Precision Livestock Farming Technologies

I. Andonovic[1], C. Michie[1], P. Cousin[2], A. Janati[2], C. Pham[3], M. Diop[3]

[1] University of Strathclyde, UK
[2] Easy Gloabl Market, France
[3] University pf Pau, France

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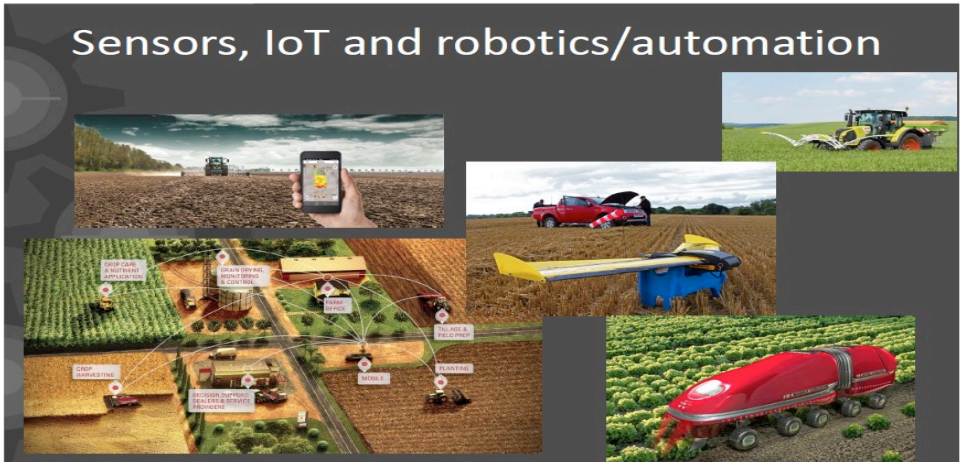
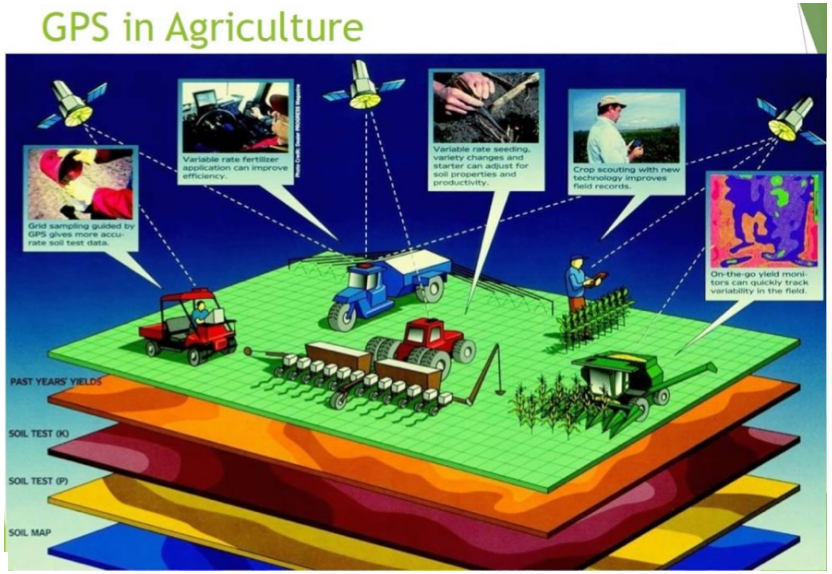
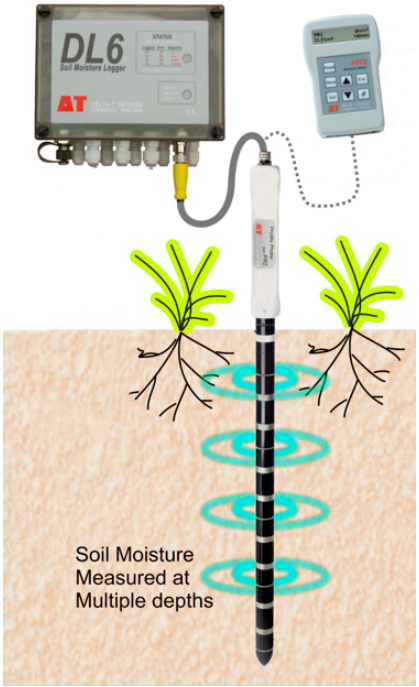
Prof. Congduc Pham
http://www.univ-pau.fr/~cpham
Université de Pau, France

ICT Agriculture & Farming



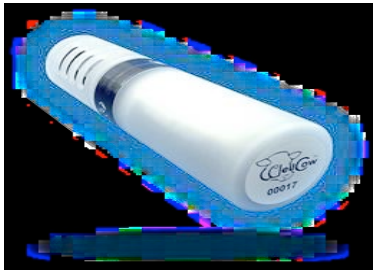


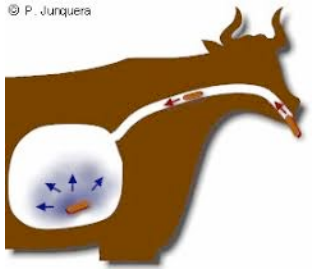


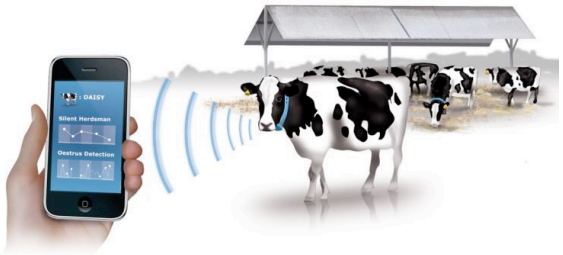
Challenges

- Agriculture
  - Competition for land, water and energy
  - Climate change
  - Yield increases of up to 50 %
  - Presently, 20-50% of some crops are wasted
- Farming
  - Pressure on Beef Farmers
    - volatile feed prices
    - 30% animal performance variation with feed
  - Dairy 13 billion litre milk annually
    - Falling milk price forced consolidation
    - farm sizes grown from 90 cattle to > 150

Internet of Cows ?







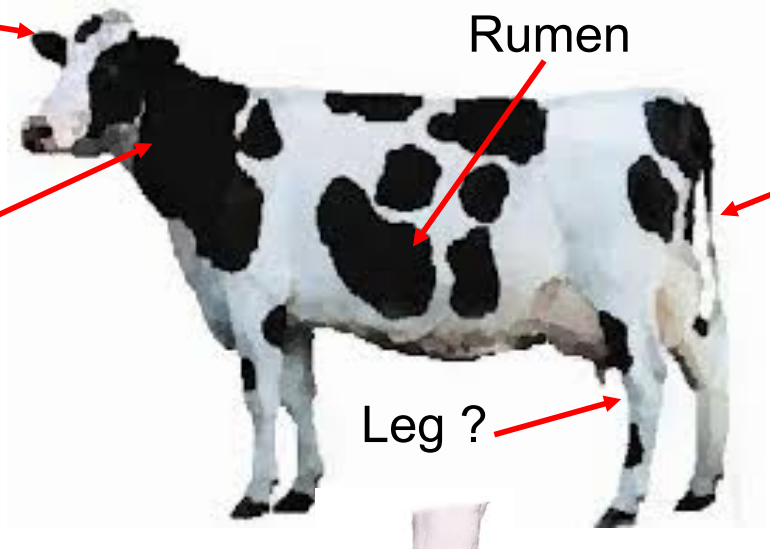
Ear ?

Rumen

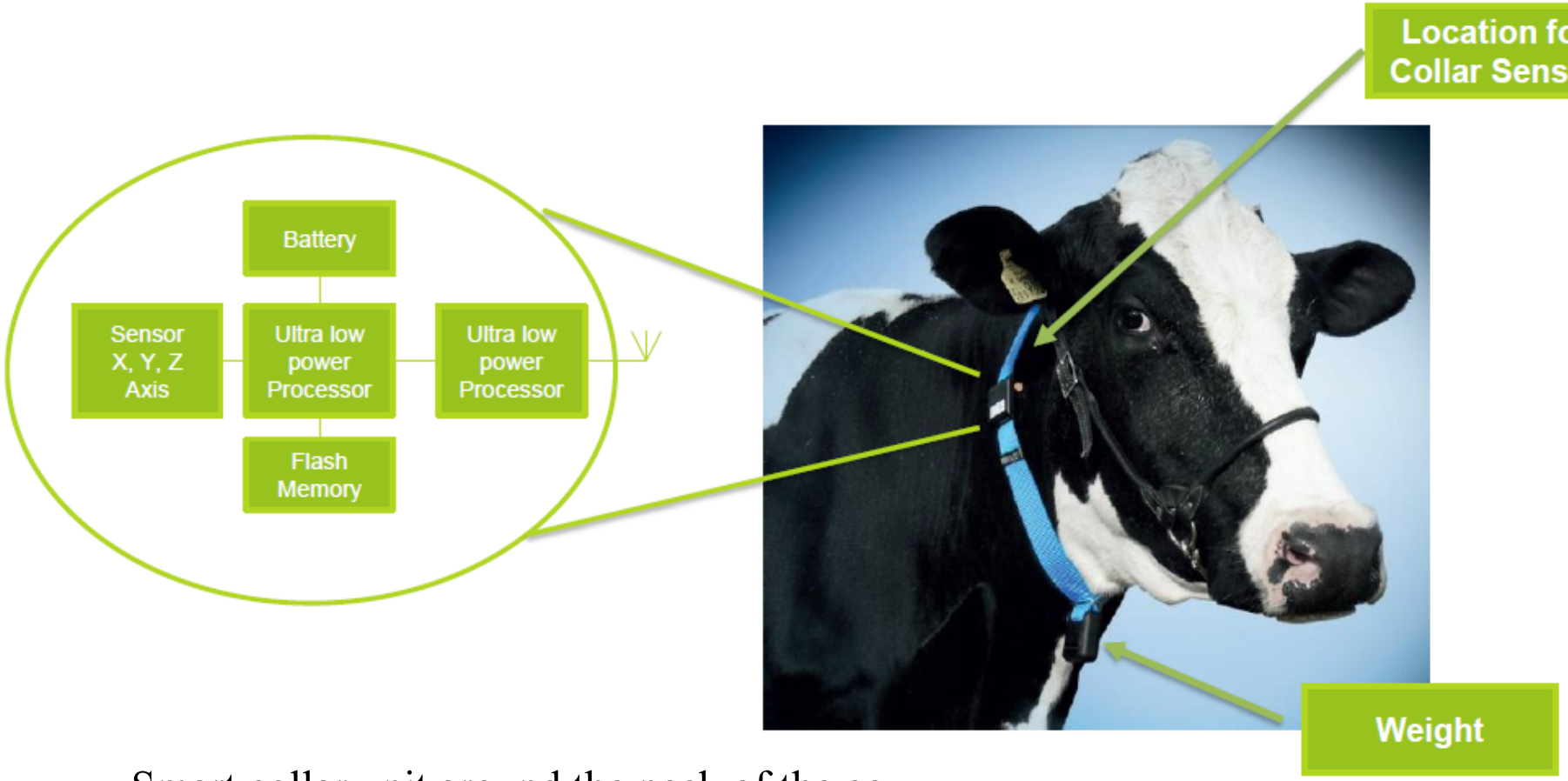
Tail ?

Neck ?

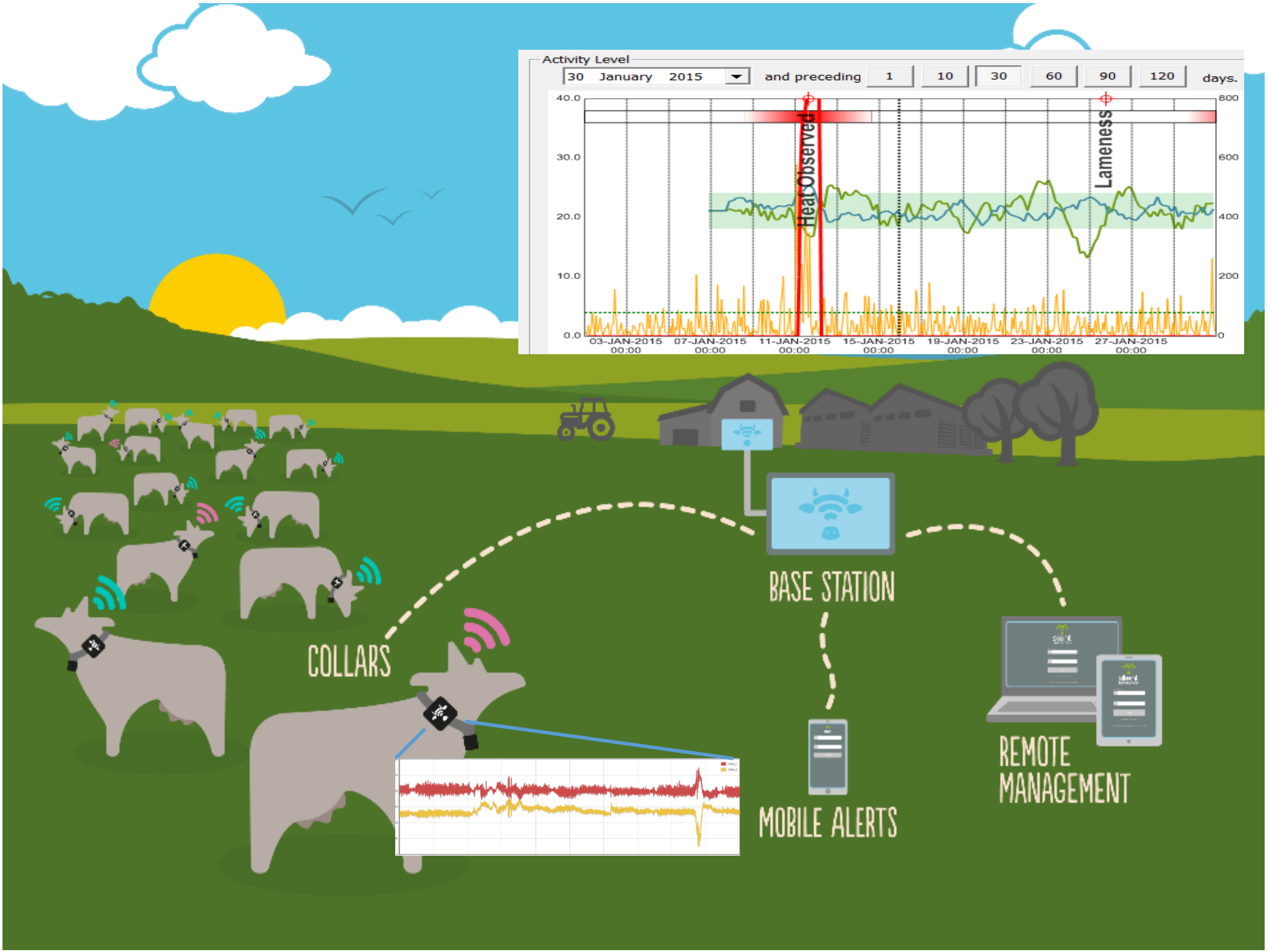
Leg ?



Investigating low-cost smart collar

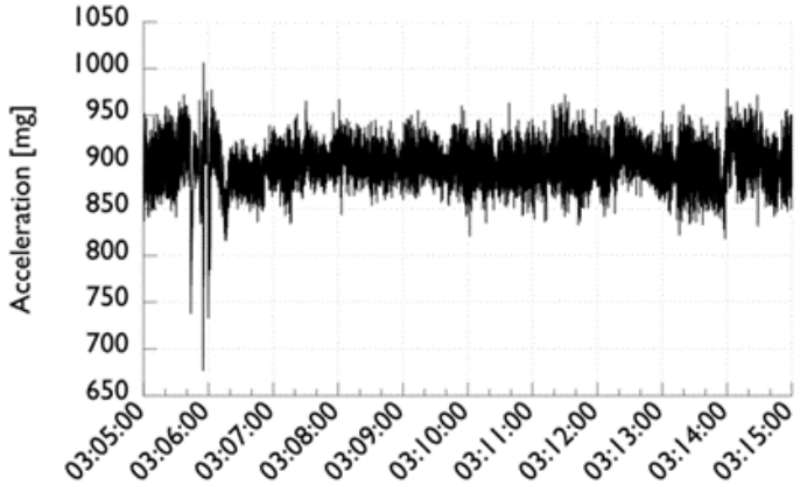


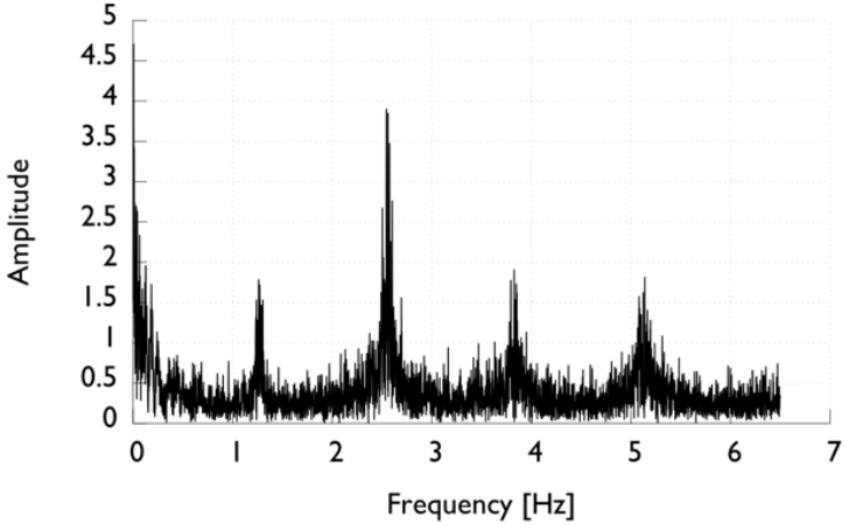
Smart collar unit around the neck of the cow which comprises a 3-axis accelerometer, processor, low power ZigBee wireless interface and two AA batteries.


Activity Level
30 January 2015
and preceding
1
10
30
60
90
120
days.
HeatObserved
Lameness
40.0
30.0
20.0
10.0
0.0
800
600
400
200
0
03-JAN-2015 00:00
07-JAN-2015 00:00
11-JAN-2015 00:00
15-JAN-2015 00:00
19-JAN-2015 00:00
23-JAN-2015 00:00
27-JAN-2015 00:00
COLLARS
BASE STATION
MOBILE ALERTS
REMOTE MANAGEMENT

Ruminating

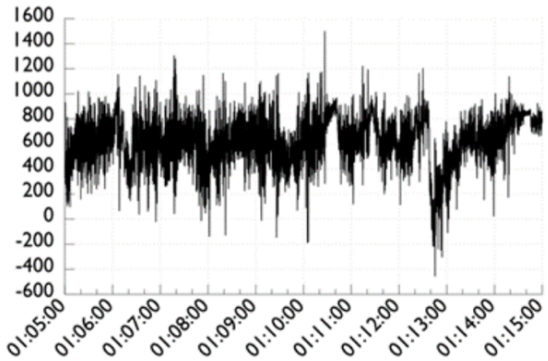
- Rumination signature is derived from estimating the variance and the frequency content of the accelerometer measurement
- Ruminating shows identifiable frequency peaks

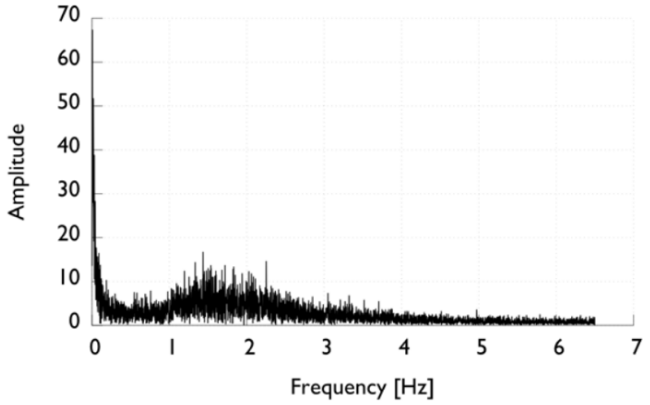




Eating

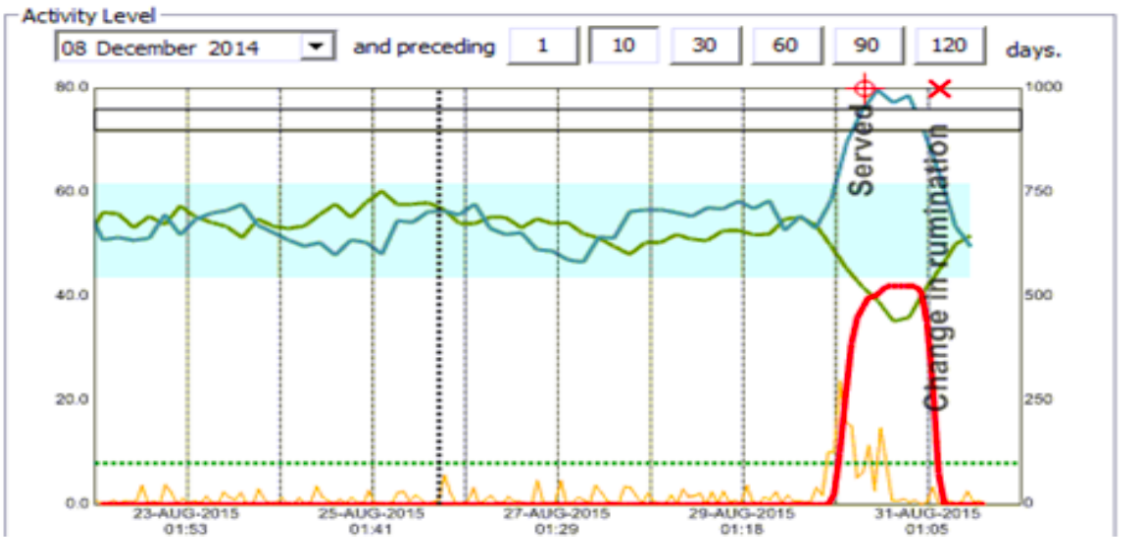
- During an eating phase, the cow has to tear the feed (e.g. grass) from the ground
- Consequently, the muscle motions observed on the neck are considerably larger
- The movements of the jaw are less rhythmic: the frequency components that are present during rumination are not observed



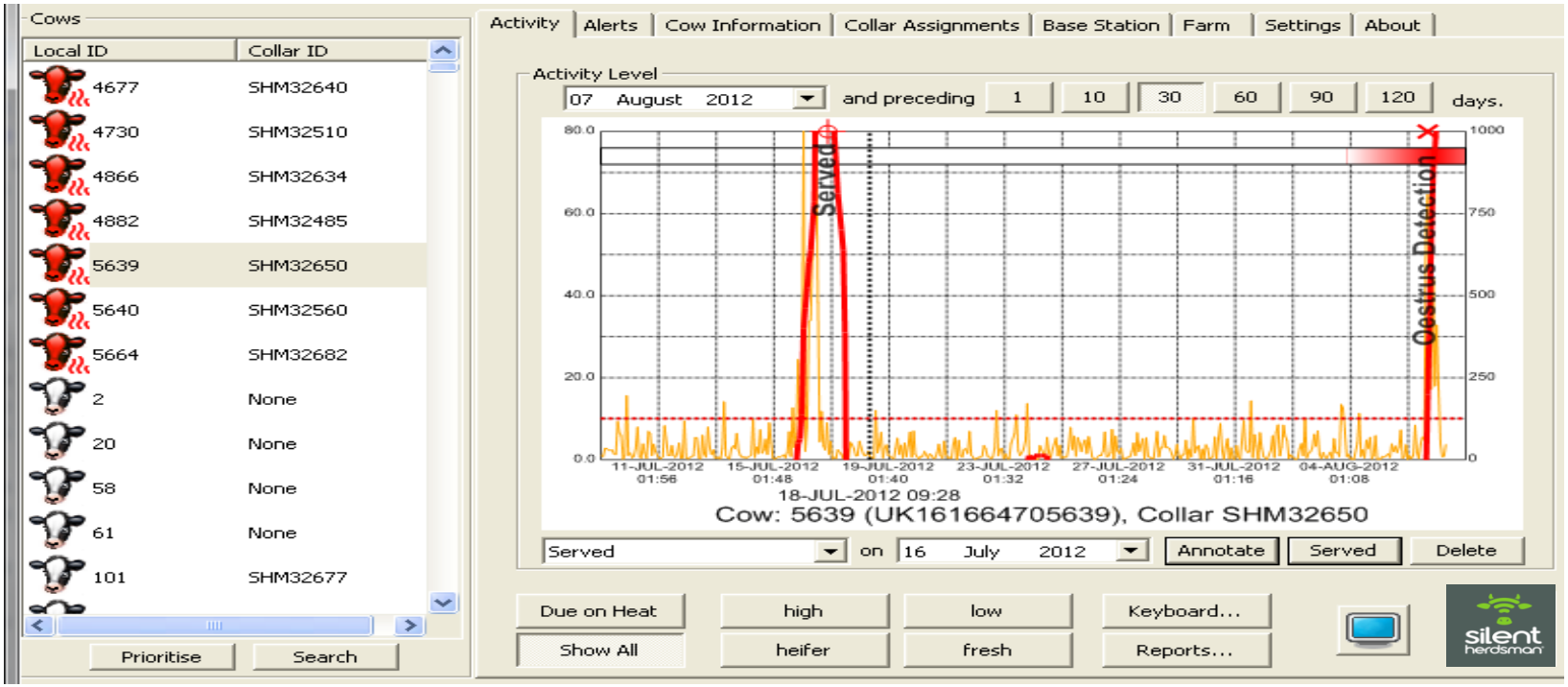


Activity detection and fertility (1)

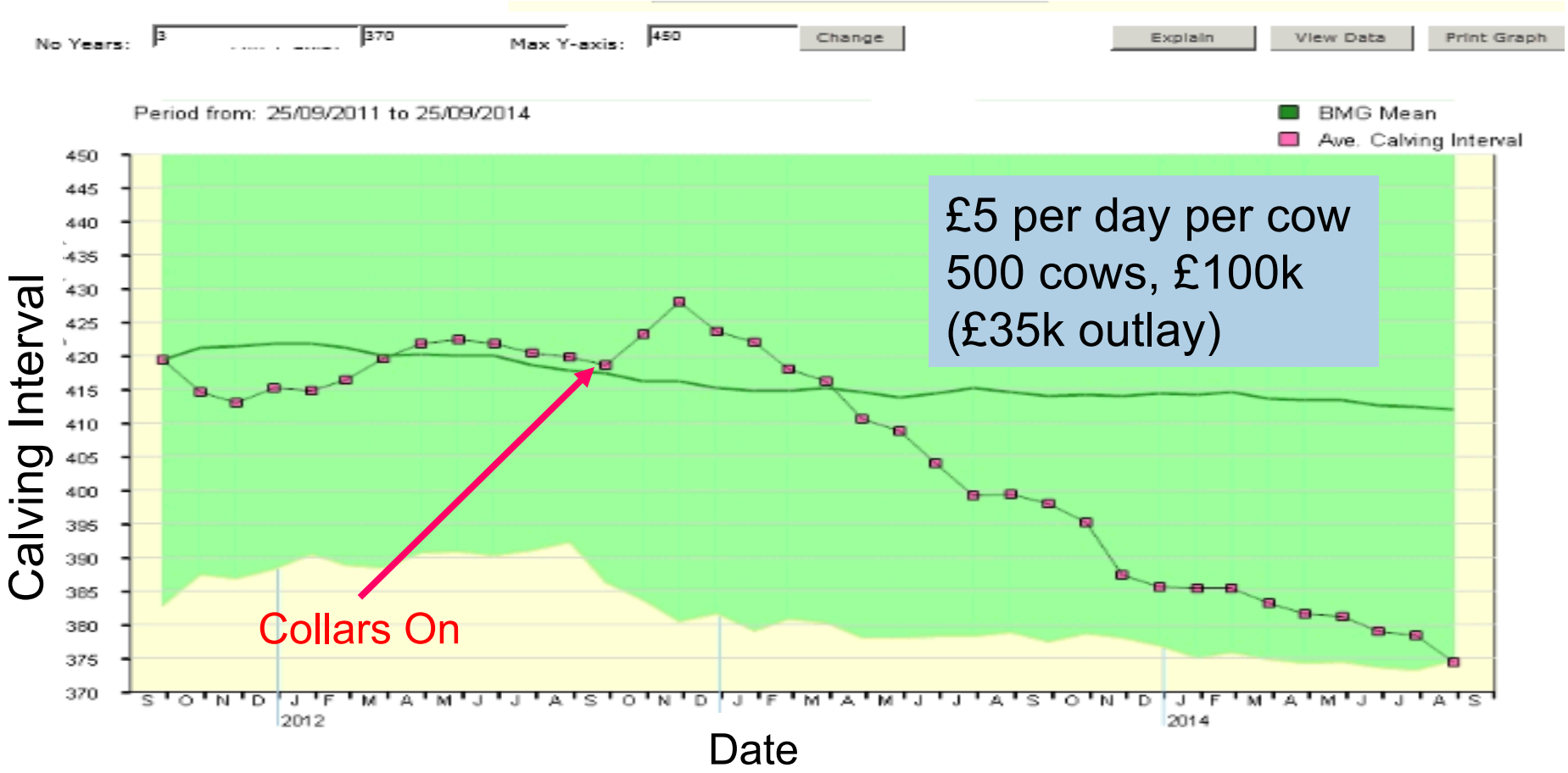
- As individual cows move into ‘heat’, their level of ‘restlessness’ increases and hence the variation in activity rises
- the ‘green’ trace is a measure of time the cow spends ruminating compared to the average rumination time for the past week



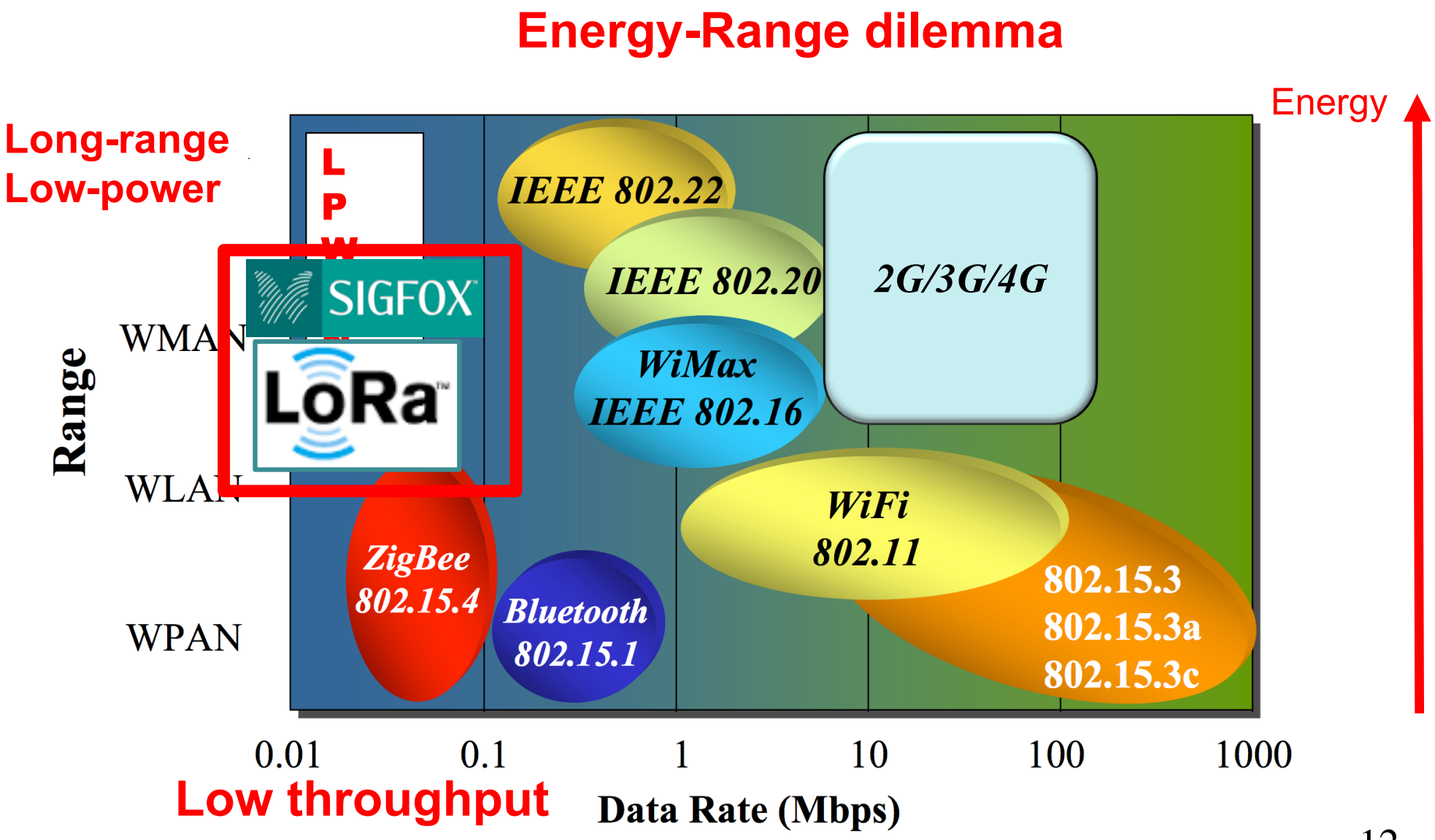
Activity detection and fertility (2)



Payback to farmer



Extending to low-power & long-range radio technologies (LPWAN)



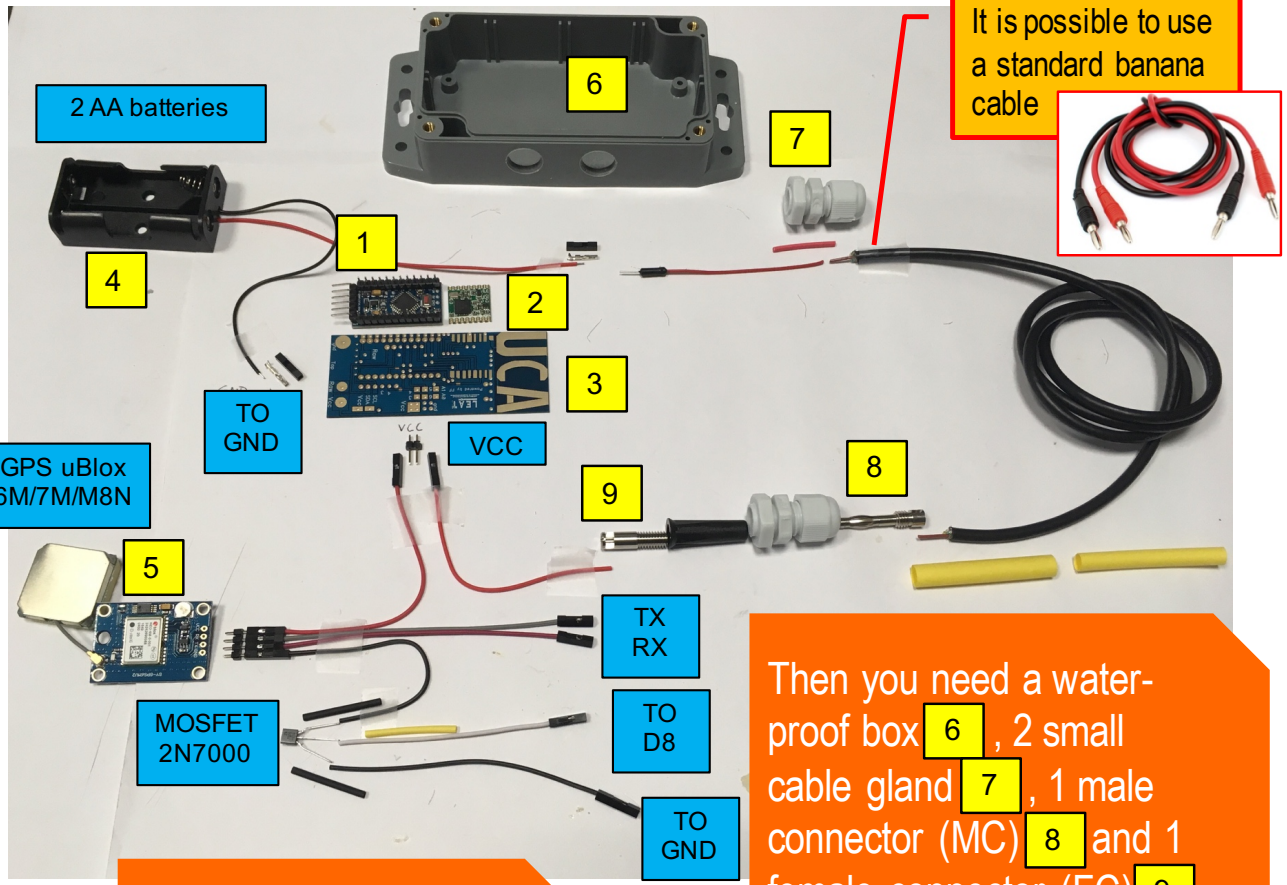
Low-cost, DIY, generic GPS device

2 AA batteries 4 will power the board with an autonomy of several months

An optional GPS module can be added 5

Use an Arduino Pro Mini 3.3v at 8MHz 1

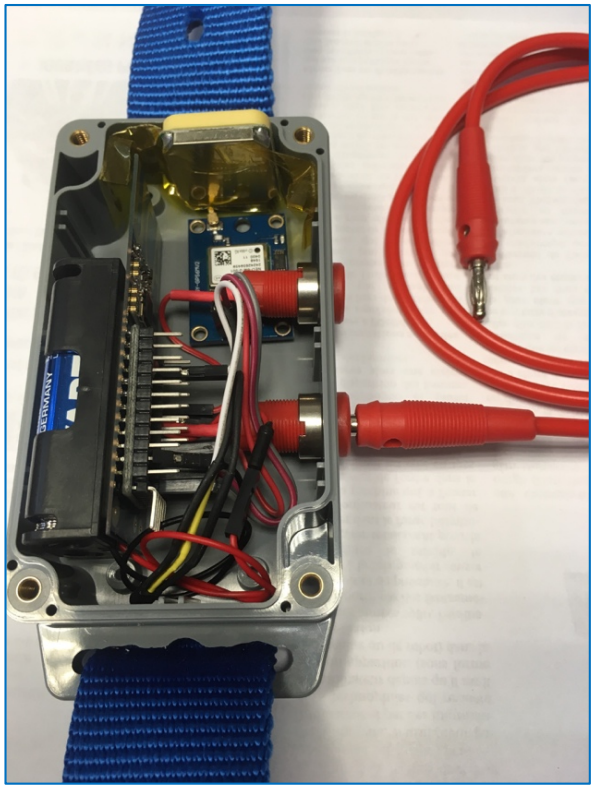
Radio module is an RFM95W 2

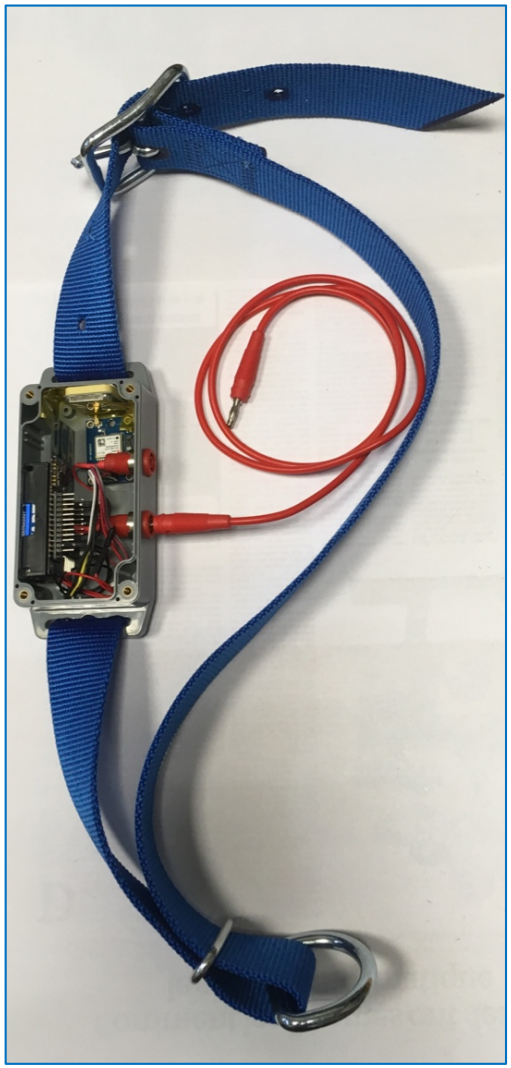


A PCB with integrated antenna will be used 3

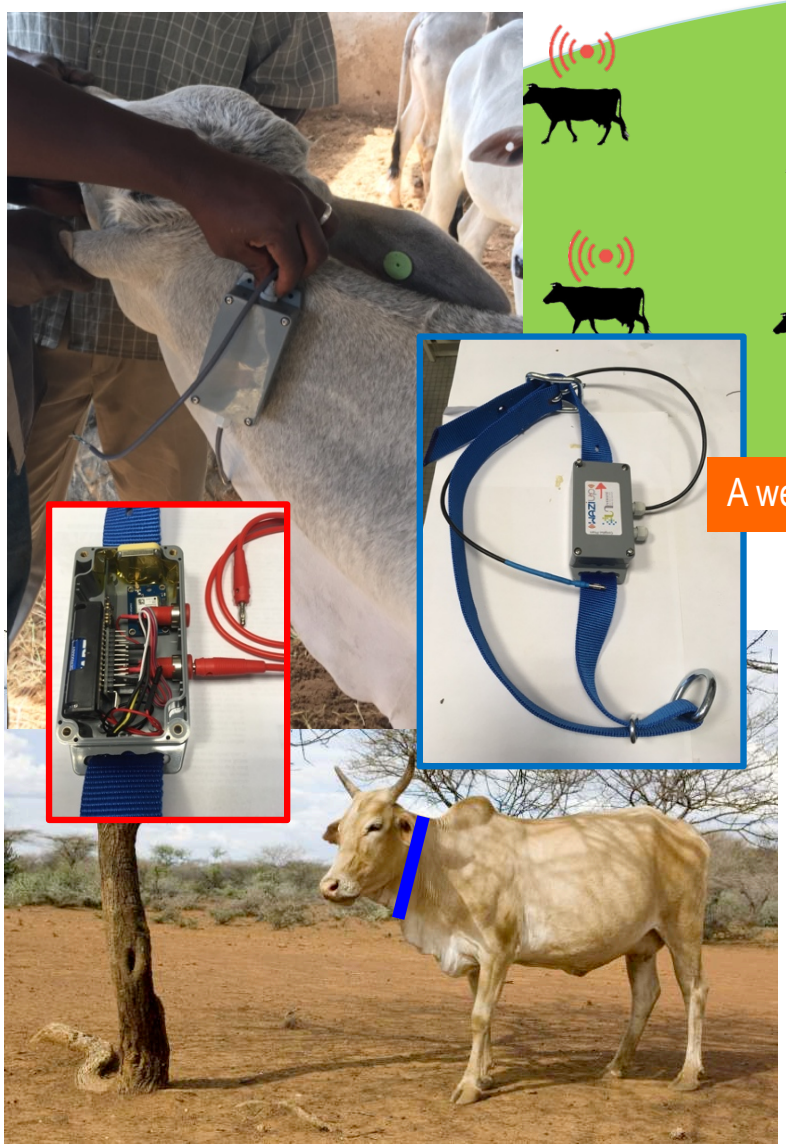
Then you need a water-proof box 6, 2 small cable gland 7, 1 male connector (MC) 8 and 1 female connector (FC) 9

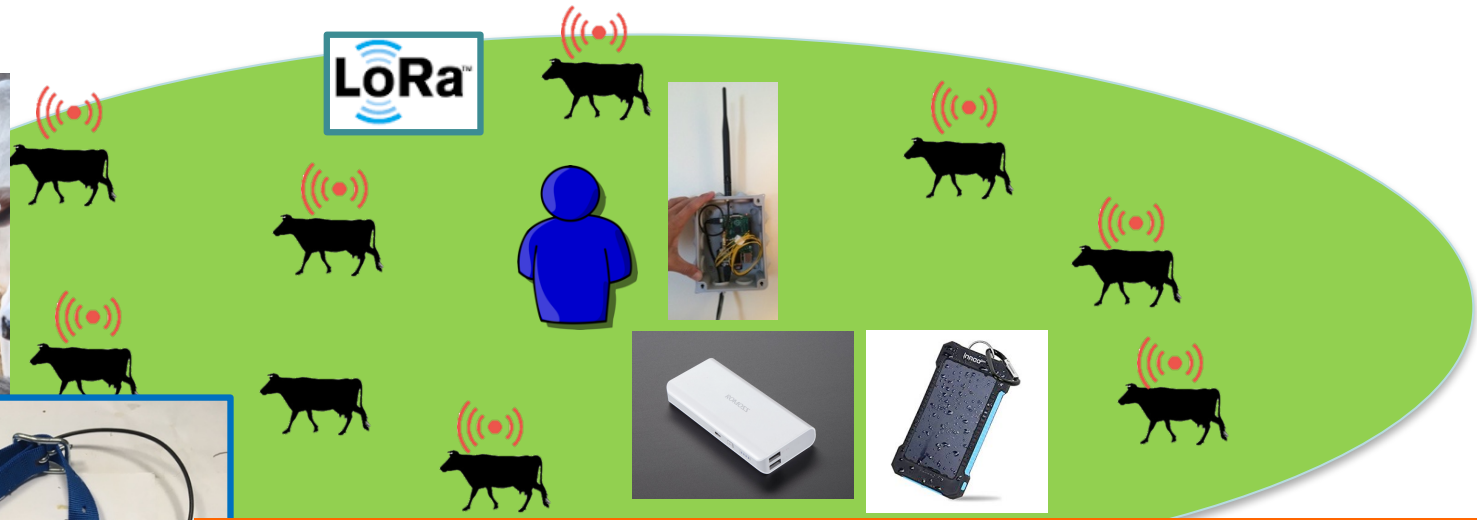
The low-cost GPS collar



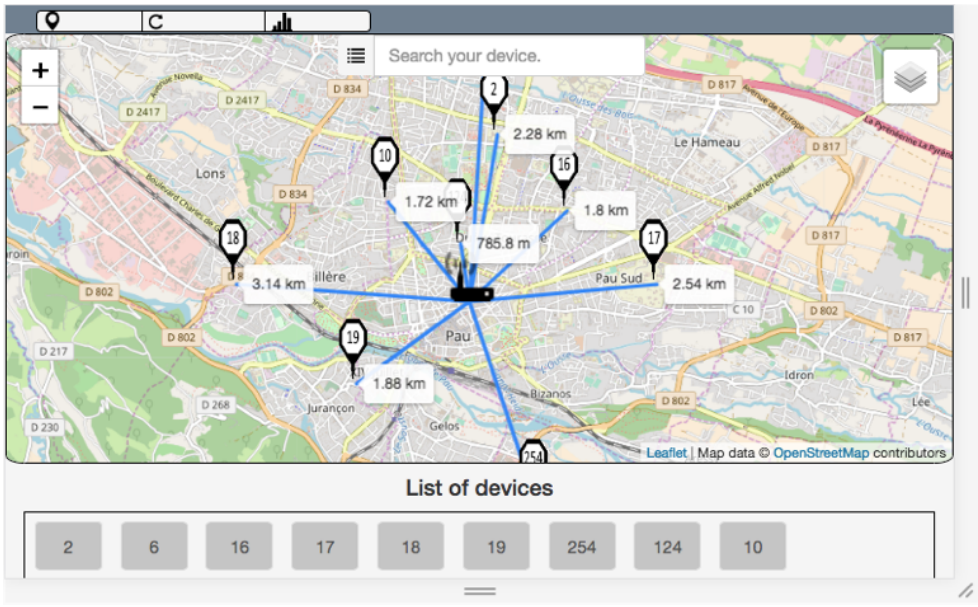


Localization/Cattle Rustling





A web interface displays the position of the gateway those of the remote GPS devices



Conclusions

- Precision Livestock Farming will be generalized in the next few years
- Experiments with low-cost collar
- Simple accelerometer data can be used to derive cattle's activity and detect relevant events with appropriate analysis
- Adding long-range radio technologies can extend the collar's features to a larger variety of remote monitoring applications: detecting predator attacks, identifying hunting situations,…
- With GPS, near real-time localization can be used for cattle rustling applications

Enabling data to be compressed