ScotEID

Cattle EID in Scotland: A research update

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Introduction

1. The European Parliament recently adopted draft versions of regulations for the introduction of electronic identification (EID) for cattle.[1] Although technical and legislative details have yet to be finalised, the drafts confirm the intention to allow voluntary adoption of cattle EID as a means of reducing some of the cumbersome burdens and errors associated with the current paper-based passport identification system.

2. EID potentially allows for the abolition of cattle passports for national herds (although they will still be required for intra-community trade) and abattoirs and livestock markets are likely to gain particularly from faster authentication of ID's and movement history. EID also offers potential opportunities for improved on-farm management of cattle by making it easier to monitor and record the performance and status of individual animals as well as reporting their movements. For example, cattle IDs are already held within the ScotEID research system for recording Bovine Viral Diarrhoea (BVD) status.[2]

EID technologies

3. The draft regulations leave open the choice of a preferred cattle EID technology. Low Frequency (LF) was mandated for sheep EID across the European Union and is thus already familiar to all abattoirs and livestock auction markets plus many hauliers and farmers. Moreover, as a mature technology, established international standards already exist for its application to animal uses.

4. Yet having developed rapidly over the past decade and being covered by other international standards, Ultra High Frequency (UHF) technology offers a viable alternative. In particular, directional antennae allow EIDs to be read at a greater distance than with LF whilst UHF's anti-collision properties and faster data transfer rates allow EIDs to be read more quickly than with LF.[3] Consequently, UHF not only speeds up the identification process for larger numbers of cattle but by avoiding the need for close handling/confinement it also offers significant health and safety benefits for stockmen. UHF tags can also hold more information, offering further possibilities for storing (e.g.) passport data, management data and/or security data.[4]

5. Previous ScotEID research confirmed the potential of UHF technology for EID, as have results reported elsewhere.[5] Anecdotal issues of performance being impaired by wet conditions or blocking by animals' bodies have proved to be insignificant and/or easily addressed.

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[1] See http://www.parlament.gv.at/PAKT/EU/XXV/EU/02/04/EU_20424/imfname_10456161.pdf
[2] See http://www.scoteid.com/scoteid/bvd_guidance
[3] See Annex A for a summary comparison of LF and UHF.
[4] See http://www.scoteid.com/Public/Documents/The_Use_of_UHF_Transponders_for_Cattle_Passportsfinal.pdf
[5] See previous ScotEID publications on UHF (and references therein) at http://www.scoteid.com/Public/Documents/UHF_note.pdf and http://www.scoteid.com/Public/Documents/Initial_UHF_testing_under_ScotEID_290312.pdf but also other recent research reported at (e.g.) http://rfid.net/applications/eid and, http://www.rfid-pathfinder.org.nz/wp-content/uploads/2012/08/Pathfinder-Report-UHF-Tag-Assessment-V05.pdf

6. On-going ScotEID research has also demonstrated proof-of-concept for dual LF-UHF technology. That is, 'dual' or 'hybrid' ear tags containing both a LF transponder and an UHF transponder such that an EID can be read using either frequency range.

7. The advantage of hybrid tags is that they offer flexibility to users, allowing those already with LF reading equipment to continue to use it whilst equally allowing others wishing to exploit UHF advantages to also do so. This co-existence of different identification technologies is merely an extension of current practice, as exemplified by the presence of written and barcode representations of IDs on conventional tags and paper passports.

8. The key point here is that retaining flexibility in how an ID can be read is a separate issue from how that information is subsequently transmitted and used in a database and from the specification of the ID format (i.e. length plus permitted alpha-numeric characters). Provided that any user can read any ID, the precise mode of reading should be unimportant and even if a particular mode is preferred for cross-border intra-community trading, other technologies should not be prohibited if they suit local needs.[6]

9. Subsequent ScotEID work has refined the design of hybrid tags and secured their production at a commercial (rather than experimental) scale. Test procedures have demonstrated no performance impairment as a result of the dual configuration. Separately, reading equipment capable of reading both LF and UHF EIDs has also been developed.[7] As with tags, hybrid readers confer convenience and flexibility by condensing into a single item of hardware the ability to use either technology.

Field trials

10. Having been tested under controlled conditions, cattle EID equipment now needs to be evaluated under commercial conditions. Hence hybrid tags and reading equipment (both handheld and fixed) are being trialled across dairy and beef cattle, including new spring calves. Initially, attention is focused at the farm-level and one livestock market but the trials will be extended to other livestock markets and to abattoirs as the season progresses and cattle movements increase. Approximately 15000 cattle/calves will be tagged, using easily-recognisable pink hybrid tags inserted as secondary tags.

11. Dairy herds offer a convenient means of rapidly gathering significant volumes of data as each movement to and from milking presents a natural opportunity to read EIDs. Some herds already use LF technology for management purposes, but these are invariably half-duplex (HDX) whereas all ScotEID hybrid tags are full-duplex (FDX) only – meaning that there is no scope for interference between the two LF protocols.

12. Beef herds offer fewer natural opportunities for EID reading, and movements of hybrid-tagged animals through livestock markets and to abattoirs may not occur in significant volumes for a while. However,

[6] For example, the United States Department of Agriculture allows either LF or UHF to be used http://www.aphis.usda.gov/traceability/downloads/AIN_device_list.pdf

[7] See http://www.tag-ie.co.uk/Tag-ie%20UHF.htm

participating farms have agreed to read EIDs during routine management operations such as weighing for livestock gain and administering drugs – so a reasonable volume of data will be generated in the meantime.

13. Although the trials are very much work-in-progress, early results confirm that UHF technology offers faster reading of a greater amount of data at a greater distance than LF under commercial conditions, but also that hybrid LF-UHF tags and readers perform as expected and offer users flexibility in how to read EIDs.

14. For example, UHF and hybrid LF-UHF tags have been demonstrated at Dingwall livestock market to local farmers and to an international conference audience,[8] with UHF shown to generate significant time-savings on the manual processing of cattle passports. Similarly, at the farm-level, a fixed UHF reader installation on a weighing crate has dramatically reduced the staffing levels and time required for recording live weight gains for a beef herd. Equally, hybrid tags can be read by LF reading equipment, UHF reading equipment and hybrid reading equipment.

15. Over the longer term, as with previous research on sheep EID under commercial conditions, the trials will provide information on the resilience of transponders - the degradation rate for both LF and UHF transponders in cattle tags has yet to be determined.

Standards

16. Much of the debate about the choice between LF and UHF concerns their respective international standards. In particular, standards ISO11784 and ISO11785 for LF relate to animal-specific applications whereas equivalent animal-specific standards are not yet in place for UHF. However, UHF *is* governed by robust international standards (ISO18000-6 and EPC GEN2) which specify how UHF operates. Moreover, since all UHF transponders and readers used by ScotEID are programmed to emulate ISO11784 and ISO11785, the animal-specific LF standards for the structure of the ID code are followed for consistency.

17. However, separately, the relevance of ISO11784 and ISO11785 is itself debatable. These standards date from the 1990s and reflect the technologies available at that time, particularly the physical capacity to store information (such as animal IDs) on transponders. Rapid technical progress since then has redefined many of the physical constraints, but adherence to the standards effectively retains them.[9] That is, they are not performance standards but rather standards describing how data are to be encoded and read.

18. Adapting the standards to better reflect technical advances and current user preferences would be helpful. For example, these standards currently preclude the storage of additional information on the

[8] See http://www.scoteid.com/Public/Documents/uhf_conference_report.pdf

[9] One consequence of this is that, despite being possible from a technical perspective (see http://www.scoteid.com/Public/Documents/WYSIWYG%20EID%20for%20cattle%20v1.5.pdf) industry preferences for true WYSIWYG (what you see is what you get) tags with the same ID written on the outside and stored internally cannot be achieved in an ISO-compliant manner without the significant disruption of changing to a different ID numbering system.

tag which might prove useful in some circumstances. Moreover, reading IDs is but one element of a wider data system and standards relating to the interface between different parts of the system are relatively more important than the frequency used to read any given ID.

Conclusions

19. ScotEID's extensive experience of working with the supply-chain to create workable EID solutions for the Scottish sheep sector suggests a number of lessons for developing cattle EID.

20. First, although highly familiar, LF technology has some limitations that are a source of frustration for some users under Scottish conditions. For example, a relatively short read range with relatively slower reading of multiple tags and electromagnetic interference in some commercial premises. Hence an alternative that offers various advantages merits serious consideration.

21. Second, however, variability in the preferences and technical capabilities of different members of the supply-chain means that retaining flexibility is of value. For example: small farmers may wish to read tags visually; larger farmers may wish to use existing sheep LF equipment for cattle; a livestock market may wish to use multiple UHF readers for handling batches of cattle simultaneously; and abattoirs may wish to use UHF to reduce electromagnetic interference problems.

22. Third, the mode of reading an ID is but one element of a much wider data system - focusing on reading alone neglects equally important aspects and hinders creation of workable solutions. For example, rules and processes for the transmission of data to the central database and for how such data are held and used.

23. These lessons have been applied to ScotEID research to-date on cattle EID and will continue to guide further development as the field trials progress. Results will be presented as they emerge.

Annex A: A summary comparison of LF and UHF transponder attributes

	LF (134 kHz)	UHF (860 - 960 MHz)	Comment
International Standards	ISO11784 ISO11785	ISO/IEC 18000-6C EPC Global Gen2 (V 1.2.0)	For consistency, ScotEID UHF hardware is programmed to comply with LF ISO standards for data storage and reading as well as the UHF technical standards.
Data capacity	112 bits (FDX) 128 bits (HDX) But limited to 64 bits (by ISO11784)	64 Bit Unique TID[10] 96-EPC[11] Bits (extendable to 480 Bits) 512 User Bits	UHF transponders have greater capacity for storing information, offering possibilities for passport and management uses. Although physical capacity of LF transponders is gradually increasing, LF ISO standards preclude the use of data storage beyond 64 bits. Speed of transfer is proportional to the frequency: any given amount of information takes longer to transmit using LF relative to UHF.
Data writing	Generally only by manufacturer/issuer	By issuer to TID & EPC By user to User Bits	Generally, users will not be able to write to LF tags. UHF tags have different areas of memory, some of which can be written to by users, others that are written to by manufacturers/issuers and then locked (e.g. for IDs). UHF offers security features whereas LF does not.
Data transfer speed	Slow	Fast	Data transfer speed (proportional to the frequency) affects how much information can be written to/read from a transponder. For example, the slower speed of LF makes it less likely that an animal will remain within the antenna field for sufficiently long to accommodate significant data transfers. Faster data transfer rates also increase the speed with which errors are detected and corrected, potentially increasing reading accuracy.
Reading multiple tags	No	Yes	The LF ISO standards specify that only one tag at a time can register in the field of the antenna. By contrast, the Gen 2 standard for UHF comprises anti-collision technology allowing multiple IDs to be read simultaneously. LF anti-collision is possible, but is not ISO compliant nor compatible with standard LF tags and readers (i.e. they cannot be mixed).
Reading distance	Less than a metre	Several metres	LF read distances are limited and close-quarter use of handhelds readers is often required. Even under challenging conditions, UHF read distances (aided by directional antennae) are greater than for LF and commonly extend beyond five metres under normal conditions. The performance of both technologies is influenced by the quality/configuration of transponders, antennae and readers.
Reading accuracy	Up to 100%	Up to 100%	Both technologies can achieve maximum accuracy, but the greater range and speed of UHF offers greater commercial reliability and convenience.
Typical cost	£2.20/cattle flag tag	£1.14/ cattle flag tag	Tag cost varies with quality and quantity. Hybrid tags cost around £2.67/tag

[10] The TID is a read-only number written to the tag's microchip by the chip manufacturer to authenticate the tag.

[11] The Electronic Product Code (EPC) is the universal identifier that provides a unique identity.