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Introduction to the IoT Stack

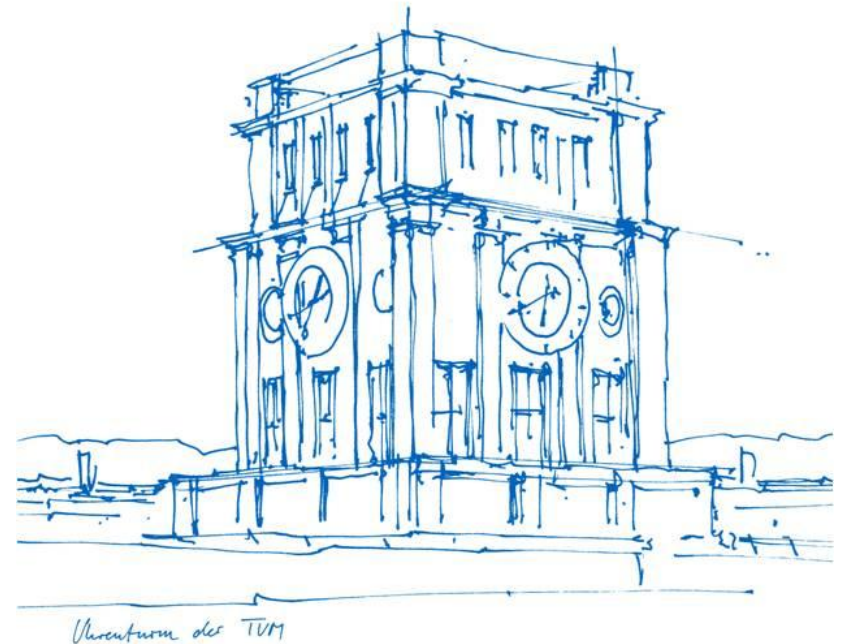
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The concept of IoT

Long Version:

“Internet of things (IOT) is a network of **physical objects**. The internet is not only a network of computers, but it has evolved into a **network of device of all type and sizes**, **vehicles**, **smart phones**, home appliances, toys, cameras, medical instruments and **industrial systems**, **animals, people, buildings**, **all connected**, **all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring**, **online upgrade, process control & administration.**”

Source: Patel et al, 2016, „Internet of Things-IoT: Definition, Characteristics, Architecture, Enabling Technologies, Application and Future Challenges“

The concept of IoT

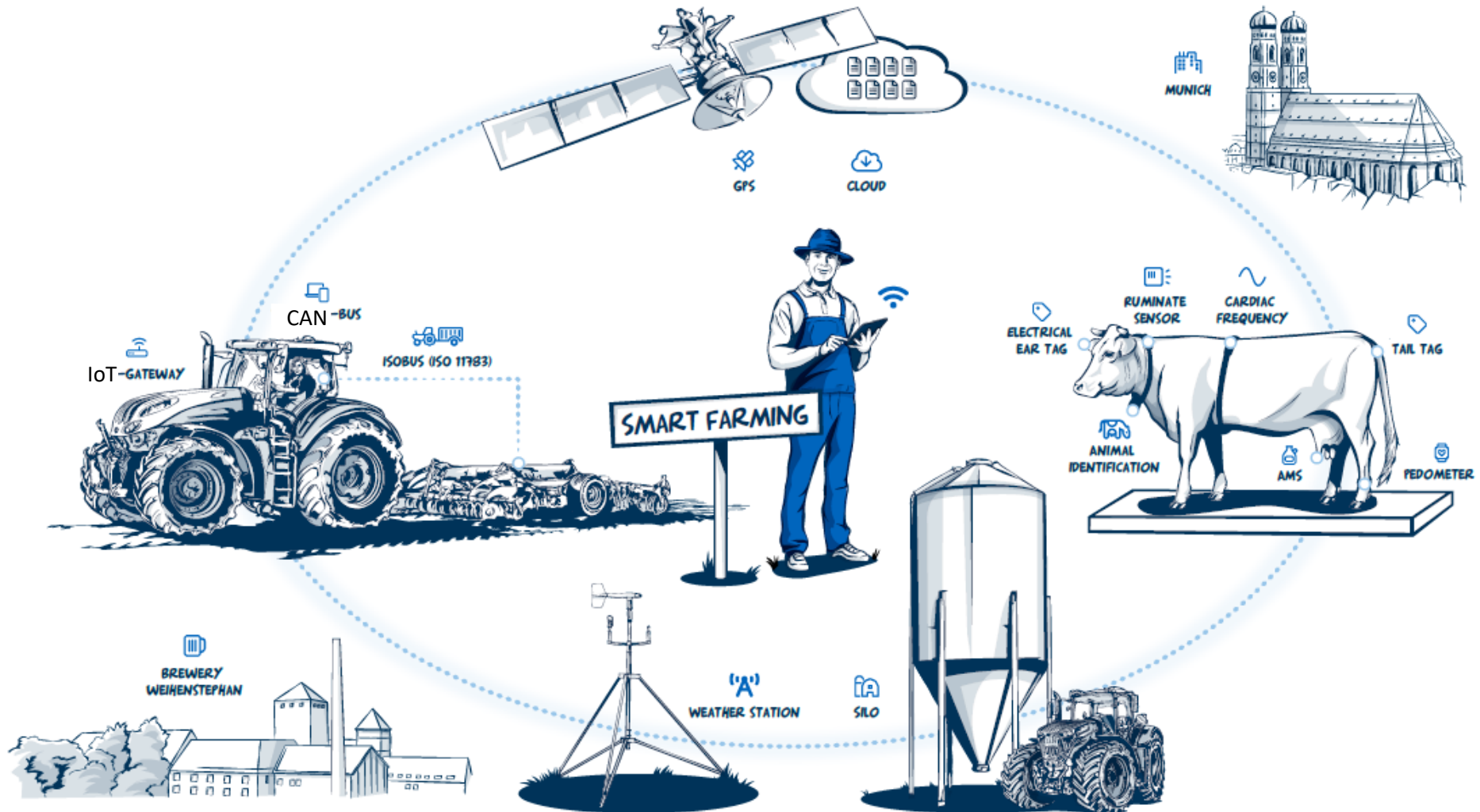
Short version:

The **Internet of things (IoT)** describes the network of physical objects—a.k.a. "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

Source: wikipedia.org (we did it again!)



IoT in Agriculture – part of Smart Farming



Stationary Systems

Stationary Systems



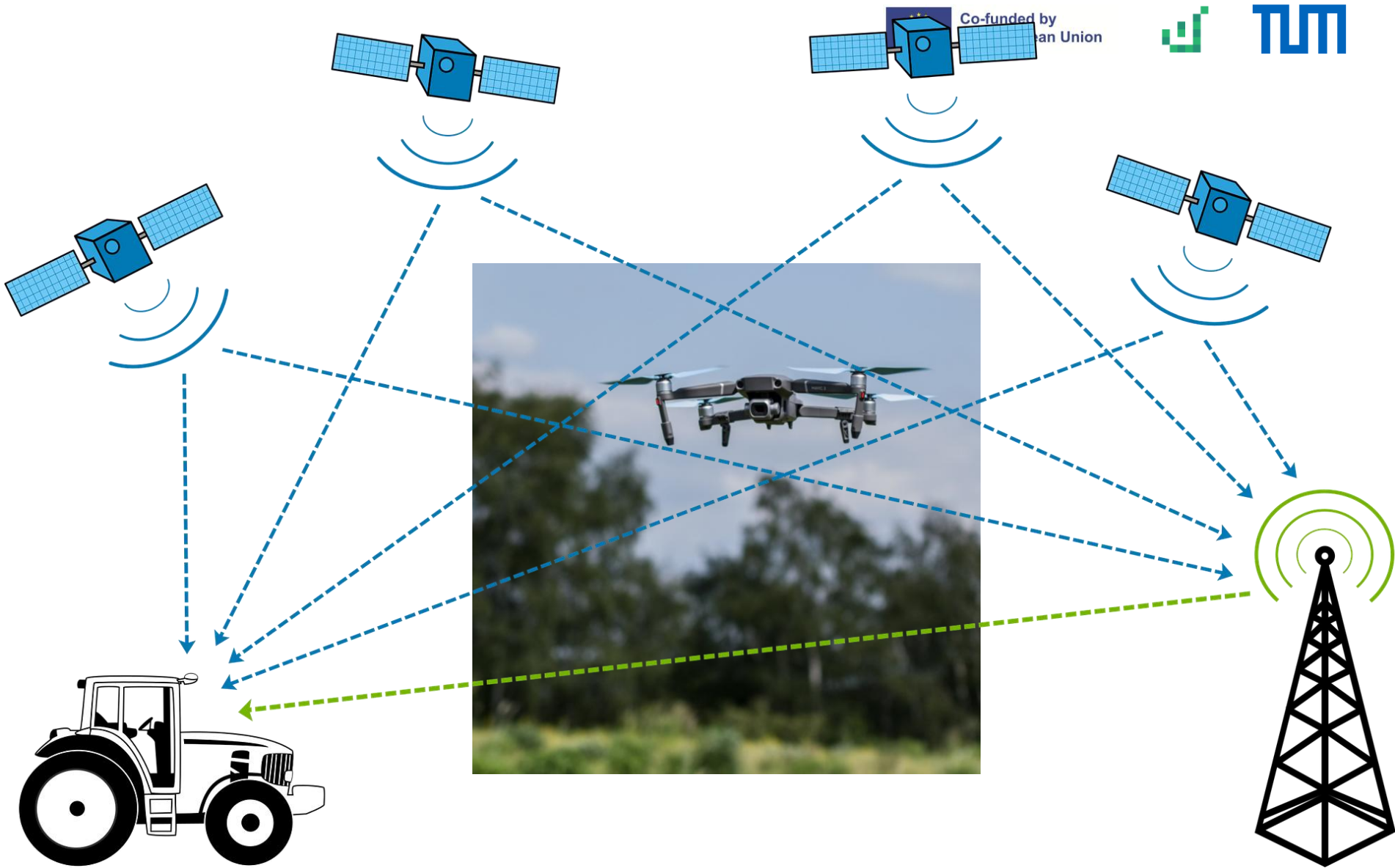
Stationary Systems



Source: milk-cooling-tanks.com



Mobile automated Systems



Source: Michael Kauer, pamel430, on pixabay



Source: Horsch (2021) own picture



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Common Challenges of the IoT

What do all pictures have in common?

Sensors:

- Identify states or locations (machines, stored goods, animals)
- Control systems offline or deliver data to clouds
- Ensure safety (Radar, LIDAR, cameras, Sonar, Ultrasonic etc.)

External Data from different sources

- Needs to be integrated
- from other sensors
- From other systems e.g. cloud APIs

Computing Power

- Process gathered Data from all sensors
- Make/support decisions
- Give control commands/trigger actions via Software
- Control any kind of actuators (electric drives, solenoids, switches, ECUs etc.)

User/Provider requirements

- Show a dashboard for the user
- Store and analyze data

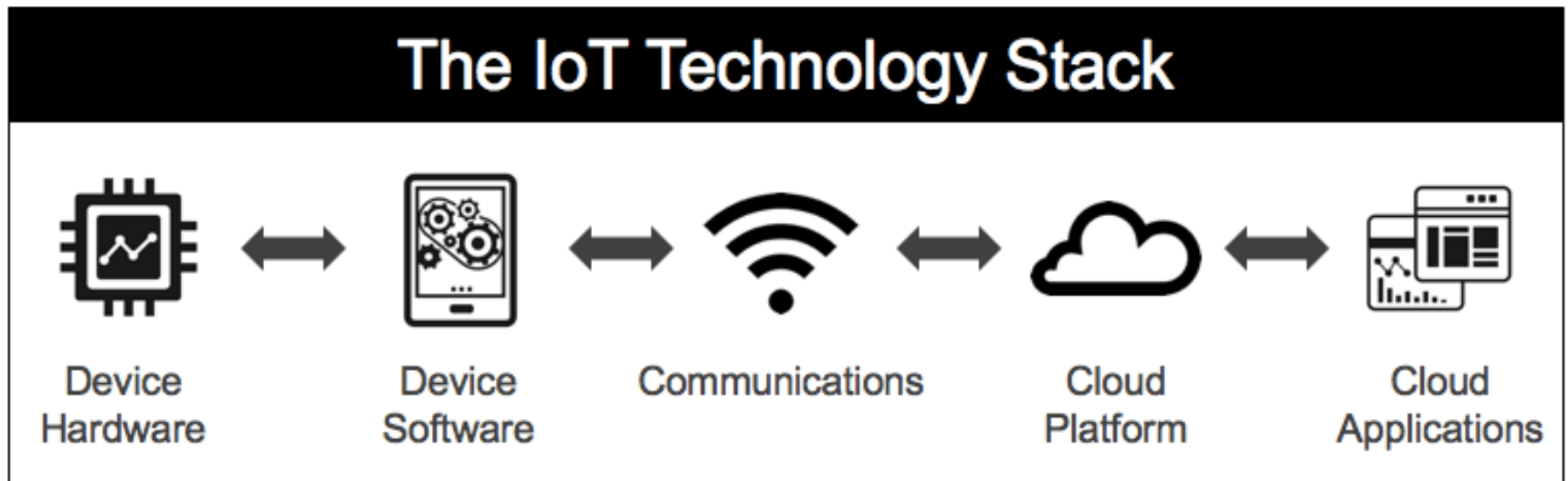
What do all pictures have in common?

A damn lot of data is produced
and has to be processed..

...at the machine or elsewhere

The IoT Stack

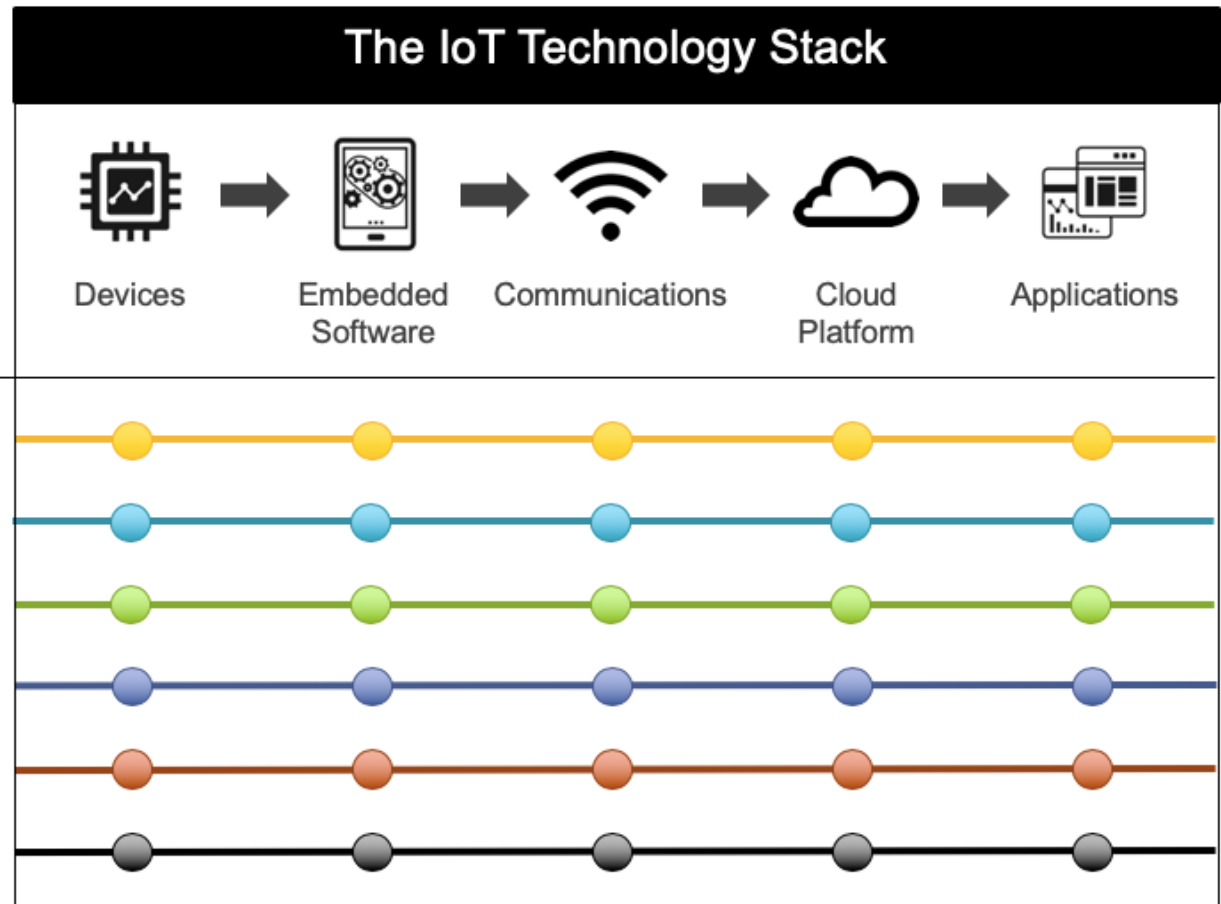
General Concept of the IoT Stack (5 layers)



Source: danielelizalde.com/iot-primer/

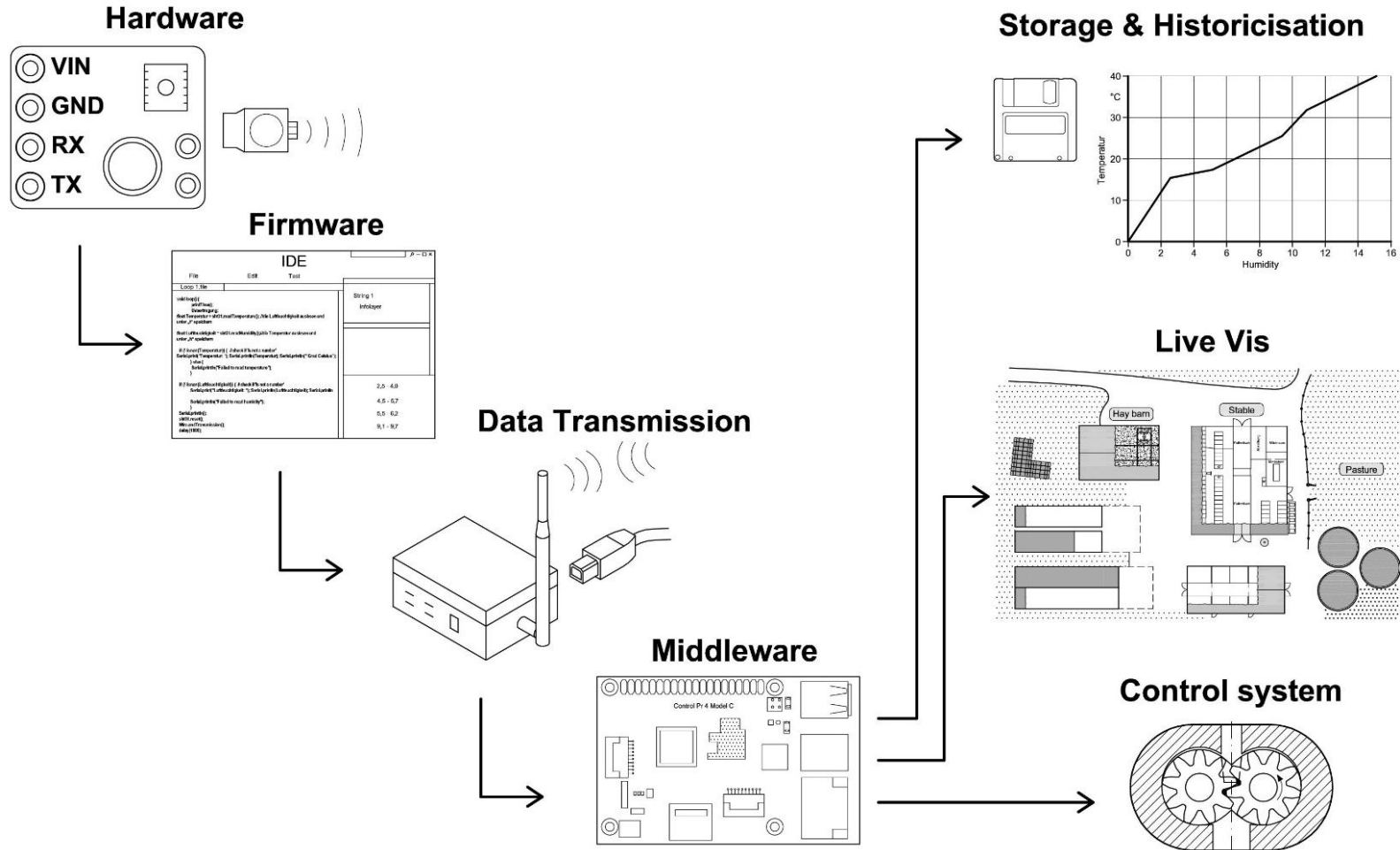
IoT Decision Framework (decision areas behind each layer)

The IoT Decision Framework



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Our exercise version of the IoT Stack



Take-home messages

Take-home messages from today

- **IoT** describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet
- To analyze IoT Systems, **thinking in layers** works best
- **5 basic layers** of IoT Systems are
 - Device Hardware
 - Device Software
 - Communications / Connectivity
 - Cloud Platform
 - Software Applications (Dashboards/storage/processing/AI)

How do we proceed?

-> in the next sessions you will be given the chance to „suffer“ through every one of these layers to gain a deeper understanding by building them yourself