feeding facilities (MSU Beef Cattle Teaching & Research Center [Feedlot], Lansing, MI and MCA/MSU Bull Evaluation Station, Crystal, MI), and a pasture setting (MSU Beef Cow/Calf Teaching & Research Center [Cow/calf], Lansing, MI). Initially, project participants met with Dr. Robert Clarke, Associate Professor/Director, Auto-ID Research & Testing Center to discuss RFID options and approaches for assembling stationary UHF reading units. The use of animals for this project was approved by the MSU Institutional Animal Care and Use Committee (approval #11/14-208-00).

A portion of the grant funding was leveraged to hire Ms. Sarah Woodruff as part of the MSU College of Veterinary Medicine (**CVM**) Food System Fellowship program. In this way we were able to leverage project funding with that of the MSU CVM program to promote education and training of this future veterinarian. Ms. Woodruff completed much of the planning and development of the beef feedlot application discussed below.

Beef Feedlot Application

A UHF RFID station was constructed using an Alien 9650 Gen 2 RFID reader. The alien 9650 Gen 2 RFID reader has an integrated antenna and can read relatively long distances with a modest cost. The cost of installing AC power in remote locations is often expensive. The ALR-9650 has capability of receiving power over Ethernet (**POE**), therefore avoiding costly AC power installation in semi-remote locations. The combination of POE and elimination of external antenna reduces the complexity of installation of a RFID read point. The components needed and cost of the Beef Feedlot RFID read point are presented in Table 1. The read point was mounted directly above an automatic waterer in an outdoor feedlot site (Figure 1). The reading area was approximately 5 meters in diameter at the water height, surrounding the watering area (Figure 2).

Mr. Aaron Reinholz, Assoc. Director for Electronics Technology, North Dakota State University Center for Nanoscale Science & Engineering was consulted on current UHF readers and software for our application. Mr. Reinholz granted permission to use two unsupported software programs for the project (Cattle Feed App v1.0.0.0 and Cattle Tag Reader Interface v0.2). These software

allow recording of tag reads and can alert the user when a lack of reads is encountered for a user-defined period of time.

Bull Evaluation Station Application

We collaborated with AniTrace (division of Hana Micron America; Milpitas, CA) to install two AniMonitor systems at the MCA/MSU Bull Evaluation Program Station (Crystal, MI). Each reader was mounted on the inside of the station hoop barn, a single antenna mounted outside directed down at each of two automatic waterers (Figure 3.) Waterers in this facility can be accessed from within the barn, but to do so, cattle must extend their head outside.

Internet access was provided by an Ubiquiti M5-400 bridge at the station residence base internet source, and an Ubiquiti NS2 receiver and ASUS RT-N10P wireless N router at the bull evaluation station hoop barn, approximately 235 meters away. Internet access was stable and at the rated 1M bandwidth.

Pre-numbered, UHF RFID ear tags (RaFid 5; Hana Micron) were applied in the left ear and an Allflex Super Maxi visual tag in the right ear of 71 bulls as they were delivered to the MCA/MSU Bull Evaluation Station on October 9 and 10, 2015. All bulls remained at the barn until they were weighed off test on February 12, 2016. One bull lost a UHF tag during this time by tearing its ear.

Remote Pasture Application

An AniMonitor system, similar to those installed at the bull evaluation, were installed in a pasture setting at the MSU Beef Cow/Calf Teaching and Research Center, E. Lansing, MI. This AniMonitor system had DC-power supplied by solar charged batteries. The components of the system are provided in Table 2. The read point components are pictured in Figure 4 and the entire solar powered AniMonitor system is shown in Figure 5. For this remote system, wireless internet access to the site (approximately 250 meters from the nearest building with Internet access) was developed by creating an Ayrmesh network (Ayrmesh Hub2n, Ayrstone Productivity, North Oaks, MN).

Forty-one, non-lactating, Angus cows were tagged on Sept. 16, 2015 with two UHF panel tags (RaFid 5 Tag; Hana Micron America, Milpitas, CA; and All American UHF 4 Star; Y-Tex Corp., Cody, WY). Each cow received one tag from each manufacturer, which were randomly assigned to either the left or the right ear. AniTrace engineers modified software settings so that the Y-Tex tags could be read. Data on waterer visitation was recorded by the AniMonitor system.

UHF Field Demonstration

A cattle ultra high radio frequency ID demonstration was held on September 23, 2015 at the MSU Beef Cow/Calf Teaching and Research Center, E. Lansing, MI. The demonstration consisted of presentations on UHF (Buskirk), trial objectives (Grooms), and the AniMonitor system and AniTrace software (Choi). Presentations were followed by participants reading UHF tags with fixed and handheld UHF readers, reading low frequency (LF) tags with a handheld reader, attempting simultaneous reads, and comparison of read distances. Participants then viewed the remote pasture AniMonitor system. Demonstration attendees included:

Mr. Ernie Birchmeier, Livestock and Dairy Specialist, Michigan Farm Bureau
Ms. Diana Darnell, Mobile Information Mgmt. Specialist, MDARD, Animal Industry Division
Dr. Theresa Drysdale, Veterinary Specialist, MDARD, Animal Industry Division
Mr. Kevin Kirk, Special Assistant to Director, Retired, MDARD, Animal Industry Division
Mr. Dean Letter, Member Services, Michigan Milk Producers Association
Mr. George Quackenbush, Executive Vice President, Michigan Cattlemen's Association
Dr. Steven Rust, Professor/Beef Extension Specialist, MSU, Dept. of Animal Science
Ms. Ginni Sheridan, Director of DHI Services/Select Sires Beef Specialist, NorthStar Cooperative
Dr. Janice Swanson, Chair, MSU, Dept. of Animal Science
Dr. Dan Grooms, Chair, MSU Dept. of Large Animal Clinical Sciences
Dr. Dan Buskirk, Assoc. Professor/Beef Extension Specialist, MSU, Dept. of Animal Science
Mr. James Choi, V.P. of System Integration for Hana Micron America, Inc.
Ms. Sarah Woodruff, MSU CVM Student
Mr. Siwaoot Laopeng, MSU Student

PROJECT OUTCOMES:

The project objective was to utilize UHF RFID in a basic system which would monitor cattle attendance at water sources. We were successful in meeting the specific aim and achieving the initial objectives to develop an on-farm UHF RFID-based system that could be used to monitor cattle health, cattle inventory, and water source status. Our work indicates that water source status and inventory can be monitored with these systems. It will require additional study and more animals to determine the utility of water visitation to specifically monitor cattle health.

Read distance using the stationary reader/antenna systems was more than adequate for the applications in this project. Mounting a single antenna at approximately 2.5 to 3 meters from the ground (out of cattle's reach) and directed over an automatic waterer, resulted in a read area of roughly 4 to 6 meters in diameter at the water surface. A minimum 6 second duration of presence was required to be registered in the AniMonitor system, which appeared to be appropriate for recording of a typical drinking bout.

Tag retention was similar to other visual panel ear tags we have used. Only one tag was lost during the project, and that was torn from the animal's ear (therefore, not a tag failure). The areas used in our project were relatively free of protrusions that would snag on the tags. Long-term, we would expect lower retention of panel UHF tags compared to LF button tags, but duration of testing was very short in this demonstration.

Problems/Limitations/Challenges

Read Point Software: The two software applications from NDSU which were used, were adequate for demonstrating the waterer visitation concept. However, these software applications are rudimentary, and do not provide logging capabilities or other features that would be desired for this application. Internet connection to the reader was problematic at times, and it was not definitively determined if this was a networking or software issue. The AniTrace software is more advanced in its capabilities, particularly in its ability to generate reports by day or over time. However, this software is also being developed and needs more

work to be producer friendly and useful. For example, historic water visitation can be viewed for each animal compared to the average of the pen, however, each animal must be queried independently. Also, all of the data resides with AniTrace, therefore the data is not readily available for additional analyses.

During the course of the project, AniTrace updated their data collection software, which was pushed out to the AniMonitor systems. The software update caused the internal memory of the POS units to be exceeded. This rendered the POS unusable, which ceased data uploads from all of the units until firmware of the POS units could be locally updated. This appears to be a limitation of the POS units used by AniMonitor, because reinitializing the units takes a fair amount of time and remote IT communication.

Unfortunately, because of a number of update and server issues with the software during our testing period, our data log files were not available for this report.

Wireless Network: Two systems were initially compared for extending wireless network connectivity to remote farm locations in barns and pastures at the MSU Beef Center. One system used Ubiquiti Network products (PicoStation M2HP Access Point and Ubiquiti NanoStation locoM2 airMax; Ubiquiti Networks, Inc., San Jose, CA), and the other system used Arystone products (AyrMesh Hub2N and AryMesh Receiver; Arystone Productivity LLC, North Oaks, MN). Although the systems consisted of similar hardware, the Arystone system was much easier to install, had better documentation, and was found to produce an extended WiFi coverage area. Both the feedlot and pasture applications were eventually connected to the Internet via the Arystone system (Arymesh area network).

We experienced challenges in maintaining adequate wireless Internet signal at the pasture location. The pasture RFID reader location is approximately 250 meters from the barn where the nearest AyrMesh Remote Hub2n is mounted. This resulted in marginal WiFi signal strength (approximately -75 dBm). However, this challenge was exacerbated by the lack of stability of Internet signal at our base station in the barn. Internet at the MSU Beef Cow/Calf Teaching and Research Center is provide wirelessly from a remote station in the MSU Corporate Research Park, approximately 1.5 miles away. The Internet provider was changed during the course of our project, and reportedly had difficulties in providing reliable service. Lack of a reliable Internet signal was problematic for both our system, which requires a local area network, and for the AniMonitor system which relies on the Internet to upload data to the AniTrace servers.

UHF RFID Reader Interference: In two of our applications, antennas were directed down over gates which split pens or pastures. Electric fencing wire, in our intimal application, appeared to create a sizeable dead spot in the read zone. Rerouting the insulated electric wire, up and, over the backside of the antenna easily resolved the issue. In a second application, an insulated electric wire running through the read zone only created a very small dead spot (which was not directly over the watering site) and did not require modification.

Solar Power for Remote System: One solar panel was broken in initial delivery to the Center and was replaced prior to installation. During the course of the project, the original solar charge

controller at the remote pasture application failed. At the request of AniTrace technicians, the controller was replaced with four individual solar charge controllers, one for each panel. These controllers have functioned properly throughout the winter (approximately 4 months). There were no other known issues with the solar powering of the AniMonitor system.

Feedback

Field day participants were generally positive about the technology and demonstrated application. The UHF RFID technology was welcomed, particularly as it was noted to provide solutions to some common limitations found with LF RFID. The ability for increased read distance and simultaneous reads (at least in some circumstances) were seen as positive aspects for UHF technology, particularly for applications in the cattle marketing chain. Currently, all livestock markets in Michigan are equipped with LF hardware and none are equipped with UHF hardware. Negative concerns related to necessary future infrastructure changes and costs, where LF technology already exists and is being routinely used. Also concerns were raised with transitions to UHF, while providing backward compatibility and support for LF technology.

CONCLUSION:

The project objective was successful in utilizing UHF RFID in a basic system which could be used to monitor cattle health, cattle inventory, and water source status. The UHF RFID technology is appropriate for this application. The UHF panel tags appear to be read easily by the hardware that we demonstrated and retention appeared to be adequate in non-obstructive environments. The majority of challenges with the technology demonstrated revolved around providing uninterrupted wireless signal to semi-remote locations and the RFID reader software interface. One of the significant challenges in adapting this technology to the cattle industry will be developing software that is robust, and requires very little user intervention.

Table 1. Components and cost of UHF fixed reader and wireless internet access for outdoor beef feedlot application*

Item	Cost
UHF RFID read point	
Alien ALR-9650 Gen 2 RFID reader (integrated antenna)	\$775.61
I.T.E. Power Supply PW130 POE	\$21.95
L-com weatherproof enclosure (14" x 10" x 4"; (120 VAC)	\$51.50
Remote WiFi	
AyrMesh Hub2n & Receiver	\$593.36
Cat6 Ethernet cable (5 ft.; 5)	\$12.99
Cat5e Ethernet patch cable (200 ft.)	\$49.97
Cat6 Ethernet cable (1 ft.; 5)	\$9.99
120 lb. tensile strength cable ties, 15 in. (50)	\$12.88
Self-adhesive cable tie mounts (100)	\$11.24
Mounting hardware	\$40.00
	Total \$1,579.49

*Requires network connected computer with Windows OS.



Figure 1. A weather-resistant enclosed ALR-9650 Gen 2 RFID reader (Alien Technology San Jose, CA; panel A) located directly above an automatic waterer in an outdoor beef feedlot application (panel B). Remote Internet connectivity was provided by an Arymesh network (Ayrstone Productivity, LLC, North Oaks, MN).

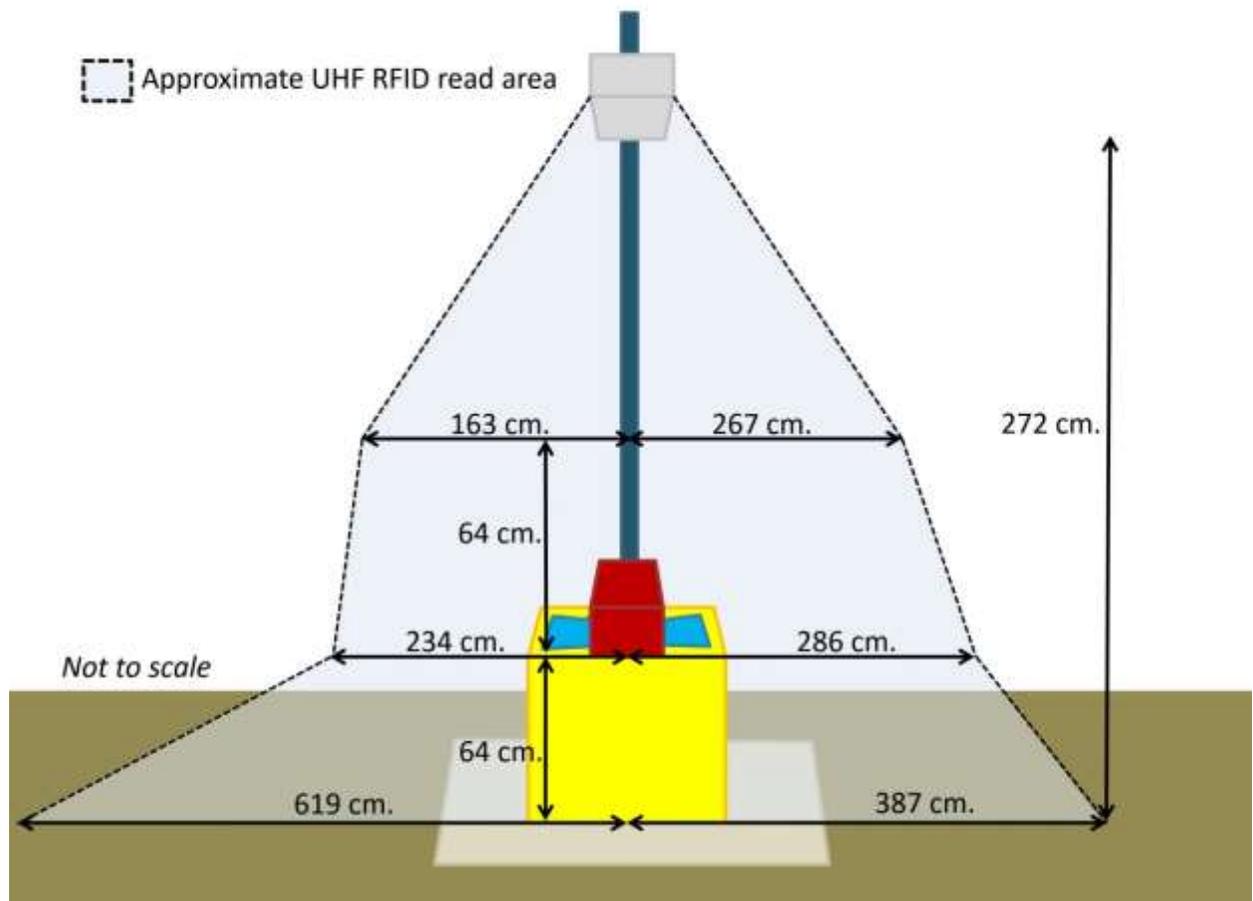


Figure 2. Approximate UHF RFID reading area of beef feedlot application at automatic waterer site. Read distance was approximately 5 meters in diameter at the water height.



Figure 3. AniTrace system installed at MCA/MSU Bull Evaluation Program Station, Crystal, MI. Antennas were mounted directly above outdoor automatic waterers (panel A). Reader boxes were mounted inside adjacent hoop barn (panel B). Remote Internet connectivity was extended from the station residence wirelessly by an Ubiquiti bridge, Ubiquiti receiver, and ASUS wireless router.

Table 2. Components of the UHF fixed reader and wireless Internet access for bull evaluation station and remote pasture applications (AniTrace, AniMonitor Systems)

UHF RFID (AniMonitor) read point*

- UHF RFID fixed type reader (NL-RF1000; Nesslab, Yongsan-dong, South Korea)
- UHF RFID antenna (IDRO Co. Ltd., Gyeonggi-do, South Korea)
- Microcomputer timer switch (ZYT16G 12V, Shanghai Zhuoyi Electronic, Shanghai, China)
- Point of sale terminal (S80, PAX Global Technology, Shenzhen, China)
- Weatherproof outdoor electrical enclosure
- Cooling fan

Solar powered unit (pasture application)**

- 4, 100 watt solar panels (4, SP100 mono-crystalline solar modules, Ramdsond, Detroit, MI)
- 3 batteries (2, 31-GEL (12v, 97.6 Ah), 1, 22NF-GEL (12v, 51 Ah), Battery Giant, Madison Heights, MI)
- Step down DC-DC converter (TH15W24055, TOBSUN, Guangdong, China)
- (Original) Solar charge controller (P30L LCD 30A, WindyNation, Ventura, CA)
- (Replacement) 4 solar charge controllers (Sunshield 12V 8A, Ramdsond, Detroit, MI)
- 2 mounting steel poles, schedule 40, 3.5" OD x 14 ft.

Remote WiFi connectivity

- Ubiquiti M5-400 bridge, Ubiquiti NS2 receiver, ASUS RT-N10P wireless N router (bull evaluation station)
- Ayrmesh Hub2n (Ayrstone Productivity, North Oaks, MN) (remote pasture application)

*AniMonitor Model #HITW4000-W00 was priced at \$2,500 (does not include shipping or installation).

**AniMonitor solar panel system was priced at \$3,800 (does not include shipping or installation).



Figure 4. Contents of UHF RFID read point (AniMonitor, division of Hana Micron America; Milpitas, CA), which was a solar powered unit installed at the MSU Beef Cow/Calf Teaching and Research Center. Original solar charge controller was replaced with 4 solar charge controllers (Sunshield 12V 8A, Ramdsond, Detroit, MI), shown on left. Remote wireless Internet connectivity was provided by an Arymesh area network (Ayrstone Productivity, LLC, North Oaks, MN).



Figure 5. UHF RFID read point (AniMonitor, division of Hana Micron America; Milpitas, CA) that is solar powered at the MSU Beef Cow/Calf Teaching and Research Center. Antenna is located directly above an automatic waterer which is split between two pastures.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Montana Department of Livestock
P.O. Box 202001
Helena, MT 59620-2001

Project Coordinator: Tahnee Szymanski, DVM

APHIS VS ADODR: Thomas Linfield, DVM

Start Date of Project: November 2014

End Date of Project: March 2016

Project Participation Summary

Participants: Tahnee Szymanski, DVM Helena, MT – Assistant State Veterinarian
Fred Schmidt, DVM Billings, MT – Accredited Veterinarian
Bryan Roe, DVM Billings, MT – Accredited Veterinarian
Marian Van Der Schraaf, DVM Billings, MT – Accredited Veterinarian
PAYS Livestock, Billings, MT – Livestock Market
Billings Livestock Sale Billings, MT – Livestock Market
John Rose Three Forks, MT – Beef producer

Number and Type of Operation(s)/Business(es)

2 Livestock Markets

1 Cow Calf Beef Operation/heifer development feedlot

Summary of Number and Type of Livestock Identified with UHF Eartags:

30,000 beef cows

Summary of UHF Readers Used in the Project:

TSL1128

Hanna “AniTrace” Stationary Reader

Overall Project Objectives and Activity Areas

Objectives:

- Demonstrate the benefits of reading UHF tags at the speed of commerce in cattle markets.
- Demonstrate the success and speed of recording UHF tags of animals moved from herd of origin to market /sale for interstate movement.
- To increase the efficiency and accuracy of collecting animal identification and animal health information using integrated electronic data capture.
- Support animal disease traceability and animal disease control programs.

Activity Areas:

- Collecting official identification and movement records required through Federal, State, Tribal traceability and animal program disease regulations.
- Integrating Mobile Information Management (MIM) devices with the Animal Identification Management System (AIMS) and/or other animal health information systems used by the cooperator.
- Automating the preparation of ICVIs through the integration of electronic ICVI solutions.
- Integrating UHF technology in various sectors; in particular marketing channels.
- Collecting data on groups of animals and recording additional group level data (e.g., age, sex, lot/group number species, etc.).
- Providing the opportunity for industry to participate in the evaluation of UHF identification technology for their purposes (management, marketing, etc.).

Outcomes of Each Target Area

Collecting official identification and movement records required through Federal, State, Tribal traceability and animal program disease regulations:

- This objective was largely being met pre-UHF project. Implementation of the UHF project focused on only those class of cattle that are covered under ADT and the use of UHF tags resulted in at least equal performance in this area.

Integrating Mobile Information Management (MIM) devices with the Animal Identification Management System (AIMS) and/or other animal health information systems used by the cooperator:

- MDOL successfully implemented the use of MIM devices at all facilities who participated in the study. This was accomplished using Juniper Mesas, Fort Supply FastEID, and Fort Supply FastCVI software. MDOL was limited to use of the private software in capturing UHF tags due to the ability of the software to capture tags in batches without a save between individual animals.
- The data captured was compatible with our animal health software USAHerds for upload of animal movement data.

Automating the preparation of ICVIs through the integration of electronic ICVI solutions:

- MDOL successfully took one market from 100% paper ICVIs to 100% electronic ICVIs over the course of the UHF project. The market and market veterinarian continued with electronic ICVIs beyond the UHF

project. The use of UHF tags does not provide any specific advantage to the implementation of electronic ICVIs.

- The second market was already using electronic ICVIs for almost all certificates generated.
- The heifer development feedlot was able to provide animal identification data to the veterinarian in an electronic format, but ultimately, the veterinarian was unwilling to convert from traditional paper formats.

Integrating UHF technology in various sectors; in particular marketing channels:

- Through the use of UHF tags in livestock markets, MDOL was able to successfully reduce the number of times animals had to be run through the chute, reduce the number of hours spent for processing animals post-sale, and to reduce the number of total personnel needed to work animals post sale.

Type of Activity	Without UHF		With UHF Technology	
	# People	Time (Hrs.)	# People	Time (Hrs.)
Processing cattle pre-sale PAYS	7	72	7	72
Processing cattle for interstate movement post sale at PAYS	7	18	3	6
Processing cattle pre-sale BLS	5	48	5	48
Processing cattle for interstate movement post sale at BLS	5	12	3	7

Collecting data on groups of animals and recording additional group level data (e.g., age, sex, lot/group number species, etc.):

- MDOL did not see an increase in the level of detail recorded on individual animals over the course of this project. For the heifer development feedlot and BLS, both of these facilities were already capturing a significant amount of detail on all animals processed. The addition of the UHF tags did not result in or facilitate capturing new data.
- For PAYS, a market that recorded moderate animal level detail for all animals processed, the transition from all paper records to electronic records provided such a significant learning curve chuteside that initially there was a decrease in the amount of detail collected. Once operation of the MIMS devices was no longer an issue, similar to the other facilities, there was not a net increase in the amount of data collected.
- The readers performed equally well in both a wooden alley as an all metal alley system.
- Read range on tags was consistently 15 ft with a clear line of sight.
- Tag retention (once initial button issue was rectified) was excellent.

Providing the opportunity for industry to participate in the evaluation of UHF identification technology for their purposes (management, marketing, etc.):

- UHF tags were used in two livestock markets and a single heifer development feedlot. The feedback received on the UHF tags was mixed. The heifer development feedlot saw increased efficiencies in subsequent handling of cattle but did not see large benefits on facilitating movement/sales of the animals as bred heifers out of the feedlot. The feedback received at livestock markets was largely

critical of the necessary size of the UHF tags along with the cost of implementation. Without some additional perceived advantage to use of the tags, large scale industry buy-in will be limited.

Conclusion

The batch reading of large numbers of animals for interstate movement post-sale was a significant and impressive accomplishment of the UHF technology. The ability to effectively reduce the number of times individual animals are worked through the livestock chute from 2 to 1 was equally significant. Some of the personnel and time reductions were not a direct reflection of the UHF technology explicitly but instead the more broad application of electronic technology, such as through the use of electronic ICVIs. Until the cost and size of UHF tags can be addressed, there will never be enough industry buy-in on a large scale basis to make implementation of the technology at markets worthwhile. The use of low-frequency RFID tags provides substantial gains to the processing of livestock and electronic generation of animal movement data without the impediments of expense of tag size.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Oklahoma Department of Agriculture, Food, and Forestry
 2800 N Lincoln Blvd
 Oklahoma City, OK 73105

Project Coordinator: Alicia Gorczyca-Southerland, DVM

APHIS VS ADODR: Becky Brewer-Walker, DVM

Start Date of Project: October 1, 2014

End Date of Project: March 31, 2016

Project Participation Summary

Participants: Terry Loman, Davidson, OK- Dairy Producer
 Sam Mitchell, Fletcher, OK- Background Operation Manager
 Bret White, Cushing, OK- Accredited Veterinarian
 Scott Anderson, Guymon, OK- Feedlot Manager
 Bill Roser, Watonga, OK- Feedlot Manager
 Bill Golightly, USDA APHIS VS AIC-OK

Number and Type of Operation(s)/Business(es)

(2) Feedlots

(1) Dairy Operation

(1) Backgrounding Operation

Summary of Number and Type of Livestock Identified with UHF Eartags:

830 Beef Feeder Cattle

250 Dairy Heifers

Summary of UHF Readers Used in the Project:

Fort Supply Dual Fixed Antenna System
 Fort Supply Quad Single Point Fixed Antenna System
 Fort Supply UHF RFID Hand Held Reader
 Archer 2 Ultra Rugged Hand Held PC with FaST EID Software
 Juno T41 RFID PDA
 Hanna AniTrace AniGate and AniChute Systems

Overall Project Objectives and Activity Areas

The Oklahoma Department of Agriculture, Food, and Forestry's (ODAFF) goal with this proposal is to determine the reliability, readability, and durability of ultra-high frequency (UHF) technology for identifying cattle moving through all stages of production. AIS will also determine the ease of integration of this technology into herd management practices, Mobile Information Management devices, USAHerds, and electronic iCVI solutions. AIS plans on determining these objectives by developing projects that will have real world applications. The benefits of this technology will enhance consumer protection and confidence in the food supply by improving disease prevention and strengthening traceability efforts. It is ODAFF hope to demonstrate the merit of using UHF technology to be able to capture data at the "speed-of-commerce" and create added value to benefit industry in multiple sectors. The work plan initially focused on the use of dairy steers moving through various sectors of production from backgrounding, to feeding, and ultimately to slaughter. As we initiated the pilot project, a lack of a consistent supply of dairy steers and interest from the feeding industry lead to modification of the work plan and project design to meet the objectives outlined within the work plan.

1. Feeder Cattle at CRI Feedlot

With this project site, the overall goals were to determine robustness of the equipment, read accuracy at collection points and prior to shipping, and determination of added value for herd management practices. Cattle used for this project site are not required to have official identification as they were less than 18 months of age and used for feeding purposes only. Identification was allocated based on the pen number a group of similarly sized and aged animals were assigned to. Pen numbers were heat stamped on tags prior to use. An objective for this project site was to determine if the UHF tags could be heat stamped and how that would affect performance of the tag. We were interested in how quickly readers could be set up on loading/unloading docks prior to shipment of cattle to a slaughter facility. As we would have the opportunity to follow cattle tagged with UHF tags to slaughter, determining tag retention was an objective we planned on accomplishing. We also utilized pen riders on horseback to determine the feasibility of using UHF handheld readers to scan individual animals.

2. Dairy Operation/Backgrounding Operation

With this project site, the focus was on capturing UHF data while minimizing handling of the dairy heifers, determine integration of UHF technology into herd management practices, and examining the durability of the equipment subjected to the elements. Dairy heifers were tagged using the UHF tags by dairy staff shortly after birth with the recommended tagger. The producer uses management tags in addition to official ID devices. In order to help the producer eliminate the need for additional management tags, Hanna Micron laser printed the management number series that the producer requested on 300 UHF tags used for this project site. The dairy heifers were shipped to the backgrounding operation when they were approximately 6-8 months old. The backgrounding operator that receives the dairy heifers prefers to handle the heifers as little as possible to avoid unnecessary stress in the animals. To accommodate this request and to meet objectives outlined in the work plan, we developed ideas to test the equipment, minimize handling, and potentially create value for both the dairy producer and the backgrounding operator. We chose to maximize the opportunity to read UHF tags by installing panel readers above the processing chute, in the alleyway to the processing barn, and on the feed truck to best capture UHF tags.

3. Feeder Cattle at Xcel Feedlot

With this project, we had the opportunity to utilize equipment on loan from AniTrace which included AniGate, AniChute and the AniMonitor software at the feedlot. Our goal with this project was to determine robustness, read accuracy, range, and ease of use of the AniTrace system. We set up the AniChute system above the processing chute and AniGate was set up in an 18 foot alleyway. We were fortunate to have IT personnel from AniTrace assist us with the setup and execution of the equipment for the first few read events. Cattle used for this project site are not required to have official identification as they were less than 18 months of age and used for feeding purposes only. Similar to the previous feedlot, identification was allocated based on the pen number a group of similarly sized and aged animals were assigned to. Pen numbers were heat stamped on UHF tags prior to use. We had already determined no ill effects were seen on UHF tag function when heat stamped due to the work at the other feedlot and felt confident we would not have issues at this project site. We were unable to follow up with shipping of animals out of the facility to determine tag retention.

Outcomes of Each Target Area

1. Feeder Cattle at CRI Feedlot

UHF Tags Applied				Retention and % Read			
Type of Animal	# Animals Tagged	Tag Type	~ Age	# Days Since Tags Applied	# Animals with Tag in Ear When Checked	# Tags Read with UHF Reader	Type of Reader
Feeder Cattle Lot 091, Lot 092, Lot 094, Lot 096	228	Large	8 months	0	228	205	Fort Supply 4 Antenna Alley System
Lot 092	50			157	48	48	Fort Supply 4 Antenna Alley System
Lot 091	56			137	53	53	Fort Supply 4 Antenna Alley System
Lot 096	58			131	56	56	Fort Supply 4 Antenna Alley System

This project site was the first of the 3 individual pilots performed and was the furthest from the office as it was located in the Oklahoma Panhandle. The distance did prove to be a challenge with setting up a long term panel reader system in an alleyway. Another challenge was determining where the feedlot could benefit from using UHF tags in the feeder cattle. Once cattle were tagged and allocated to their assigned pen, they were not moved until they were ready to be shipped for slaughter thus eliminating the need for pen counts or for inventory purposes. There was a discussion with the feedlot manager about setting up a stationary bunk reader to monitor feed intake of UHF tagged cattle, but the cattle tagged were not centrally located within the feedlot and access to an electrical source to power the panel reader proved difficult. Due to the limitations of distance and practical applications for the equipment, we chose to initially tag several lots and then follow them to a slaughter facility in an adjacent state. One objective that we were interested in the outcome was whether or not the UHF tags could be subjected to heat stamping. We were able to determine that readability was not affected even when heat was applied for a prolonged amount of time. Mild distortion of the tag was noted with prolonged heat application.

Once the cattle were processed and tagged with the UHF tags, they were moved to a holding pen and then allowed access to a 16 foot alleyway. The cattle were allowed to move at their own speed and the alleyway was not manipulated to concentrate or slow the cattle before passing through the panel readers. This was done to simulate normal business practices as the feedlot was not able to adjust the alleyway to accommodate the readers. Because of this, the readers were hung on an up and over rail system and adjusted as necessary to try to attain better read accuracy. The end result was we were not able to obtain 100% read accuracy on all cattle presented to the reader. We believe several factors went into the decreased accuracy: stressed cattle, inability to slow cattle or concentrate cattle at reader, and positioning of the readers. The hand held readers were utilized once each lot had been moved into a

pen. Handlers on horseback moved through the cattle, attempting to scan the tags to determine range and accuracy. It was determined that the handheld readers were more accurate when the cattle were not moving and the handler could single out a particular animal. We were able to follow three out of the four lots that were tagged from feeding to processing. We were unable to follow one lot as they were sent to processing before we could get to CRI to set up readers. A temporary panel reader was set up at the loading dock at CRI and cattle were read as they were loaded. The same set up was used at the processing facility as the cattle were off loaded. Overall, the panel readers worked very well and had 98-100% read rate on animals tagged. The few animals that were not read either did not have a tag placed (7/8) or the animal placed its head in a way to obstruct the tag from being read (1/8). To assess tag retention we were only able to verify this objective for the remaining lots that were presented to the panel reader at the time of shipment. For the three lots presented there was a 4% retention loss. It is unknown at this time if it is due to the size of the tag or the tag applicators used as they were not the recommended taggers. It is important to note, that the Hanna Micron tags with the replacement backs were used.



2. Dairy Operation/Background Operation

UHF Tags Applied				Retention and % Read			
Type of Animal	# Animals Tagged	Tag Type	~ Age	# Days Since Tags Applied	# Animals with Tag in Ear When Checked	# Tags Read with UHF Reader	Type of Reader
11-20-15: 1 pen	50	Large	5-8 months	120-150	50	30	Fort Supply 4 Antenna Alley System attached to feed truck
2-19-16: 3 pens/1 bunk	192/37	“	“	130-160	192/37	162/37	Fort Supply 4 Antenna Alley System attached to feed truck
2-24-16 MIMS read	9	“	“	135-165	9	9	Juno T41 PDA UHF reader & Fort Supply 4 Antenna Alley System attached chute side
3-4-16: 3 pens/1 bunk	228/44	“	“	180-240	228/44	202/44	Fort Supply 4 Antenna Alley System attached to feed truck
3-18-16: 1 pen/1bunk	55/42	“	“	180-240	55/42	49/42	Fort Supply 4 Antenna Alley System attached to feed truck

To meet our objectives and to try to read as many UHF tags as possible while minimally handling the dairy heifers, we set up panel readers in different locations on the backgrounding operation facility. One goal was to determine if attaching a panel reader to a feed truck would prove to be useful for the backgrounding operator and be an efficient way of reading UHF tags. We tested the panel reader that was affixed on the outside of a feed truck in several different configurations to determine the most effective set up. We also had the opportunity to utilize both bunk feeding and pile feeding to compare readability. After multiple read events, it was determined that pile feeding does hinder readability of the tags due to normal feeding behaviors of cattle (bunching, heads down) in comparison to bunk feeding. Read range varied from 8-15 feet when scanning cattle being fed in piles versus 5-10 feet for bunk feeding. We averaged approximately 86% readability when using the feed truck to read UHF tags when the heifers were fed in piles. Bunk reads were slightly higher than pile reading during the earliest panel reader configurations but after several read events, we ultimately determined the most accurate configuration. We were consistent in obtaining 100% reads from the heifers as they ate in the bunks. Nonfunctional tags were not an issue as UHF tags scanned while cattle were feeding in piles, were later captured with 100% accuracy when the same cattle were fed in bunks. It is important to note that all of the dairy heifers tagged with UHF tags were never presented to a reader as a group. Statistics provided in the table were the amount of animals presented to the panel reader during each read event. Once determining the correct placement of the panel readers on the feed truck during bunk feeding and

being able to consistently and accurately obtain head counts proved to be important for the producer. It is their hope that they will be able to utilize this configuration to monitor animals and their feeding habits and try to identify animals that may be becoming ill. This could potentially be a cost benefit for the backgrounding operator as he would be able to treat the animal more quickly and in the long run less expensively than an animal in an advanced stage of illness.

In order to test UHF equipment entirely, we utilized handheld readers to determine if that would be practical to use to capture UHF tags while cattle are congregated around feed piles. Readability varied depending on distance from handheld reader in relation to the UHF tags, but overall did not seem to outperform the bunk feeding read events utilizing the panel readers attached to the feed truck. Panel readers were also set up chute side (positioned above the chute) where the heifers were processed as well as in the alleyway. We were present when the heifers were processed and took advantage of using the chute to examine the ears that the UHF tags were placed in. In the heifers examined, slight retention issues were noted and were attributed to incorrect placement of the tag within the ear. Out of the 250 heifers tagged, we are aware of 3 having lost the UHF tag. Bluetooth connectivity between the PDA and the chute reader became an issue on several occasions and it was unknown if the amount of metal within the barn where the chute and reader are located caused the interference.

During one read event, we also took the opportunity to be present when the accredited veterinarian came to officially calftag and vaccinate one of the groups of dairy heifers. This group had a few of the remaining dairy heifers tagged with the UHF tag from the dairy. We demonstrated MIMS to the veterinarian and generated an electronic VS Form 4-26. The Trimble Juno T41 handheld was utilized to read the UHF tags and to use MIMS. 100% readability was attained using the Trimble unit. An electronic Certificate of Veterinary Inspection was also generated at this read event. Using the IIAD mCVI app, a spreadsheet generated from the Sightings report in MIMS was modified and uploaded into the mCVI app. From there it was very simple to upload the 60 animals that required official identification onto the eCVI being generated. Even though interstate movement of the animals did not occur, we wanted to simulate the process to determine if integration of data collected using MIMS could be incorporated into the eCVI and ultimately into USA Herds. The entire process of generating the OCV chart and eCVI took <15 minutes and only required 1 person.

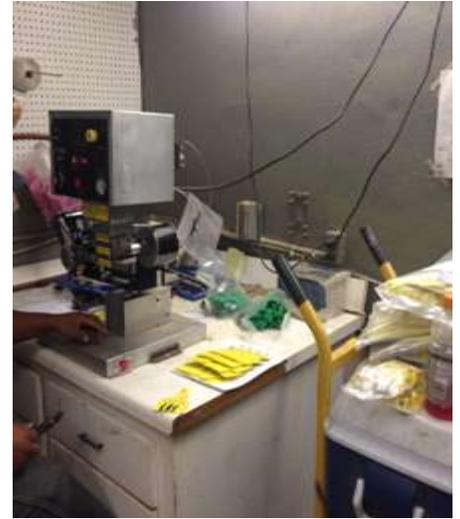


3. Beef Feeder Cattle at Xcel Feedlot

UHF Tags Applied				Retention and % Read			
Type of Animal	# Animals Tagged	Tag Type	~ Age	# Days Since Tags Applied	# Animals with Tag in Ear When Checked	# Tags Read with UHF Reader	Type of Reader
9-1-15 beef heifer read	66	Large	8-10 months	0	66	60	Hanna "AniTrace" 4 antenna
9-1-15 Holstein steer read event	26	"	"	0	26	23	Hanna "AniTrace" 4 antenna
11-3-15 mixed feeders read event following adjustments to AniGate	54	"	"	0	54	54	Hanna "AniTrace" 4 antenna
1-21-16 Lot 6010 read event following ice storm	63	"	"	0	63	63	Hanna "AniTrace" 4 antenna
2-10-16 thru 2-24-16 Lot 6015, Lot 6016, Lot 6020, Lot 6020, Lot 6027	211	"	"	0	211	211	Hanna "AniTrace" 4 antenna
3-2-16 Lot 6027 final read event	76	"	"	0	76	76	Hanna "AniTrace" 4 antenna

At Xcel Feeders, we tagged 6 separate lots of mixed feeders for a total of 324 head tagged. We were unable to verify tag retention during this time period, but feel confident retention should not be an issue as UHF tags were placed correctly and the recommended tagger was used. We utilized AniMonitor while the cattle were being processed and passed by the panel readers. We were able to monitor the activities of the processing crew offsite through the use of a website login and had access to all records being entered in real time. This is a great tool and would be beneficial to feedlot operators when it is set up with protocols pertinent to the management of the feedlot. The AniChute System had a 100% read accuracy at each read event. This system is controlled using a mobile application on any Android device. During the first read events, slight tag reading issues were noted using the AniGate within the alley way. This issue was contributed to the wider alleyway at Xcel (18 feet) than CRI (16 feet). IT personnel from AniTrace were able to make modifications to the panel reader system (AniGate) to correct this deficit. During the remaining read events we were consistently getting 100% read accuracy at 18 feet. A special bracket was built to suspend the AniGate panel readers on. This bracket was easily moved out of the way when the panel readers were not in use. This allowed for permanent installation of the equipment and gave us the ability to meet the objective of how the equipment performed when subjected to environmental conditions. It also allowed for normal operations to continue without interference from the AniGate system overhead when the readers were not in use. This project site was subjected to several winter weather events and resulted in significant ice accumulation on the AniGate system and exposure to frigid temperatures. The AniGate system fared well considering the extent of ice storm damage to the surrounding area and no significant malfunctions were noted. An interesting feature of the AniMonitor software is a timer that is initiated

once the AniGate system was activated. Typically, once the panel readers were activated, we would move away from the alley as to not serve as a distraction for the cattle being pushed through. On one occasion, we had the opportunity to observe the timer while animals were moving through the alley and 61 head of steers moving at a fast rate of speed were successfully read in <3 minutes and this included the time from them being released from the pen into the alley. Overall the AniTrace system was consistent and had 100% accuracy and readability when used.



Conclusion

Our overall impression of ultra-high frequency technology is that it works and works well when used in the appropriate settings. We believe it has the potential to improve traceability based on the parameters measured at the project sites described in this report. We were able to demonstrate functionality of the tag, the maximum capacity of the read range for different modalities, and the accuracy and efficiency in which a group of animals can efficiently and accurately be captured electronically while maintaining the speed of commerce. We were able to demonstrate how using this technology can be incorporated into existing programs to help create electronic documentation that provides timely and sharable data. We designed the individual pilot projects to be applicable to the demonstration sites and integrate ways the technology could add value within these sectors of the cattle industry without manipulating existing facilities to achieve our goals. We determined that within the feedlot sector, the most practical use of this technology was during the receiving and shipping of the lots of cattle. For niche type operations like the backgrounding operation selected for this project, we were able to demonstrate the potential for added value just by incorporating the equipment into everyday herd management practices simply by feeding cattle. Finally, we were able to demonstrate that the equipment can handle the weather extremes Oklahoma is known for.

We believe that the read range in the hand held devices needs to be drastically improved. Adjustments to these readers to allow for more accurate scanning of the tags in the direction the reader is aimed at would be our recommendation. While we proved the fixed equipment works well and has its advantages over the hand held, we do not see it being utilized on a daily basis the way a convenient hand held reader would be. Improving the readability and accuracy of the hand held reader would prove to be an incentive for producers to purchase this equipment for daily use for inventory and herd health purposes. While the larger tag proved to be useful in the feedlot project sites as it was easily heat stamped with management numbers, a smaller button-type tag would better suit the niche type operations like the backgrounder and even the dairy producer that was utilized for the pilot project and may allow for better adoption of the technology if a smaller, less noticeable tag was offered. There were concerns using the larger sized tag in the dairy heifers as far as tag retention. Unfortunately, the project has reached its completion and we will not have the opportunity to follow the dairy heifers into adulthood to determine if tag retention truly becomes an issue. We understand that additional testing of a smaller tag would be warranted to determine if the functionality of the tag is affected when limiting the size of the tag. Overall, we feel like there would only need to be minor adjustments to the UHF tag and equipment in order for it to be fully adoptable by industry standards.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Tennessee Department of Agriculture
436 Hogan Road, P.O. Box 40627
Nashville, TN 37204

Project Coordinator: Dr. Doug Balthaser

APHIS VS ADODR: Dr. Keary Krause

Start Date of Project: October 31, 2015

End Date of Project: March 31, 2016

Project Participation Summary

Participants: Three east Tennessee Livestock Markets
Two middle Tennessee Dairy Farms

Number and Type of Operation(s)/Business(es)

Three Livestock Markets

Two Dairy Operations

Summary of Number and Type of Livestock Identified with UHF Eartags:

Dairy Steers 19,309

Dairy Heifers 301

Dairy Bulls 108

Summary of UHF Readers Used in the Project:

Trimble Juno T 41 with built in RFID reader

Fort Supply TSL1128 Handhelds

Fort Supply Antenna Alley System

Overall Project Objectives and Activity Areas

Tennessee has 27 livestock markets in the state that participates in the Tennessee Ag Enhancement traceability program. The program pays the markets to enter official identification information into the (TDA) Tennessee Department of Agriculture's data base. The program's goal is the identification of all eligible cattle in marketing channels. Three (3) participating cattle markets are unique in that they have approximately twenty special dairy steer sales per calendar year in addition to the regular weekly sales. These markets move a large number of dairy steers from the southeast to feeding operations in the Midwest and West. Using the UHF technology and working with these markets to identify producers in Tennessee and the southeast, the project tested the tagging of Dairy steers in the markets and by Tennessee producers. Also the information gathered by the UHF project was used to track interstate movement from these Tennessee livestock markets. The cattle sold at the Holstein steers sales are being shipped to feedlots operations in Ohio, Indiana, Michigan, Kansas and Texas or back grounded on local farms in Tennessee, Virginia and Alabama to be later sold through the market or to feedlots in the Midwest.

Overall Objectives and Activity Areas.

1. Have dairy steers tagged with UHF RFID tags in the state of origin or receiving state.
 - a. Determine the durability and readability of the Ultra High Frequency (UHF) 840 EID tags.
2. Documentation of movement by the use of Mobile Information Management (MIM) devices for the collection of official identification data.
3. Compare the MIMs and Fort Supply FASTEid devices for collection of UHF 840 data. Also test the use of the Fort Supply antenna alley system integrated with the livestock market's computer program. Test the collection of official identification data at the "speed of commerce."
4. Increase the use of electronic CVIs by the market veterinarians and improve the collection of official identification for use on CVIs.
5. Tracking through the livestock markets. Using the UHF RFID readers to scan cattle unloading or loading trucks for interstate movement.

Outcomes of Each Target Area

The UHF project included twenty-four Holstein Steer Sales at three market locations in east Tennessee. Information on the livestock markets that participated in the UHF project is listed below.

One Stockyard had twelve Holstein Steer Sales from January 2015 to February 2016. Average head tagged per sale 700 Holstein Steers.

A. Determine the durability and readability of the Ultra High Frequency (UHF) 840 EID tags

Hanna Micron (77mm and 118mm) UHF 840 tags were used in all twelve Holstein Steer Sales. The reliability and durability was excellent. As far as readability the 118 mm tags were excellent and the 77mm tags were very good. At the stockyard sales a total of 8,398 dairy cattle (8,113 dairy steers, 217 dairy heifers and 68 dairy bulls) were tagged with UHF tags over a 14 month period. During the 14 month period an additional 717 older UHF tags were read multiple times, these tags had been in the cattle for varying periods of time from 1-13 months. See chart on page 8 for details. Non reading tags were nine 118 mm tags and fourteen 77mm tags out of 8,398 UHF tags.

B. Test the use of the MIMs devices and Fort Supply FASTEid devices for collection of UHF data. Also test the use of the Fort Supply antenna alley system integrated with the livestock market's computer program. Also test the collection of UHF data at the "speed of commerce".

The UHF project began using the Trimble Juno handheld computers with the internal RFID readers at the chute as the UHF tags were being applied to record tag information. When the temperature was in the 20s and 30s, the Trimble units would automatically turn off the internal RFID readers when the battery capacity reaches 50-60% battery capacity even with the extra battery packs. Using the internal RFID reader in cold temperatures seems to drain the battery faster. To correct the cold weather issue, the Trimble Computers were kept on a base charger when not in use for any extended period and near a small portable heating unit.

During the second phase of the project, the Fort Supply/TSL1128 UHF readers and the Fort Supply antenna system were used at the sale. The UHF tags were read as the tags were applied at the chute. The UHF 840 tag along with any NUES tags information was entered along with the breed, sex and age information in the FS FASTEid program on the Trimble Juno. A second reader was stationed in the arena outside the scales. Tags were read a second time to capture the pen number once the calves were sorted and graded. The pen numbers was added so the UHF 840 tags could be matched with the out of state buyers after the sale. The read distance for the Fort Supply hand held readers was 10-14 feet in the arena.

Also as part of the project one Fort Supply Antenna alley reader was mounted directly over the north end of the scales. The system worked well when first set up and tested with the Trimble Juno hand held computer in May 2015 by the Fort Supply representative. The FS antenna system would read up to eight head of cattle standing on the scale. It was January 2016 before the market owner could change the market computer program, so the FS stationary antenna system would load the UHF 840 tags directly into the market computer system. The stationary antennas were used for 472 head in the February sale. Readability was 100%, all tags were read and an APC battery backup was not needed as at the other livestock market center. The plan

was to use the FS antenna system at the March Steer sale, but the market owner decided not to use the UHF tags for the sale due to a lack of help for tagging the steers.

- C. Increase the use of electronic CVIs by the market veterinarians and improve the collection of official identification for use on CVIs.

A challenging issue occurred that we did not anticipate when planning the UHF project, all the Holstein Steer sales were held on Thursday evening and did not conclude until after 11:00 PM. Most of the Dairy steers were shipped out immediately after the sale, so we were unable to assist the market veterinarian with any electronic CVIs. Because of the time of night the accredited veterinarian used hand written CVIs for the Holstein steers shipped interstate. We supplied the lists of UHF 840 tag numbers for the cattle moving interstate and this was included with the interstate (CVI)s.

- D. Tracking through the livestock markets. Using the UHF RFID readers to scan cattle unloading or loading trucks for interstate movement.

The UHF Readers were used to read the UHF tags as the tags were applied at the chute. The UHF 840 tag along with any NUES tags information was entered along with the breed, sex and age information and the seller's name. A second reader was stationed in the arena outside the scales. Tags were read a second time to capture the pen number once the calves were sorted and graded. The pen numbers were matched up with the out of state buyers after the sale to retrieve UHF 840 tag information for interstate CVIs.

The second east Tennessee livestock market had twelve Holstein Steer Sales from February 2015 until March 2016. Average head tagged per sale 828 Holstein Steers

- A. Determine the durability and readability of the Ultra High Frequency (UHF) 840 EID tags.

Hanna Micron UHF 840 tags (77mm and 118mm) were used in all twelve Holstein Steer Sales. The reliability and durability were excellent. As far as readability the 118 mm tags were excellent and the 77mm tags were very good. At the livestock market sales a total of 9,930 dairy cattle (9,809 dairy steers, 84 dairy heifers and 37 dairy bulls) were tagged with UHF tags over a 14 month period. During the 14 month period an additional 577 UHF tags were read 2 or more times, these tags had been in the cattle for varying period of time from 1-13 months. See charts on page 8 for details. Non reading tags out of 9,930 tags were nineteen 118 mm tags and two 77mm tags. Fourteen of the nineteen non reading 118 mm tags occurred during the first 3 months of the project when there was an issue with the male buttons, so some of the tags could have been a functional instead of a readability issue.

- B. Compare the use of the MIMs devices and Fort Supply FaSTEID devices for collection of UHF data. Test the use of the Fort Supply antenna alley system integrated with the livestock market's computer program. Test the collection of UHF data at the "speed of commerce."

The UHF project began using the Trimble Juno handheld computers with the internal RFID readers at the chute as the UHF tags were being applied to record tag information. Use the

internal RFID readers during cold temperature seems to adversely affect the units. To correct the cold weather issue, the Trimble Computers were kept on a base charger when not in use for any extended period and near a small portable heating unit.

During the second phase of the project, the Fort Supply/TSL1128 UHF readers and the Fort Supply antenna system were used at the livestock market Steer sale. The same procedure for reading UHF tags was used at both livestock markets. The UHF tags were read as the tags were applied at the chute. The 840 tag along with any NUES tags information was entered along with the breed, sex and age information. A second reader was stationed in the arena outside the scales. Tags were read a second time to capture the pen number once the calves were sorted and graded at the scales. The read distance for the Fort Supply hand held readers was 10-14 feet in the arena.

Also as part of the project two Fort Supply Antenna alley readers were mounted one on the left side of the fence and another one above a small alley as the cattle exit the scales. The Fort Supply representative recommended the placement of the antennas when he set up the system for particular livestock market. The system worked fine when tested in May, but under market conditions the readability of tags was poor even when the cattle were run under the antenna multiple times. The stationary antennas were used for first 200 head in the June livestock market sale. Reading the UHF tags slowed down the cattle processing so the Fort Supply hand held reader was used for the rest of the sale. The Fort Supply representative suspected when the market had all the lights on and running the hydrolytic chute this was causing reduced electric supply to the FS antenna units so it was recommended that an APC battery back-up be installed. The APC battery backup was used and the FS antenna alley readers were tested in five additional Dairy steer sales with mixed results. The cattle had to be directed along the outside of the sale ring in order for the stationary antenna to have a better readability rate. If the cattle were not directly in line with the stationary antenna, it would not read the tags, causing us to run cattle back and forth through the ring multiple times.

- C. Increase the use of electronic CVIs by the market veterinarians and improve the collection of official identification for use on CVIs.

A challenging issue occurred that we did not anticipate when planning for the UHF project, all the Holstein Steer sales were held on Friday evening and did not conclude until 11:00 -12:00 PM. Most of the dairy steers were shipped out immediately following the sale, so we were not able to assist the veterinarian with any electronic CVIs. Because of the time of night the market veterinarian was more comfortable hand writing CVIs for the Holstein steers shipped interstate. We did supply lists of UHF 840 tag numbers for the interstate cattle through the market and these were included with the interstate (CVI)s. Some of the 840 UHF tags movement information has been uploaded into StateVet.com.

- D. Tracking through the livestock markets. Using the UHF RFID readers to scan cattle unloading or loading trucks for interstate movement.

The UHF Readers were used to read the UHF tags as the tags were applied at the chute. The UHF 840 tag along with any NUES tags information was entered along with the breed, sex and age information and the seller's name. A second reader was stationed in the arena outside the

scales. Tags were read a second time to capture the pen number once the calves were sorted and graded. The pen numbers were matched up with the out of state buyers after the sale to retrieve UHF 840 tag information for interstate CVIs.

The third east Tennessee livestock market held two bi-annual Dairy Steer Sales in March and September 2015. Average head tagged per sale 694 Holstein Steers.

- A. Determine the durability and readability of the Ultra High Frequency (UHF) 840 EID tags. To test the collection of UHF data at the “speed of commerce.

Hanna Micron 77mm UHF 840 tags were used in both livestock market Dairy Steer Sales with a few of the 118mm tags. The reliability and durability were excellent. As far as readability, the 77mm tags were very good. At livestock market a total of 1,390 dairy cattle (1,387 dairy steers, and 3 dairy bulls) were tagged with UHF tags. During the two sales an additional 32 older UHF tags scanned with a 100% readability rate, these tags had been in the cattle for varying period of time from 1-7 months. See chart on page 7 for details for all the markets. There were no non reading tags out of 1,422 tags used at the two livestock Dairy steer sale.

- A. Test the use of the MIMs devices and Fort Supply FaSTEID devices for collection of UHF data.

During both Dairy steer sales only the Fort Supply/TSL1128 UHF readers were used at the sales. The UHF tags were read as the tags were applied at the chute. The 840 tag along with any NUES tags information was entered along with the breed, sex and age information. A second reader was stationed in the arena. Tags were read a second time to capture the pen number once the calves were sorted and graded at the scales. The pen numbers was added so after the sale the UHF 840 tags could be matched with the buyers. The read distance for the Fort Supply hand held readers was good, 10-12 feet in the arena as in the other two livestock market arenas.

- B. Increase the use of electronic CVIs by the market veterinarians and improve the collection of official identification for use on CVIs.

These two sales were conducted during the afternoon, but no CVIs were written at these two sales. One Tennessee order buyer shipped cattle to Michigan from the sale one week after the September sale and we did supply a list of UHF tag and cattle information for his veterinarian for a CVI.

The two middle Tennessee Dairy Farms

A. Determine the durability and readability of the Ultra High Frequency (UHF) 840 EID tags.

Hanna Micron UHF 840 tags (118mm) were used by both Dairy Producers. These two producers received UHF tags directly from TDA in January 2015 to be used in dairy cattle to be sold at two livestock markets in the coming year. The cattle were tagged by the producer. The reliability and durability were excellent. As far as readability, the 118 mm tags were excellent. UHF tags scanned from these two dairies at six Holstein steer sales when these dairy steers were marketed had a 100% readability rate. These tags had been in the steers for varying periods of time from 4-10 months. There were no non reading tags from these two dairies out of 70 UHF tags in Holstein steers marketed at the Holstein Steer sales.

Livestock Market	Total # of Cattle tagged with UHF tags	Total tagged with 118mm tag	Total tagged with 77mm tag	Total # of UHF tags read	Non reading UHF tags	Type of Animal
First East TN Livestock Market	8,398	3,594	4,804	9,115	9 118 mm 14 77 mm	8,113 Dairy Steers 217 Dairy Heifers 68 Dairy Bulls
Second East TN Livestock Center	9,930	4,032	5,898	10,507	19 118 mm 2 77 mm	9,809 Dairy Steers 84 Dairy Heifers 37 Dairy Bulls
Third Livestock Market	1,390	209	1,181	1,422	0 118 mm 0 77 mm	1,387 Dairy Steers 3 Dairy Bulls
Totals	19,718	7,835	11,883	21,044	28 118 mm 16 77 mm	19,309 Dairy Steers 301 Dairy Heifers 108 Dairy Bulls

Outcome of Durability and Readability of the 118mm UHF 840 EID tags

# Animals Tagged & Read at a second sale	Tag Type 118mm	~ Age of Dairy Cattle	# Days Since Tags Applied	Animals with Tag in Ear at second sale	# Tags Read with UHF Reader	Type of Reader
26	Large	6-18mon	390	26	26	Hand Held & Stationary Ant.
28	“	“	360	28	28	Hand Held & Stationary Ant.
18	“	“	330	18	18	Hand Held & Stationary Ant.
74	“	“	300	74	74	Hand Held
24	“	“	270	24	24	“
57	“	“	240	57	57	“
173	“	“	210	173	173	“
126	“	“	180	126	126	“
52	“	“	150	52	52	“
91	“	“	120	91	91	“
121	“	“	90	121	121	“
88	“	“	60	88	88	“
99	“	“	30	99	99	“
977				977	977	

Outcome of Durability and Readability of the 77mm UHF 840 EID tags

# Animals UHF Tags & Read at a second sale	Tag Type 77mm	~ Age of Dairy cattle	# Days Since Tags Applied	Animals with Tag in Ear when sold at second sale	# Tags Read with UHF Reader	Type of Reader
0	Small	6-18mon	390	0	0	Hand Held
0	“	“	360	0	0	Hand Held
29	“	“	330	29	29	Hand Held
30	“	“	300	30	30	Hand Held
12	“	“	270	12	12	“
5	“	“	240	5	5	“
41	“	“	210	41	41	“
36	“	“	180	36	36	“
121	“	“	150	52	52	“
109	“	“	120	109	109	“
31	“	“	90	31	31	“
25	“	“	60	25	25	“
10	“	“	30	10	10	“
449				449	449	100% Readability

Conclusion

The durability and readability of the Hanna Micron (UHF) 840 EID tags was excellent during the 14 months that the tags were tested in Tennessee. Hanna Micron UHF 840 tags (77mm and 118mm) were used in all 24 Holstein Steer Sales. Once the issue with the male buttons was solved the reliability and durability were excellent. As far as readability the 118 mm tags were excellent and the 77mm tags were very good. During the Holstein Steer sales a total of 19,718 dairy cattle were tagged with UHF tags over the 14 month period. All these UHF tags were read at least twice. During the 14 month period an additional 1,326 UHF tags were read 3 or more times, these tags had been in the cattle for varying periods of time from 1-13 months. See charts on page 8 for details. Non reading tags out of 19,718 tags were twenty-eight 118 mm tags and sixteen 77mm tags. Fourteen of the nineteen non reading 118 mm tags occurred during the first 3 months of the project when there was an issue with the male buttons, so some of the tags could have been a functional instead of a readability issue.

The UHF project was started using the Trimble Juno T41CLR-TYW-00 with internal RFID Reader and MIMS software. Some problems/limitations that were encountered with the UHF equipment during the early months of the UHF project were low readability distance (6-24 inches) and a reduced battery life when using the built in RFID reader on the Trimble Juno computer. Issues encountered at the first sale were the RFID readers only have a two foot reading range. We did have better reading range (3-4 ft.) if there was wood plank fencing in the pen but only two feet in the work area and scales with the pipe fencing. The battery life was an issue when using the Trimble T 41even with the extra battery packs in 30 degree weather all day. When the battery level reached 50-60%, the Trimble hand held computer automatically turns off the internal RFID reader to conserve the battery. The battery issue was likely due to the cold weather and using the Trimble computers for 10 hrs. This was an easy fix, the Trimble units were left on the charging stand during extended down time and during cold weather a space heater was next to the charger.

The MIMS software has a good inventory program and after the Holstein steer sales it was easy to merge data from multiple handheld computers. The Trimble hand held computers with the internal RFID readers do not have an auto scan feature, so work can only be done as fast as the user, so sometimes it is hard to support the “speed of commerce”.

During the second phase of the UHF project, the Trimble Juno T41CLR-TYW-00 hand held computer was used with the Fort Supply/TSL1128 reader and FaSTEID software. The Fort Supply /TSL1128 have an excellent read range, at least 10-12 feet. When used in the arena area it would read UHF tags at twelve (12) plus feet. The Fort Supply UHF reader worked so well, that while using it in the work area tagging the cattle, that we dialed the read range setting to 20 inches, so the reader would not scan the UHF tags in the box on a table four feet from the cattle chute. The Fort Supply/TSL1128 reader appeared to scan the 118 mm UHF tags better than the 77 mm tags at long distances (>12 feet). The battery life of the Trimble Units was not an issue when using the separate FS UHF reader even though the units were on for 12-14 hrs.

It is possible to merge data from multiple handheld computers with the FaSTEID program, but it is more difficult than merging data from the MIMS devices. CSV files from the FASTEID program from the two handheld computers would have to be downloaded to a laptop then merged in an Excel macro spreadsheet using a 14 step process given to us by Fort Supply. Expense was the main reason this method was chosen for the project. The Fort Supply UHF reader costs \$1320.00 and then the FaSTEID program for one handheld computer costs \$690.00. So the veterinarian would have at least \$4000.00 invested in a hand held computer and the FS UHF reader to read and record the tags on a CSV file.

Fort Supply does have a FaST Auction CVI PC program (\$1495.00) and Fast eCVI program (1 yr. subscription) for \$790.00 that the veterinarian and market can purchase as an add on to the FS market program that will translate this information into an electronic CVI.

The Fort Supply /TSL1128 had some connection issues, the Bluetooth connection would disconnect when idle for long periods in between cattle. We learned to disconnect the reader from the handheld during breaks, and make a new connection right before starting to scan again.

The Auto scan on the Fort Supply /TSL1128 was excellent for reading large groups of cattle like checking 840 tag numbers in pens. Read range was much more efficient than the Trimble Juno with internal RFID reader.

Working with the FS Antenna Alley system we did learn some tricks to make the antenna system work better. At the second east Tennessee livestock market, the cattle had to be directed to the outside of the sale ring for the stationary antenna to have a better readability rate. If the cattle were not directly in line with the stationary antenna, the tags would not be read, causing us to run cattle back through the ring multiple times. If the FS stationary antennas are used in an area where the UHF tags are being read as the cattle move by, three to four antennas need to be used. If the FS antenna system is being used over an area where the cattle are confined for short periods of time as the scale area, the readability increases dramatically and one antenna works well as demonstrated in the first stockyard barn.

The project did generate both negative and positive interest at the livestock markets. The first livestock market upgraded their computer program software, so it now is connected into the FS stationary antenna mounted over the scales. The livestock market is taking bids on UHF tags from several different companies. Once the market decides on a UHF tag manufacturer, they plan to order UHF tags. It is a possibility the market will use UHF tags to replace the use of low frequency 840 tags. The second livestock market does not want to purchase new market software so they continue to use low frequency 840 RFID tags for their dairy steer sales.

I believe there is great potential for the use of the UHF tag to promote Traceability at the Speed of Commerce for stakeholders. The Hana Micron UHF tags are excellent, very durable and the readability is excellent. The two areas that are slowing the usage of the UHF technology by Tennessee veterinarians at the present time is the expense of the UHF equipment and reasonably priced software to convert the CSV files generated by the FaSTEID program into data that can easily be uploaded into the KS/CO PDF CVI. The new Texas A&M m(CVI) may be the CVI program that can solve this issue. Also another solution could be to have the animal health office use StateVet.com to upload 840 tag information from the markets for loads of cattle moving interstate.

Animal Disease Traceability

UHF Cooperative Agreement Demonstration Project Report

Cooperator: Wisconsin Department of Agriculture and Consumer Protection
2811 Agriculture Drive
Madison, WI 53718

Project Coordinator: Gretchen May, DVM

APHIS VS ADODR: Kevin J. Petersburg, DVM

Start Date of Project: October 1, 2014

End Date of Project: March 31, 2016

Project Participation Summary

Participants: Equity Cooperative Livestock Sales Association, Monroe, WI – Livestock Market
Lena Veterinary Clinic, Lena, IL –Veterinary Clinic
Oneida Nation Farm, Seymour WI –Beef and Bison Producer
Fort Supply Technologies, LLC, Kaysville, UT - Fort Supply
Tim DeVeau, Merrill, WI – USDA VS VMO
Oneida Nation Farm, Seymour WI –Beef and Bison Producer

Number and Type of Operation(s)/Business(es)

- 1 Livestock Market
- 1 Veterinary Clinic
- 1 Cow Calf Beef Operation (same as bison producer)
- 1 Bison Producer (same as beef operation)

Summary of Number and Type of Livestock Identified with UHF Eartags:

- About 900 Feeders (dairy steers or beef heifers)
- 230 Beef cows
- 470 Beef calves

Summary of UHF Readers Used in the Project:

- Fort Supply /TSL1128
- Fort Supply antenna system (1-3 antennas per site)

Overall Project Objectives and Activity Areas

The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) expected to implement the following objectives for the UHF Cooperative Agreement Demonstration Project:

- At the market, evaluate ultra-high frequency (UHF) technology to document its potential in reading UHF tags at the speed of commerce in cattle markets to aid normal market operations.
- At the market, evaluate ultra-high frequency (UHF) technology to document its potential in reading UHF tags at the speed of commerce in cattle markets to avoid delays in releasing animals after sales due to reading official identification and preparing health documentation when required for compliance with regulations.
- At the market, evaluate short term tag retention of UHF tags compared to metal NUES tags.
- With the beef/bison herds, evaluate ultra-high frequency (UHF) technology to document its potential in reading UHF tags to streamline cattle and bison herd processing by integrating identification with herd records.
- With the beef/bison herds, evaluate tag durability and retention in beef cattle at spring and fall processing.
- With the beef/bison herds, evaluate tag durability and retention in bison at spring and fall processing.
- With the beef/bison herds, evaluate tag retirement at the time of slaughter at publicly owned slaughter plants if the plants are willing to be involved.

Livestock Market – Monroe Equity

At the market, feeder sales are held the 1st and 3rd Friday of every month. It had been noted that there could be a wait time, causing complaints, for cattle buyers after the sale to be able to pick up their animals and leave as they were waiting for the appropriate official documentation (Interstate Certificates of Veterinary Inspection (ICVIs)). DATCP was evaluating the use of the UHF technology in decreasing the wait time for the cattle buyers and otherwise streamlining the process for the veterinary personnel writing the ICVIs. In addition, DATCP was evaluating the technology related to efficiencies for the market in keeping management and mandatory business records. Further, there had been some complaints about NUES tags falling out at the market or shortly after leaving. DATCP was looking at the UHF tags with respect to retention compared with NUES tags.

Cow Calf Operation – Oneida Tribe

DATCP was evaluating the use of the UHF technology in streamlining cattle herd processing and management at a beef cow calf operation. In addition DATCP was interested in evaluating the retention of the UHF tags in a beef herd in east central Wisconsin. Finally DATCP was looking at the ease of tag retirement using UHF tags and technology.

Bison Operation – Oneida Tribe

DATCP was evaluating the use of the UHF technology in streamlining bison herd processing and management at a bison operation. In addition DATCP was interested in evaluating the retention of the UHF tags in a bison herd in east central Wisconsin. Finally DATCP was looking at the ease of tag retirement using UHF tags and technology.

Outcomes of Each Target Area

Livestock Market – Monroe Equity

The market was unable to realize the benefits of the UHF technology and it actually cost them time and an extra person when tagging animals. It took an average of an extra 10 seconds per animal tagged to use the UHF tags compared to the NUES tags. This included the time to tag the animals, read the tags with the handheld reader and to enter information associated with the animals into the Mesa PC. Fort Supply Technologies made a second evaluation of the process at the market which resulted in the mounting of an antenna and stationary reader at the front of the chute allowing for a quicker read. The antenna power was scaled down so that only the tag associated with the animal in the chute would be read. This evaluation also led to further, specific training in the use of the Mesa PC which allowed for easier data entry for a group of animals when all relevant information (such as back tag number) might not be known for the first few animals that came through. These adjustments helped with the time factor a great deal, but it still required a second person to be present to enter data while someone else tagged. The market manager suggested that this time investment might be worth it if the market could use the information entered about the animals in their market records. However, the current computer system did not allow the integration of the 15 digit 840 tags.

The efficiency and accuracy in preparing certificates of veterinary inspection (CVIs) for animals moving interstate did benefit from the technology. The veterinarians were using Global Vet Link for their CVIs prior to the project and will continue to do so. But without the UHF technology, back tag numbers and corresponding official identification are noted on a handwritten paper which is walked up to the office at intervals. The CVIs are prepared in the office. If there are questions on what is written, 2-way radios are used to communicate between the office and the cattle pens to be able to gather the necessary information to complete the CVIs. However it can be difficult to hear due to noise. Waiting buyers inherently put pressures on staff to finalize the paperwork. Additionally, every time a number is written or typed there are chances for the introduction of errors. Using the technology the official identification numbers and animal information entered at the time of tagging were able to be wirelessly sent to the market office. Then that information was able to be transferred to the CVIs through Global Vet Link without needing any further manipulation such as retyping. Since it was still requiring an extra person to tag animals and enter data even with the adjustments that were made at the second evaluation and given the way this market operates, it was determined that the veterinary staff

could still benefit from the Mesa PC and wireless connection even without the UHF tags. A simple way of recording the NUES tags at the time of application into the Mesa PC instead of on paper was demonstrated. This process allowed the market to use only one person for tagging, but still allowed the veterinary staff in the office to be wirelessly sent official ID and animal information. The veterinary staff realized benefits through this practice until the wireless connection was lost.

Both the market manager and veterinary staff expressed interest in the future use of the technology. Although timeframes and specific planned capabilities are not known, the market is in the process of updating their computer system. If the new computer system can integrate with the UHF technology, the market may be able to capitalize on the investment of time involved with tagging the animals and recording the information. A reliable wireless connection would also be needed for the veterinary staff or a way to integrate the market records with the production of CVIs.

In the market environment, there were no problems reported with tag retention. Although not a specific objective for our project, there were no reported complaints related to tag size. It was observed at the feeder sales that many animals arrive at the market with management tags of several different colors and of a similar size.

Cow Calf Operation – Oneida Tribe

The beef herd was not able to fully explore all the benefits associated with the UHF technology during the course of this project although they will continue to work with it moving forward. The FaST Herd Manager software was going to be installed to allow for easier integration of data between the Archer PC and the herd management software. The Herd Manager was not ready for use by the end of this project. There was some initial hesitation in using the technology without the Herd Manager. In addition, the farm supervisor at the time of the initial installation retired shortly after that. The new supervisor was not able to receive any training regarding the technology until March 2016.

During the initial set up at the farm, one antenna was secured at the front of a chute used to process cattle. This is a mobile chute equipped with a scale. The stationary reader can be used with this antenna. Animals are read as they enter the chute and their weights from the scale automatically populate the weight field on the handheld Archer PC. The power of the antenna was scaled down so that only the animals entering the chute were read and not tags or animals that might be present to the side. The farm will get the most use from this reading location as they process most of the cattle with this chute. Additionally, three antennas were secured to a utility vehicle. The stationary reader can be moved to the utility vehicle and then that can be moved out into pastures or any other optimal location to record animal movements where needed. The farm indicated they had used this on one occasion but that their current pastures and cattle numbers were such that there wasn't as much use as anticipated for a reader in the pasture. The farm was also provided with a handheld reader which they can use on an as needed basis. Although the handheld reader would pick up many of the animals standing bunched at the back of the pens, the entire group was read most easily and reliably with the handheld reader when they were calmly moved past the person holding the reader in approximately single file.

Because the read distance was about 8-10 feet during trials, this seemed a comfortable distance for the animals to move calmly without getting excited.

Fort Supply Technologies made another visit to the farm on March 2, 2016 to review tag reading techniques and data transfers between the Archer PC and the current herd management software without the use of the FaST Herd Manager. The herd will be participating in another project involving the evaluation of growth weights. They will be able to use this system to help manage the data associated with this project.

Farm staff has tagged all the adult cattle, most of the 2014 calves, all of the 2015 calves and are continuing to tag the 2016 calves (about 700 tags used). The farm reported good retention in the cattle. They felt these tags had better retention than the unofficial tags they normally use. They found one tag that had been ripped out (found intact) and 5 out of about 700 (0.7%) tags that had broken out. Again not a specific objective of this project, but this farm had no concerns with the size of the tags. Their management tags (unofficial identification) were about the same size.

The farm was able to have the slaughter plants collect the UHF tags from the cattle at the time of slaughter after March 1, 2016. The tags were brought back to the farm to read with the handheld reader. Information associated with the slaughtered animals including official ID number, management number, birth date, birth weight, gender, slaughter date, yield weight, and slaughter plant were submitted to DATCP in an Excel file. At DATCP an AIN Event was submitted in AIMS for each official ID with the event listed as “Harvested (10)”. This process took about 15 minutes. The numbers were entered individually as they were not in sequential order. After they were entered it was realized that a file could have been uploaded which would probably have taken even less time.

Bison Operation – Oneida Tribe

DATCP was unable to evaluate the use of the UHF technology in bison as the Oneida farm was unable to schedule processing times for these animals during the course of this project.

Conclusion

Livestock Market – Monroe Equity

- Objective 1: Full benefits from use of the UHF tags and equipment were not realized for normal market operations.
 - The current computer system in use at the market will not integrate the data associated with the tags so the market was not able to utilize this information.
 - Use of the tags actually cost the market some time (less with the changes that occurred March 2016) and an additional person was needed. Ongoing familiarity with the handheld computer (Mesa) and a deeper understanding of its

capabilities may have helped with some of the lost time initially. As with all technology, anticipating best uses and providing training for all possible scenarios can be difficult up front. It was very helpful to have a second evaluation with Fort Supply where training more specific to optimal use was provided.

- Updating the market's computer system was beyond the scope of this project.
 - DATCP felt that the UHF technology would have been helpful if the entire computer system had been integrated. The anticipated time savings after sales may have accommodated the increased time that was spent prior to sales in tagging and recording information. Additionally it may have made retrieval of information easier for the market. The market manager also saw benefit to the system if there was integration.
- Objective 2: The veterinary staff was able to more efficiently and accurately incorporate data associated with the UHF tags into the Certificates of Veterinary Inspection (CVIs) created through GlobalVetLink.
 - The same benefits were achieved using NUES tags and the Mesa computer.
 - Any benefits realized were reliant upon a working wireless connection.
 - A reliable wireless connection was unable to be maintained.
 - Objective 3: There were no problems reported with lost tags and there were no reported concerns with the size of the tags in the animals for which they were used.

Cow Calf and Bison Operation – Oneida Tribe

- Objective 4: UHF technology showed promise in its ability to streamline beef cattle processing.
 - Most benefits going forward are expected to be seen with the use of the stationary reader associated with the mobile chute and scale system in use by the farm.
 - This particular farm found that they did not have as much need as initially anticipated for the stationary reader associated with the utility vehicle. However this was an interesting idea that might be more useful in another situation such as more animals and increased or more remote pasture acreage.
- Objective 5: Tag durability and retention in beef cattle in Wisconsin was found to be good.
 - One tag out of 700 used was found to have been ripped out.
 - Five tags out of 700 (0.7%) used were found to have broken out.
 - There were no concerns with tag size as the UHF tags were about the same size as the unofficial tags already in use at this farm.
- Objective 6: Tag durability and retention in bison were unable to be evaluated due to an inability for the farm to schedule processing during the course of this project.
- Objective 7: Tag numbers were able to be easily retired in AIMS once received from the farm after they collected them from the slaughter plants.