university of groningen

REAL-TIME

FARMVOLUTION

MONITORING

Smart Livestock Solutions

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Contents

System Overview

Farmvolution

- Is the complete automated solution for livestock production and management
- Help farmers manage animals by providing dependable information to make operational and strategic decisions
- Health monitoring and management for cattle and pigs

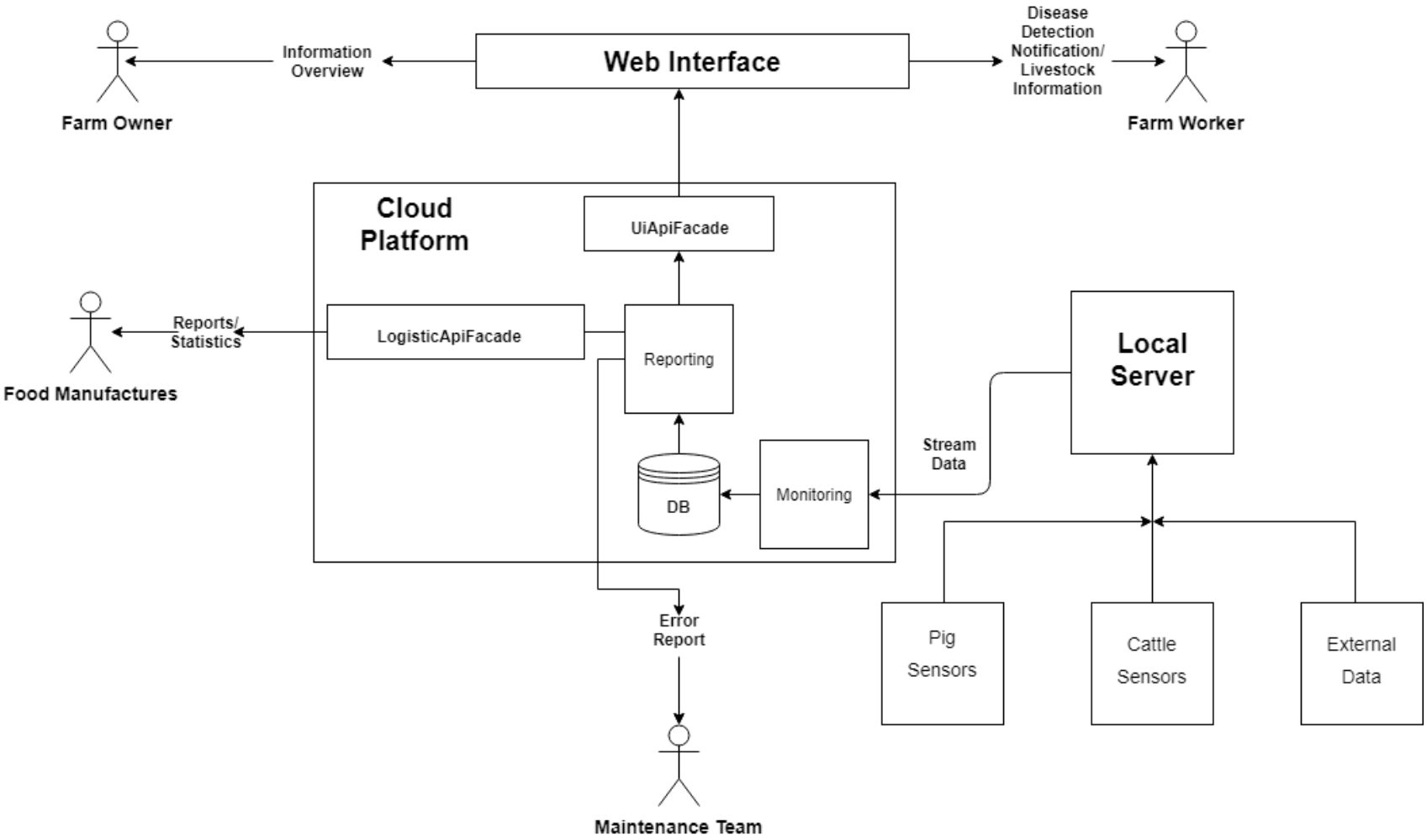
Actors

- Farm Worker
- Farm Owner
- Food Manufactures
- Maintenance Team

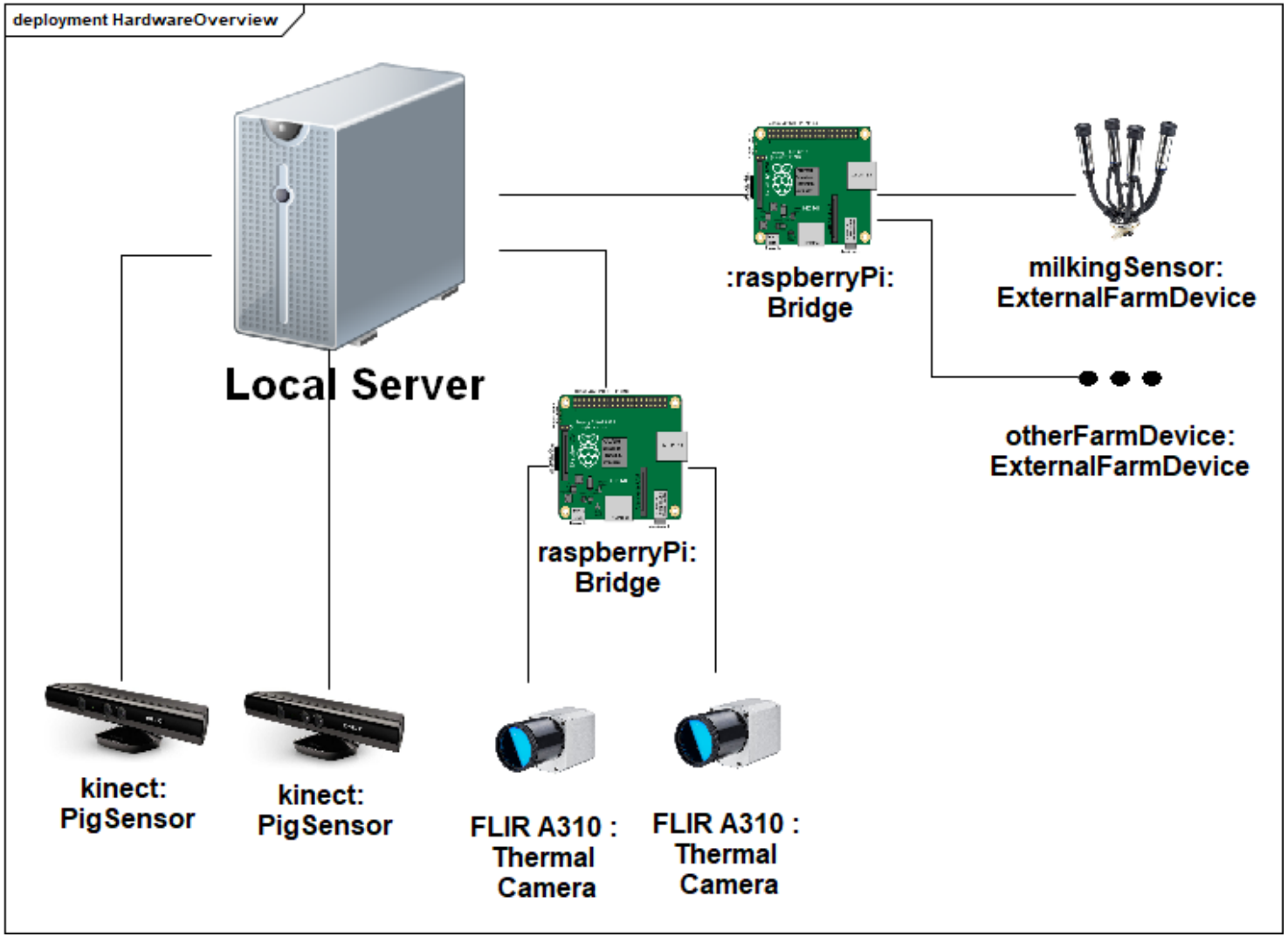
Components

- Pig Sensors
- Cattle Sensors
- External Data
- Local Server
- Database
- Monitoring
- Reporting
- LogisticApiFacade
- UiApiFacade
- WebInterface

System Architecture
System Model



Hardware Architecture
Hardware Overview



2 types of sensor arrays:

- Kinect v2 for pigs
- 2x FLIR A310 for cattle

Pig setup produces an order of magnitude more data than the cattle setup

Hardware Architecture
Sensor specifications

Kinect v2

- 1920x1080 BGRA video @ 30 fps
- 512x424 depth sensor @ 30 fps
- 4 channel audio with 32 bit samples @ 16000HZ

FLIR camera

- 320x240 RGB video @ 30 fps
- periodic measurements, twice per cow per day
- single measurement takes 2-3 seconds on average, and 10 seconds at most.

Hardware Architecture
Network requirements

For Pigs

- Typically 10-15 pigs per unit
- Peak bandwith of 260 MB/s
- Average bandwith of 120 MB/s
- Around 12 MB/s after compression

For Cows

- Peak bandwith of 13MB/s
- 5 MB/s after compression

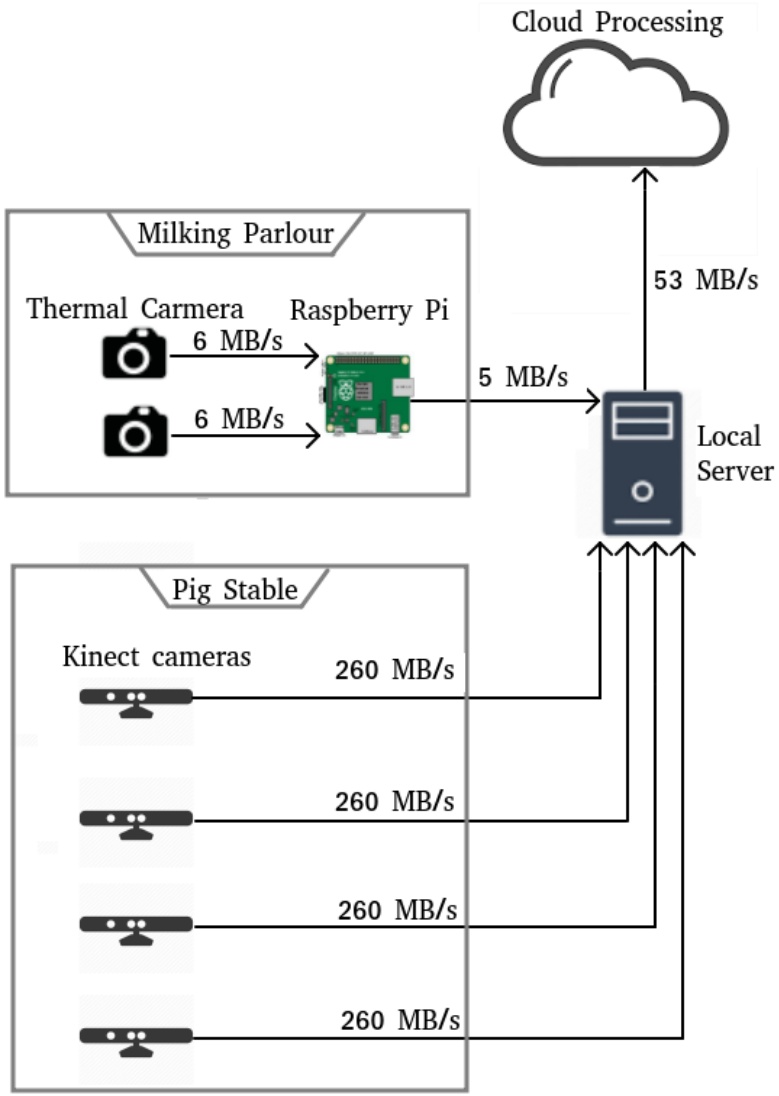
Maximum storage required for buffering for 24 hours:

- 165 TB of storage per pig farm
- 6 TB of storage per cattle farm

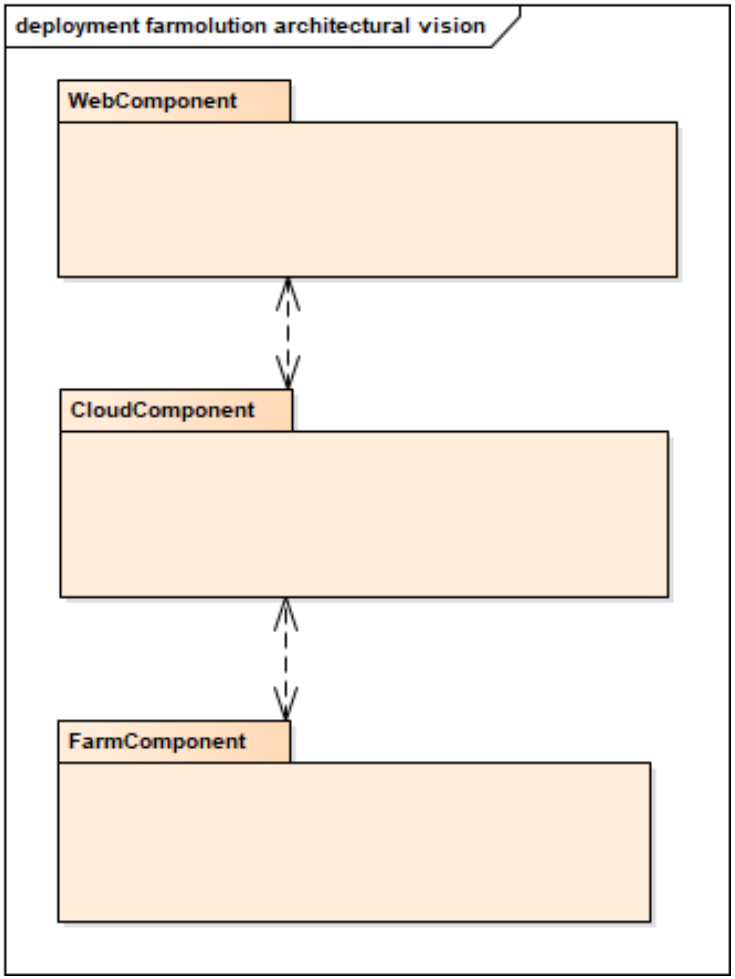
Core i7-6700K CPU @ 4.0GHz can compress 500MB/s using gzip.

Hardware Architecture

Data flow rates for example setup



Software Architecture
Overview of components



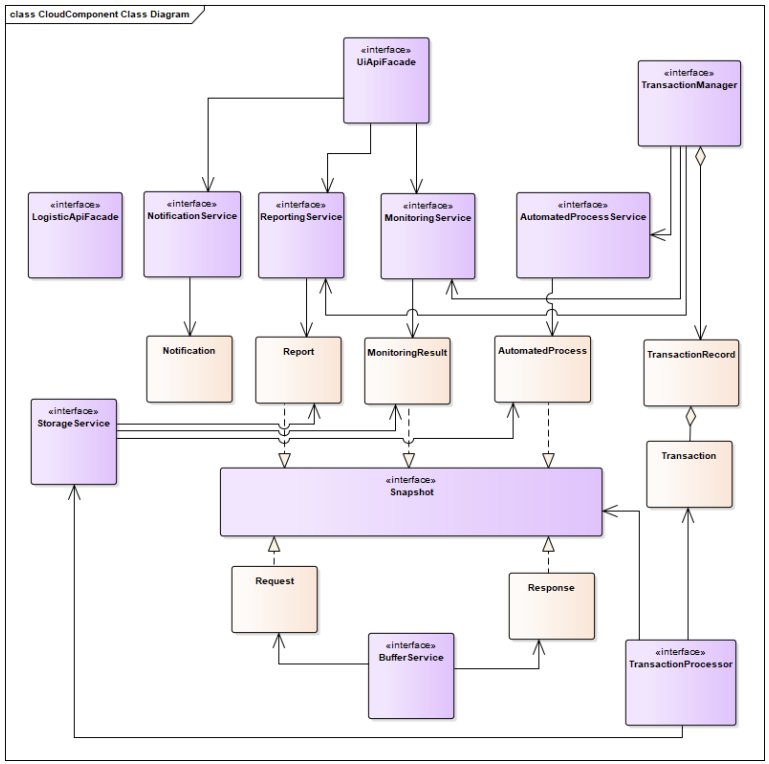


Figure: Structure of Cloud

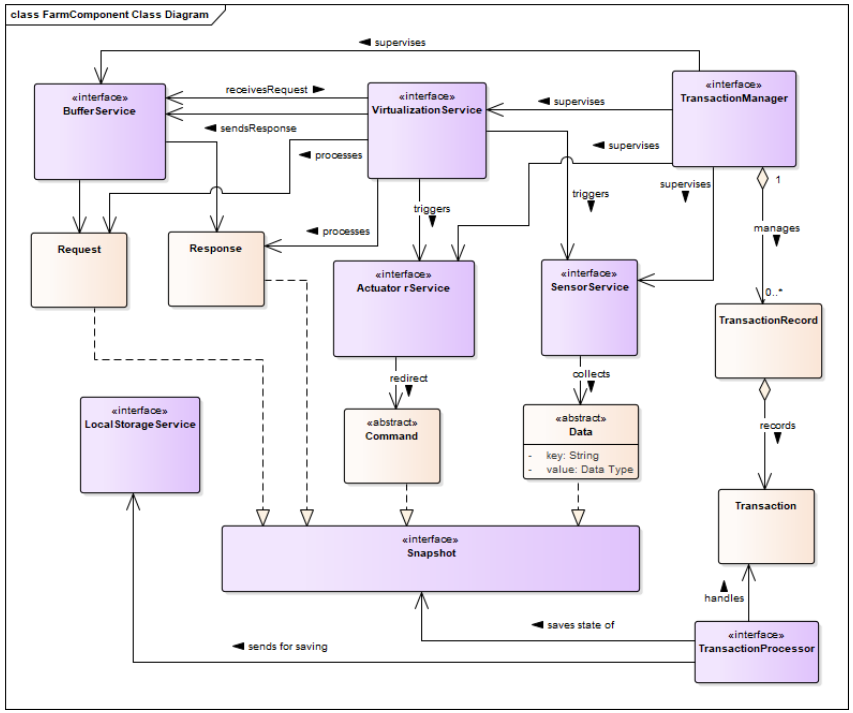
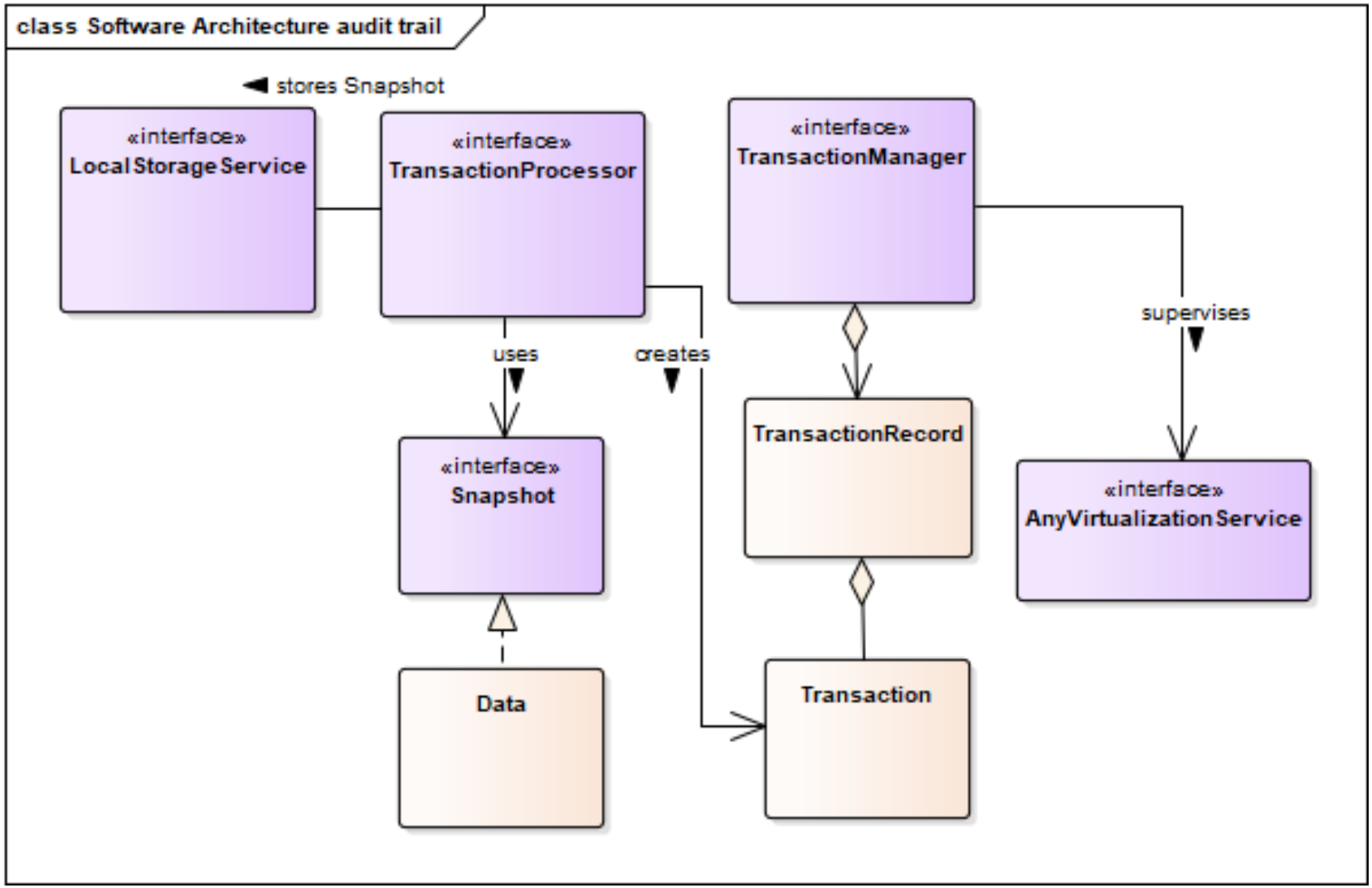


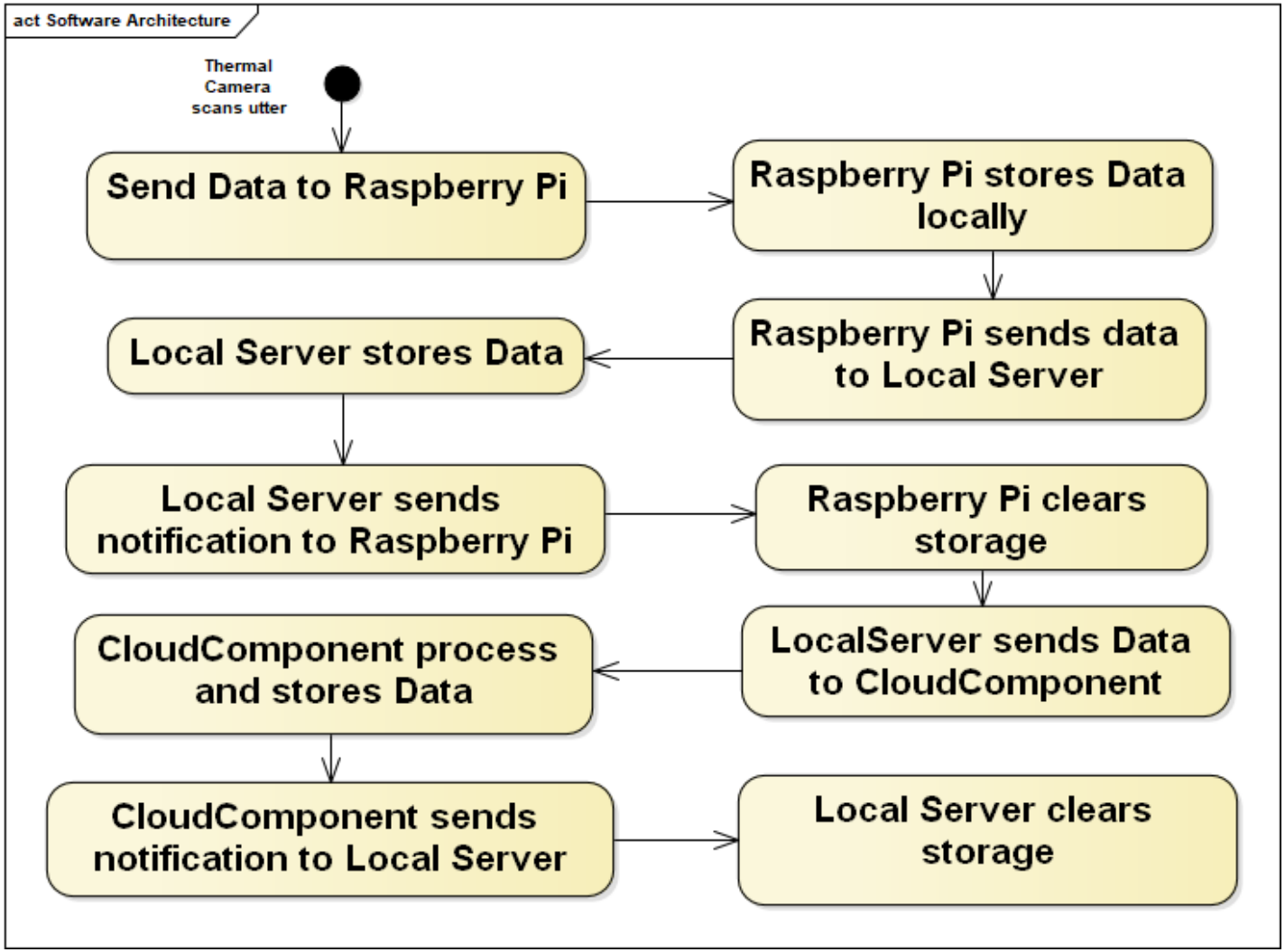
Figure: Structure of Farm

Software Architecture
Transactions - Audit Trail Pattern



Software Architecture

Transactions - Audit Trail Pattern

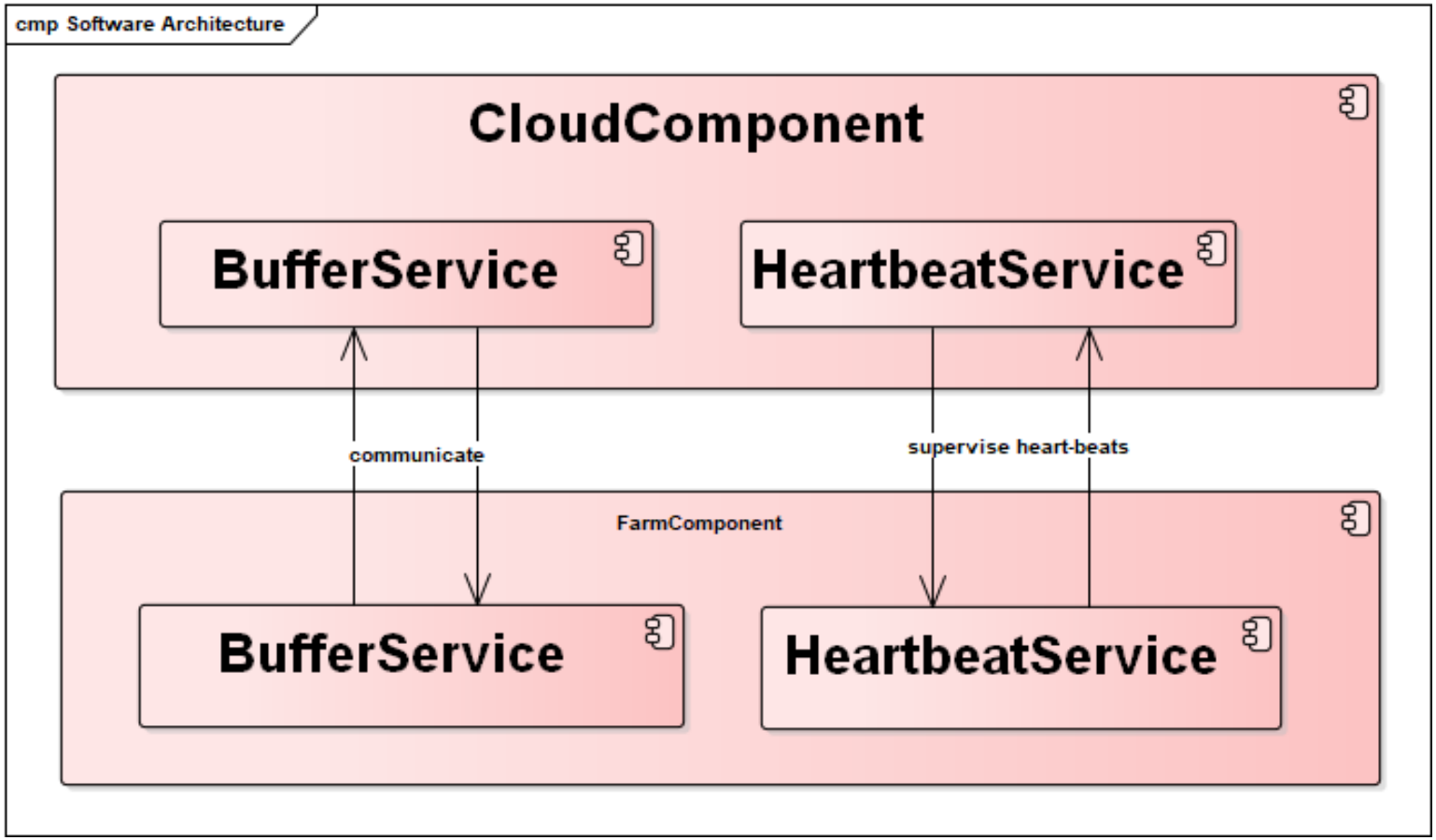


Sensitivity 1: If sensor fails no transaction was created.

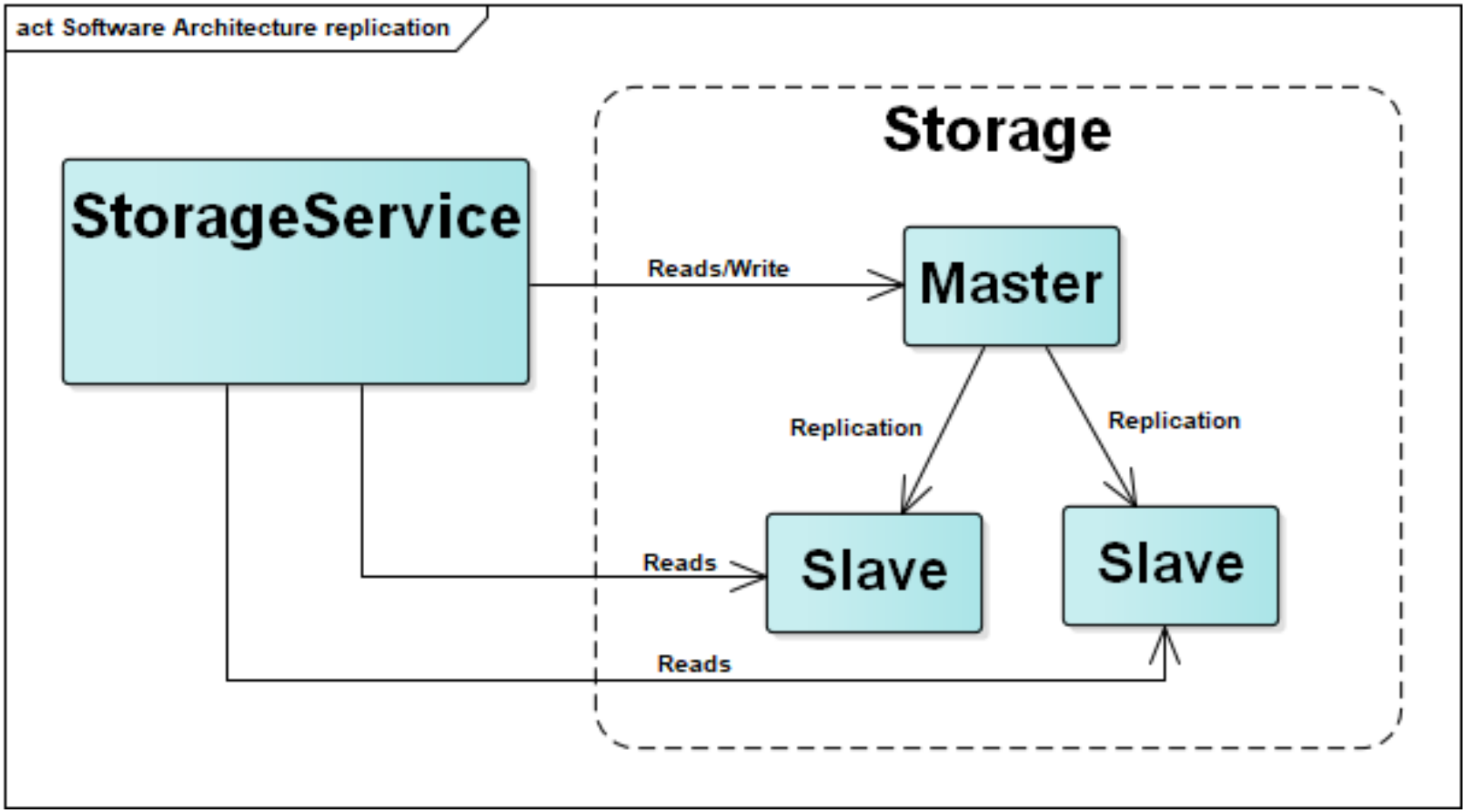
- Trade off 1: If Local Server or Bridge does not receive data within a certain timeout process will triggered again

Therefore: We have a risk that sensor fails during collection and have to make a trade off.

Software Architecture
Buffering



Software Architecture
Redundancy of Storage



Architecture Evaluation
Scenario

Any component between sensor and cloud storage might fail during:

- collection of data
- sending data
- processing of data

Architecture Evaluation
ATAM Table

Scenario 1	One Component fails during collection, sending or processing data				
Q-Attribute	Reliability				
Environment	Data of a certain sensor is collected				
Stimulus	One part of Farm- or CloudComponent fails				
Response	99 % Reliability				
Decisions	**Requ.**	**Sensitiv.**	**Tradeoff**	**Risk**	**Non-Risk**
Transaction Audit Trail	ATNFR1	S1	TO1	R1	
Buffering	ATNFR1				NR2
Redundancy of Storage	ATNFR1				NR3
Reasoning	The decisions reduce the loss of the data and will nearly always rely on correct data				
Arch. model	Audit Trail Pattern for transactions, Buffering, Redundancy of Storage components				

Table: ATAM Evaluation of Senario 1

Closing remarks

Roadmap

Quarter	1st iteration (2019)
Q1	Minimum viable product for cattle and pigs
Q2	Train and Test ML models for cattle and pigs
Q3-4	Define Web UI for cattle and pig products
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Our team

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Questions?