

Large scale sensor data logistics for Smart Dairy Farming

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TNO

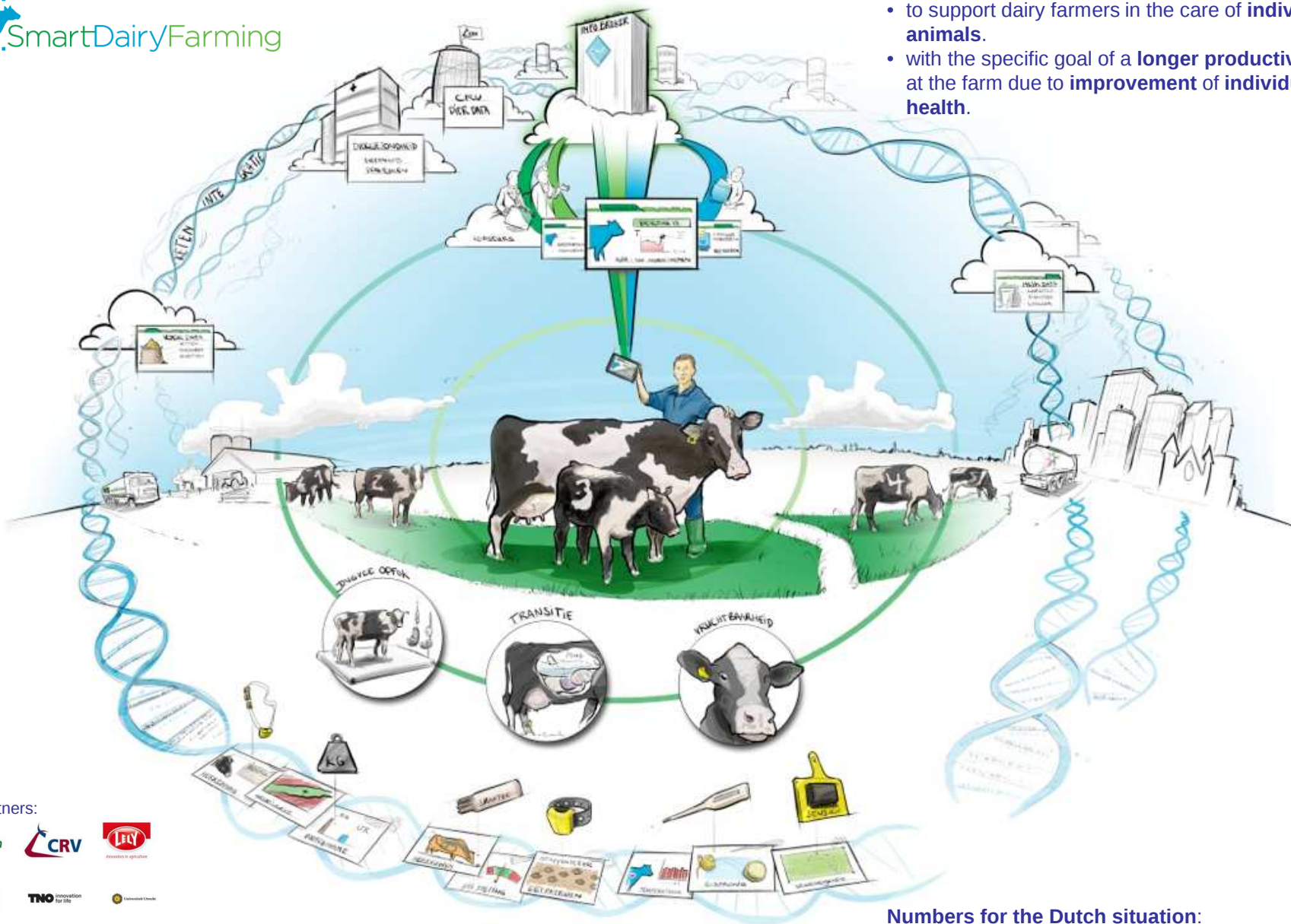
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- to support dairy farmers in the care of **individual animals**.
- with the specific goal of a **longer productive stay** at the farm due to **improvement of individual health**.



A collage of logos for various agricultural and research organizations, including Agrifirm, CRV, Lely, Wageningen University & Research, TNO, VHL, smaxtec, SAS Systems, rolvecom, accosavm, Dairy Partners, and Nutrifeed.









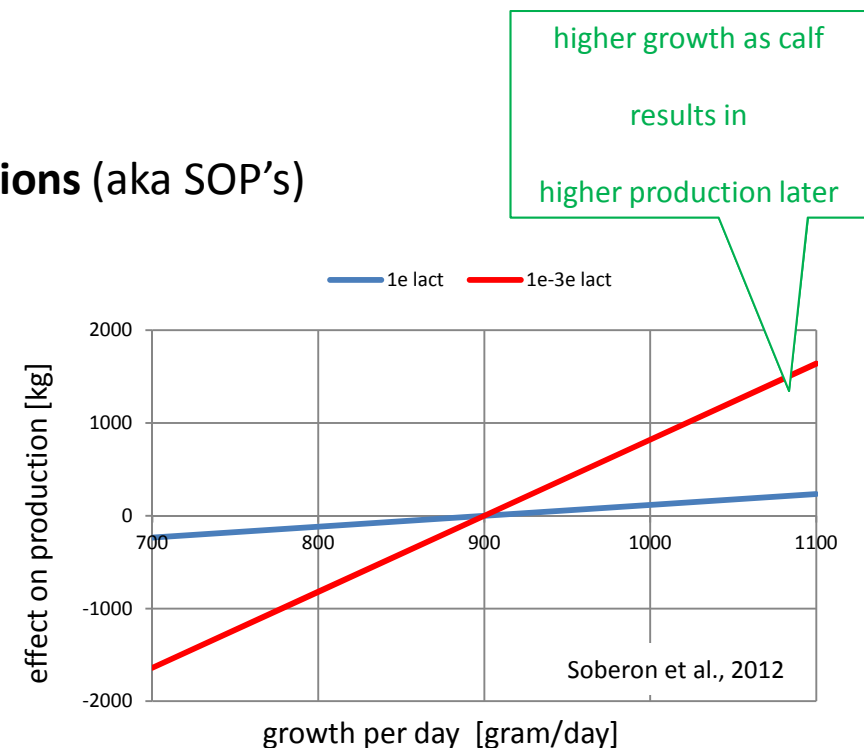



- 18000+ farmers
- in total more then 1.5 million cows
- 20 to 200+ datafields per cow
- many different stakeholders in the chain

Support dairy farmers in the care of individual animals



- SDF provides support on **3 specific theme's**
 - Young cattle
 - Transition period
 - Fertility
- Support is given with **work instructions** (aka SOP's)
 - based on **sensor data**
 - e.g. weight, multiple times per day
 - in **(near) real time**
 - e.g. within 5 min. after measuring
 - for a **specific cow**
 - use unique life numbers
 - a **specific instruction** is given
 - e.g. "give this calf more milk, because it does not grow according to ideal curve"



SDF - starting points



- The cow is key: “**cow centric** data”
 - model the cow and not the measuring device, e.g.
 - ask the specific cow C for the weight W at time T
 - versus: ask all (!) scales $S1-Sn$ if they know the weight W for cow C at time T
 - (sensor) data stays connected to the cow
 - also when the cow changes farm
- The **farmer is in control** (in Dutch: “boer aan het roer”)
 - he is owner of the cow related (sensor) data
 - and decides if he carries out the work instruction (or not)
- Result is an **open platform** / solution
 - with open interfaces
 - where all farmers, all suppliers and all service providers could connect

IT-challenge: upscaling

- Project
 - 7 farmers
 - with 100 – 350 cows each
 - 20+ different sensor systems (with 200+ different datafields)
 - 3 models
 - some standards (on static data); almost no standards on sensor data

upscaling

- The Netherlands
 - 18000+ farmers
 - totally > 1.5 million milkcows
 - xxx different sensor systems (yyy different fields)
 - lots of potential new models (existing or new companies)
 - from no standards to a lot of standards

upscaling

- Other places in the world
 - ...

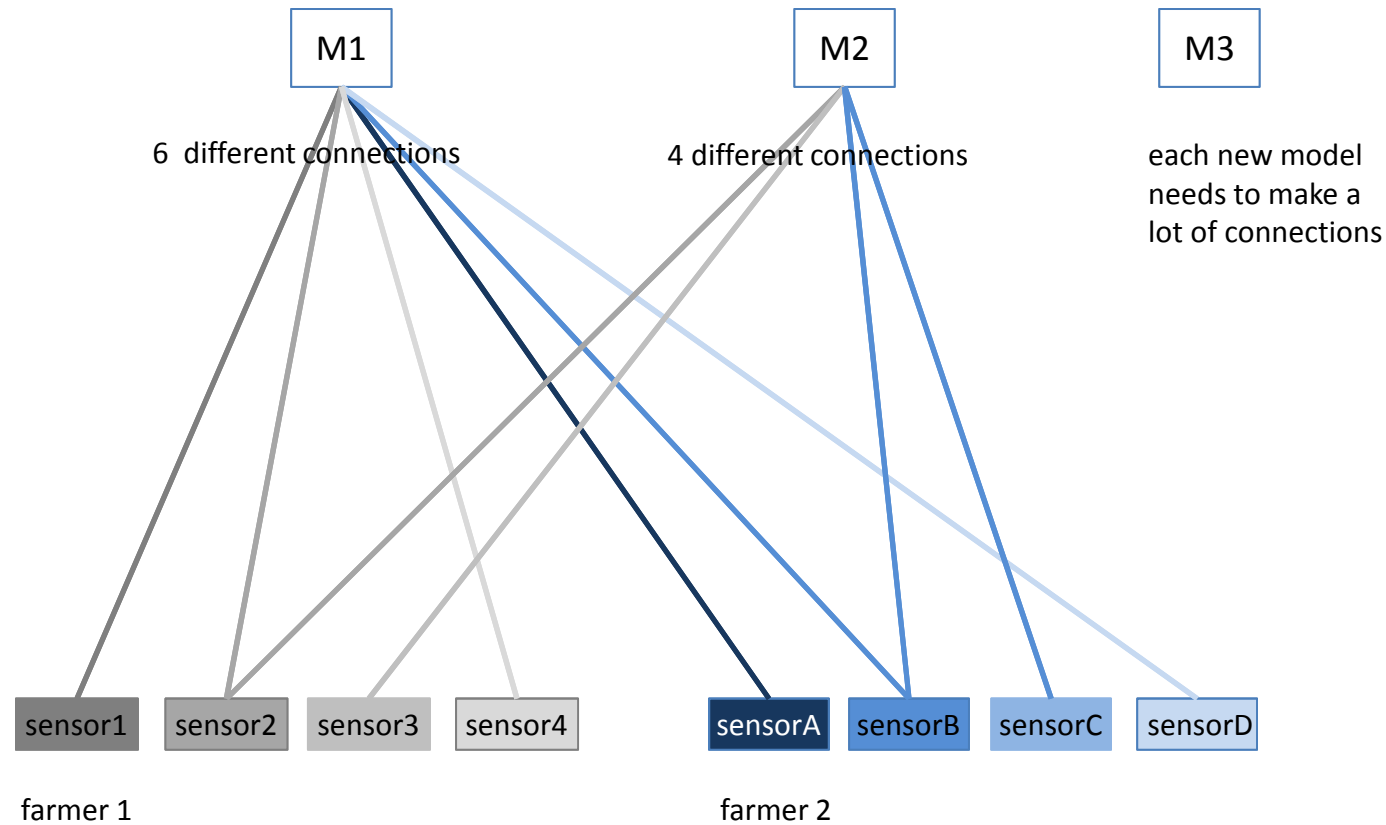
Role for TNO:

Help with the architecture / vision
on Large Scale Sensor Data
Logistics

Our motto:

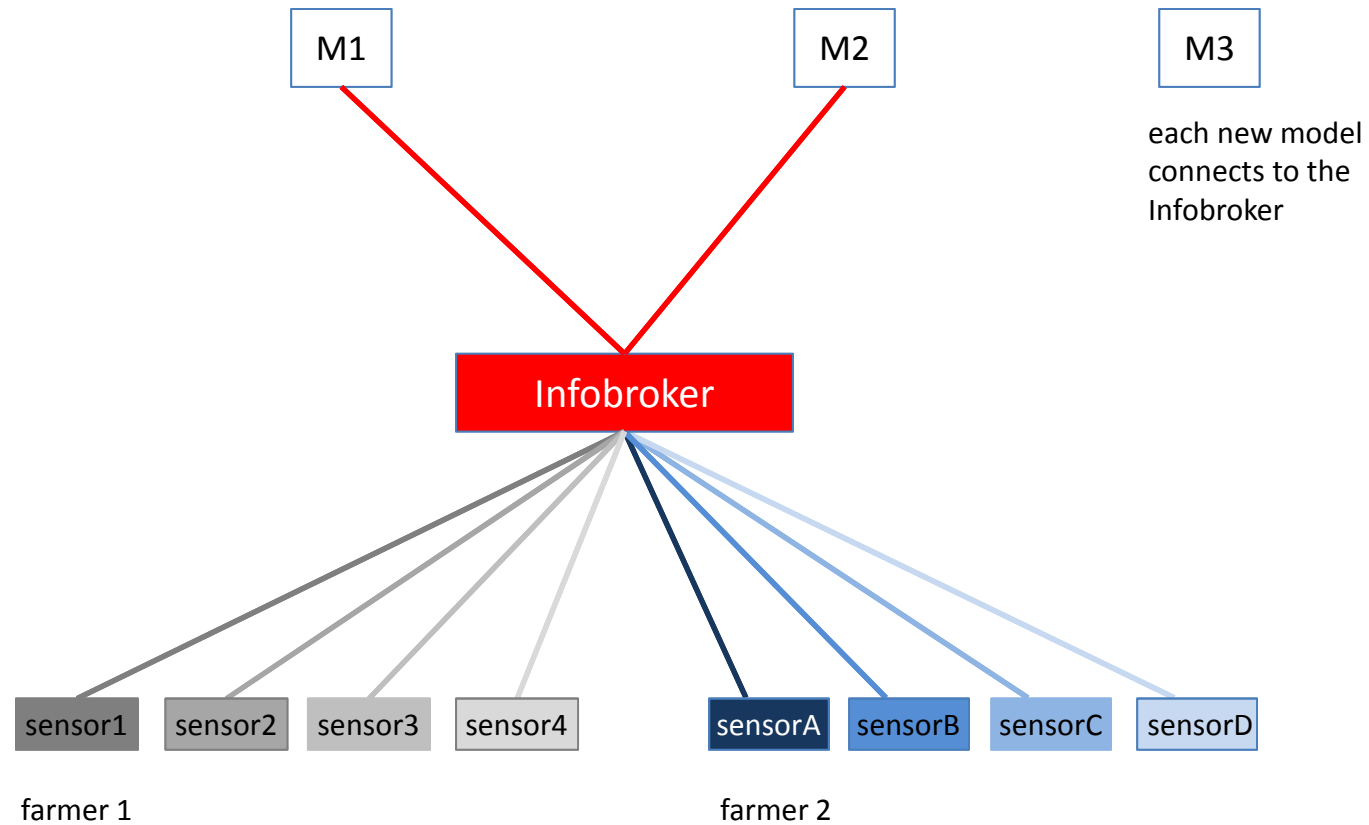
“Think big, start small”

Current / traditional way (example)

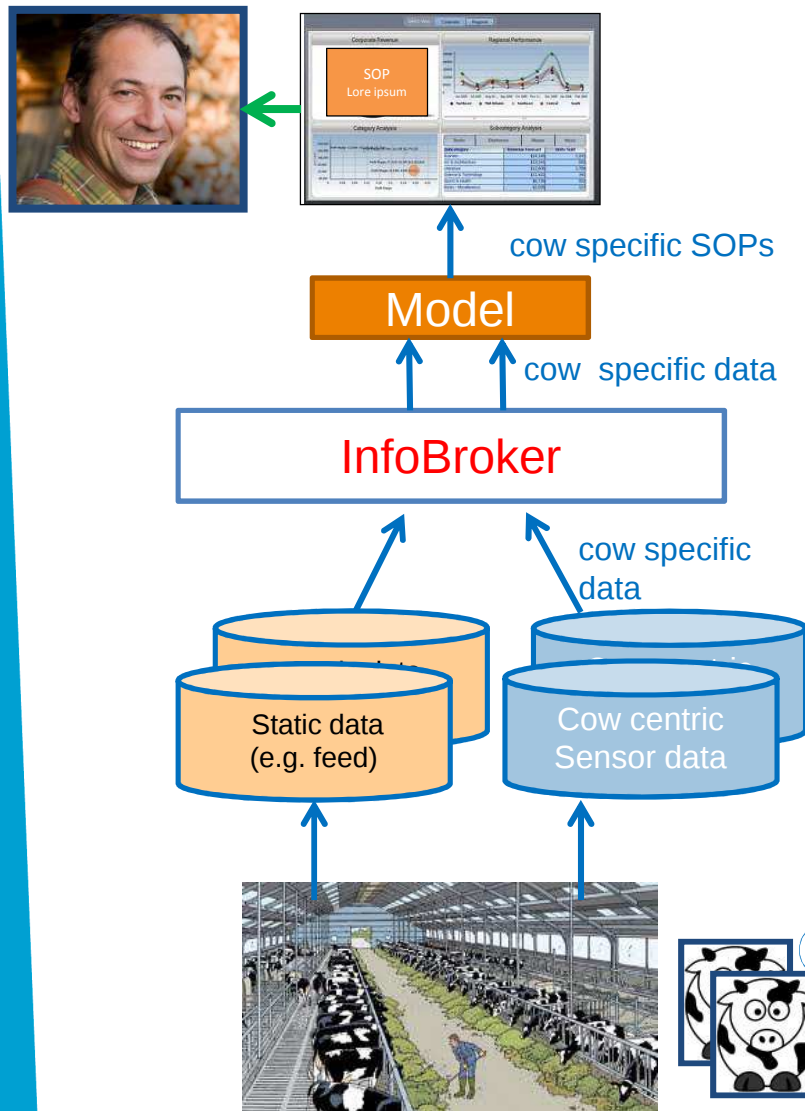


Note: Next to the physical connections also the permissions have to be arranged
Per farmer, per sensor system for each model (nowadays : manually)

2. Large Scale Sensor Data Logistics: InfoBroker



SDF Infobroker concept



Infobroker functionalities

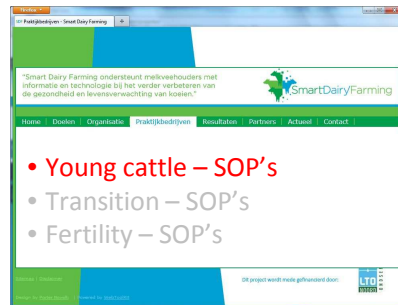
- Open interfaces for data exchange (API)
 - Authentication
 - who are you (are you allowed to login)
 - Permissions
 - which data may be used by whom
 - to be set by the farmers
 - Namingservice
 - location where the data can be found
 - static data
 - cow-centric sensor data
 - Integration
 - combining info from different sources
 - Pay-per-use
 - fixed costs (connections)
 - variable costs (used data)
- So:
- no central datastore for (sensor)data!
 - but indeed a broker
 - which re-uses available (standard) interfaces
 - and reduces/prevents duplication

3. Impression of SDF-demonstrator

Farmer: Dairy Campus

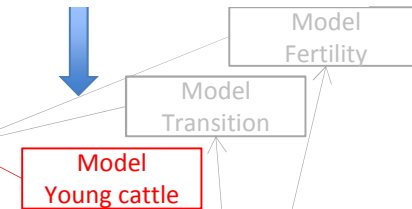
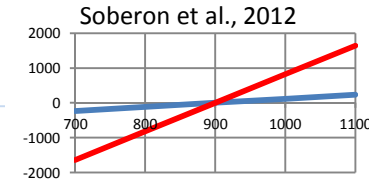
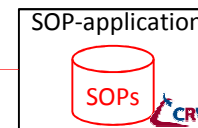


Dashboard

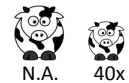


SOP-generation by models

Speenschema aanpassen
Krachtvoer aanpassen
Ruwvoer aanpassen
Pink insemineren
Kalf/pink behandelen
Voeradvies inwinnen
Selecteren voor afvoer



Datacollection on the farmer



Milk intake
RFID 2x



Weight
4x



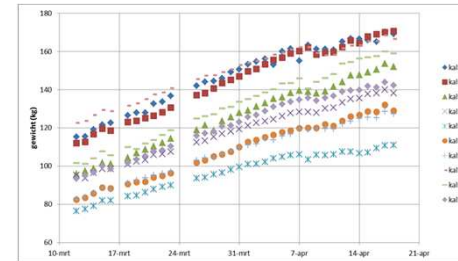
RFID 4x

Water intake
4x

Dairy Campus
laptop

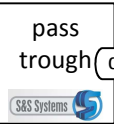
loggers
6x

Sensor data logistics



```
life_number, sensor, date_time, wcorr, wstable, wzero, wavg, wavgmin, wavgmax, werrors, wnousecounter, wnousestime, wusetime
NL 916075572, dc_roostervloerhok1_weegschaal1, 2013-11-04 04:18:35 UTC, 129.0, 129.0, 0.0, 102.3, 30.8, 129.0, 0.0, 470, 18590
NL 916075572, dc_roostervloerhok1_weegschaal1, 2013-11-04 04:18:40 UTC, 129.5, 129.5, 0.0, 129.6, 129.5, 130.0, 0.0, 475, 18590
NL 916075572, dc_roostervloerhok1_weegschaal1, 2013-11-04 04:18:45 UTC, 130.0, 130.0, 0.0, 129.5, 129.0, 130.0, 0.0, 480, 18590
NL 916075572, dc_roostervloerhok1_weegschaal1, 2013-11-04 04:18:50 UTC, 130.0, 130.0, 0.0, 129.8, 129.5, 130.0, 0.0, 485, 18590
```

Forster.csv

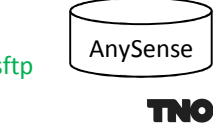


Match & Merge

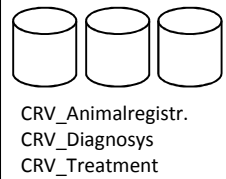
RFID -> lifenr

milkintake.csv
weight.csv
waterintake.csv

Realtime cow
centric sensor data



Static data



InfoBroker



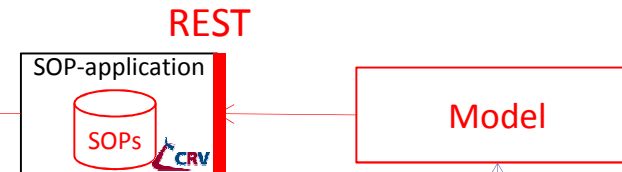
Koppelvlakken



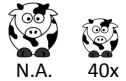
Dashboard



SOP-generation by models

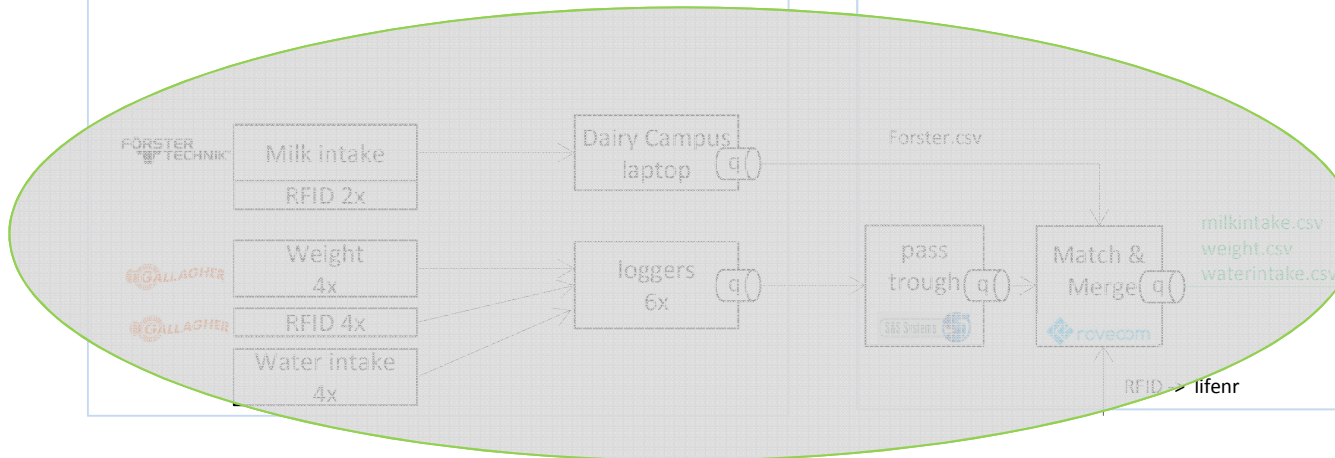
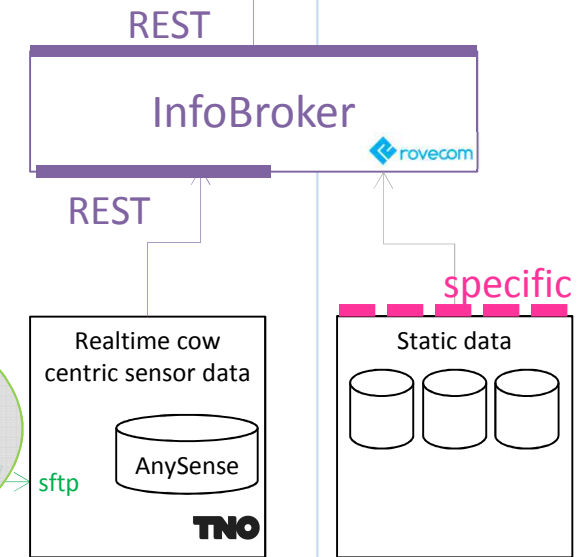


Datacollection on the farmer



Tijdelijk voor het project (Proof of Concept)

Sensor data logistics



InfoBroker REST interface (concept version)



Resources

- [Animal](#)
 - [Get animals](#)
 - [Get animal ID](#)
 - [Create animal](#)
 - [Update animal](#)
 - [Delete animal](#)
- [Property](#)
 - [Get properties](#)
 - [Get property values](#)
 - [Create property](#)
 - [Update property](#)
- [Source](#)
 - [Get sources](#)
 - [Create source](#)
 - [Update source](#)
 - [Delete source](#)

Get property values

GET /animals/1/properties/1/values.json

Parameter	Description
after	Unix time.
before	Unix time.

Response 200

```
{"2013-02-25 05:16:24 +0100":12.3,"2013-02-25 05:17:45 +0100":10.59}
```

Exception response ¹ 404

```
{"error":"Couldn't find Animal with id=1"}
```

Exception response ² 404

```
{"error":"Couldn't find Property with id=1"}
```

4. Wrap up and next steps

- Large scale sensor data logistics for Smart Dairy Farming
 - Cow –centric
 - measurements on individual cow level
 - individual SOP's (work instructions)
 - Farmer in Control
 - decides on what to do with SOP's
 - permissions to be set via the InfoBroker
 - Scalable architecture
 - from 7 up to 18000+ farmers
 - using InfoBroker concept with an open API
- Next steps
 - Finalize and test models/work instructions
 - Complete and test InfoBroker
 - Make (near) realtime models
 - SDF foundation for exploitation of InfoBroker after project

5. Discussie punten 1/2

Waar moet de sensor data komen te staan?

- bij de boer (wie beheert de IT?)
- bij de sensor leverancier (wil de boer dat?)
- bij een 3rd party (en wie dan?)
- hybride

Standaardisatie van de sensordata

- manier van meten en manier van vastleggen
 - bijv: “activiteit”

Hergebruik deze infrastructuur voor andere toepassing bij veehouders

- verlagen regeldruk/administratieve handelingen/...
- hoe kunnen de veehouders de data gebruiken om voor “borstklopperij”
 - kijk eens hoe goed ik /wij

Andere data-afnemers:

- wie wil er (tegen betaling) data afnemen en wat gaan ze dan doen

5. Discussie punten 2/2

Andere bronnen

- welke (statische) bronnen zouden zinvol gekoppeld kunnen/moeten worden?

Toepasbaarheid in andere deelsectoren met dieren

- met unieke dier-identificatie
 - paarden, varkens, schapen, geiten..
- zonder unieke dier-identificatie (is het dan bruikbaar?)
 - kippen, eenden, ...

Thank you for your attention



Questions? & Discussion!

This project is made possible by :



Ministerie van Economische Zaken,
Landbouw en Innovatie

