

How to develop: cloud & embedded devices?

What is the impact of scalability on the cloud development?



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26 T/M 28
SEPTEMBER '23
JAARBEURS UTRECHT

AGENDA

IoT Devices & Cloud

Design process cloud for embedded devices

Important aspects for IoT device

Important aspects for the cloud

Case Studies for scalability



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SPINNOV

Engineering company for IoT devices

- + 30 engineers
- Electronics
- Embedded firmware
- Cloud
- Mechanical / Industrial



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SJEF

CEO from SpinNov

- Industrial Design TU/e
- Founder of SmartGoals Football
- Founder of SPINNOV



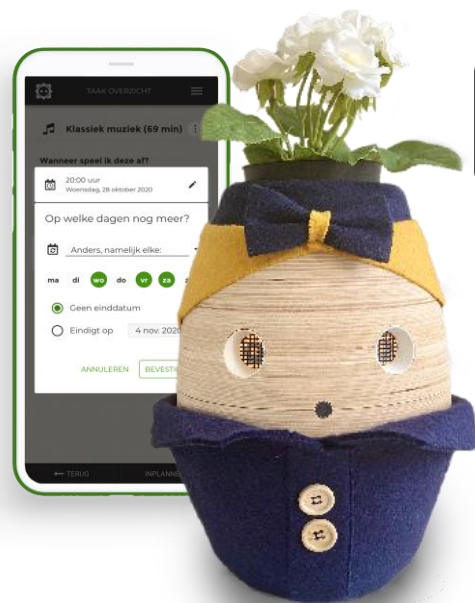
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EXAMPLES OF IOT SOLUTIONS



Rituals Genie
Wireless Perfume



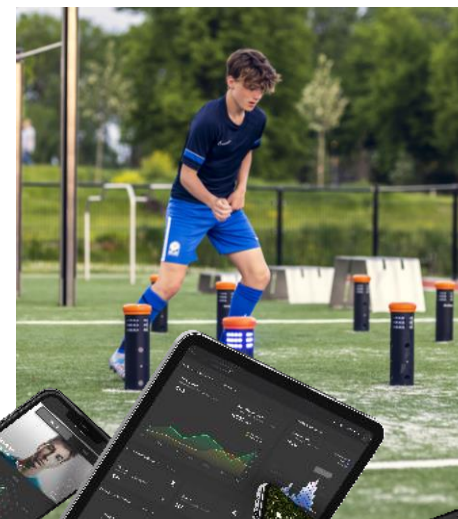
Ethernet



Care taking robot



4G - LTE



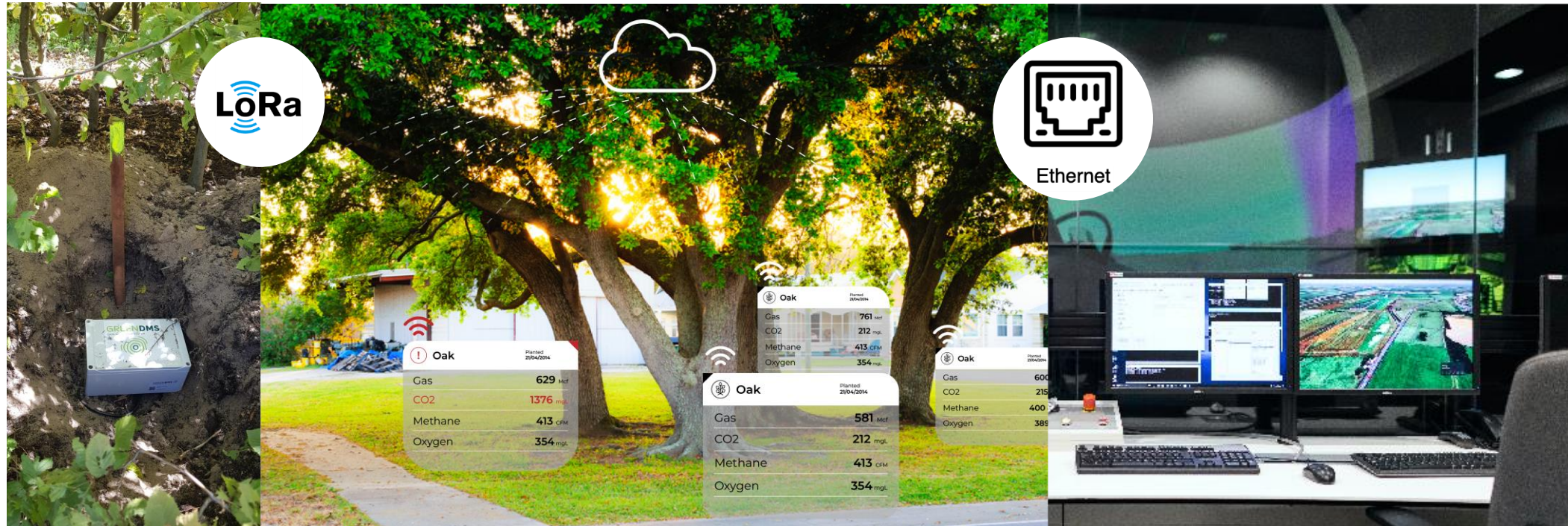
Interactive
playground



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EXAMPLES OF IOT SOLUTIONS



Environmental Sensor
LoRa - REST

High Demanding Telephony
system



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EXAMPLES OF IOT SOLUTIONS



IP Camera's
ball detection

Parking barrier control



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IOT – EMBEDDED DEVICES

Purpose:

- ✓ Sensoring
- ✓ Harvesting data
- ✓ Remote control of actuators
- ✓ Maintenance
- ✓ Service/ support
- ✓ Etc.



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IOT – CLOUD DEVELOPMENT

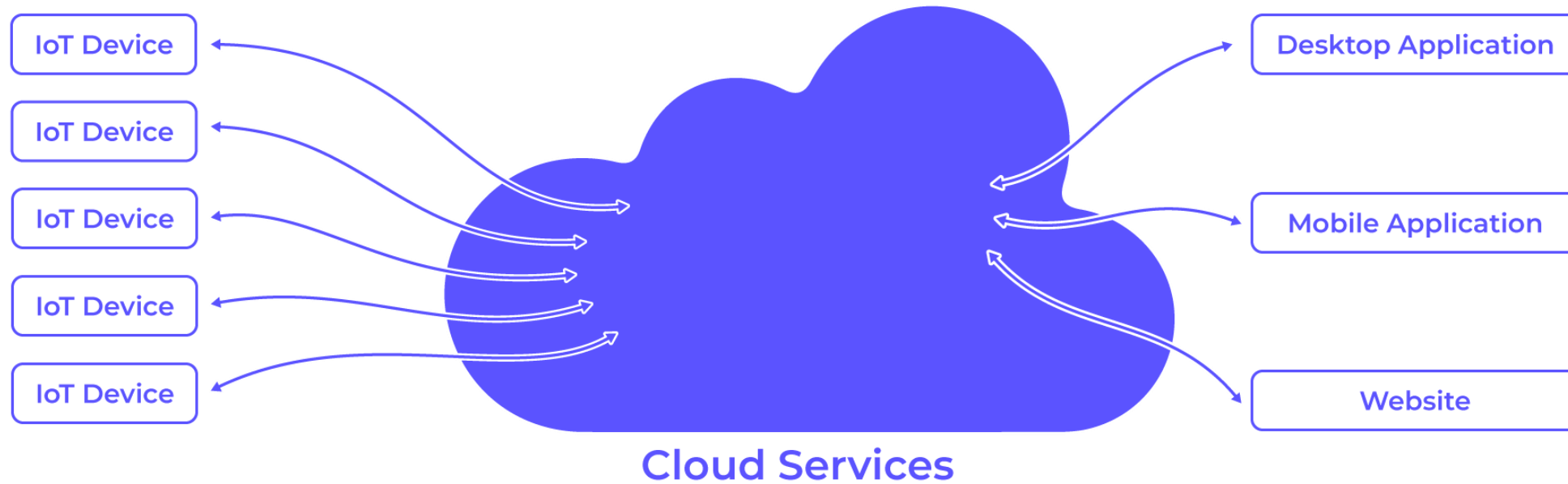
- ✓ Storage of data
- ✓ Visualisation of data
- ✓ Control devices
- ✓ Management of devices
- ✓ Business logic/ event triggering
- ✓ Etc.



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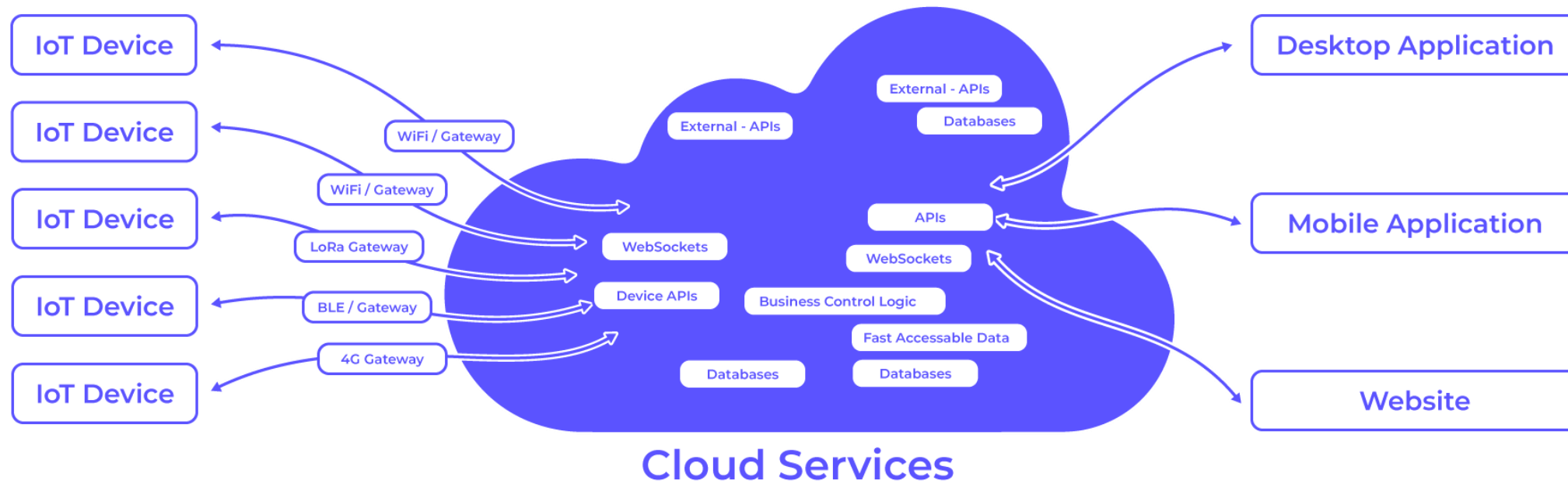
IOT – SCHEMATIC OVERVIEW



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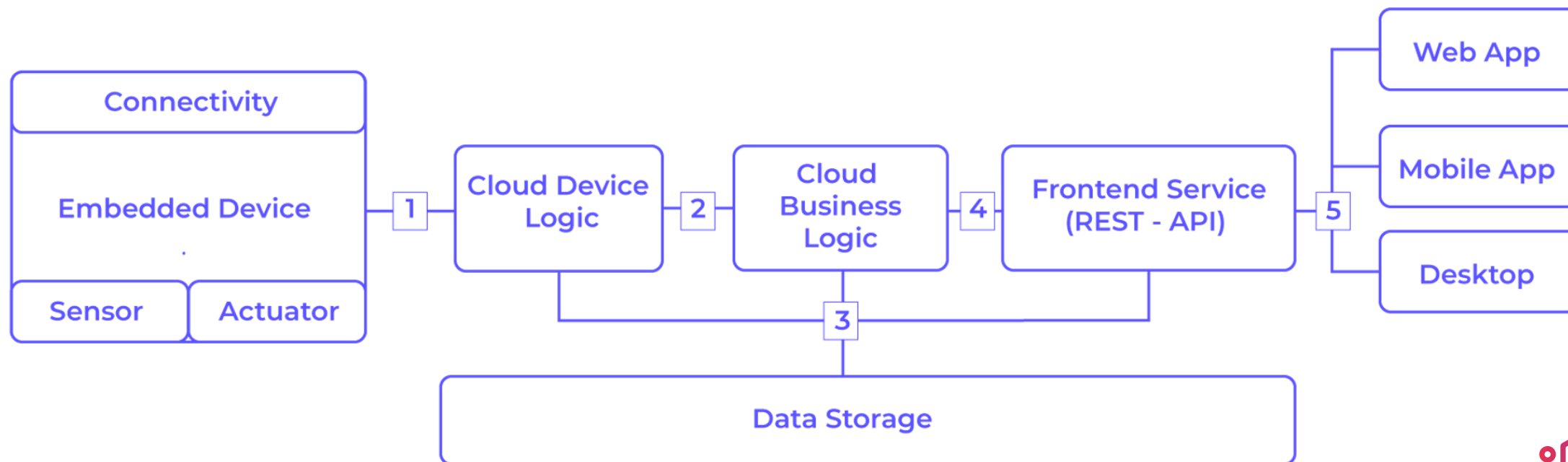
IOT – SCHEMATIC OVERVIEW



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IOT – SCHEMATIC OVERVIEW



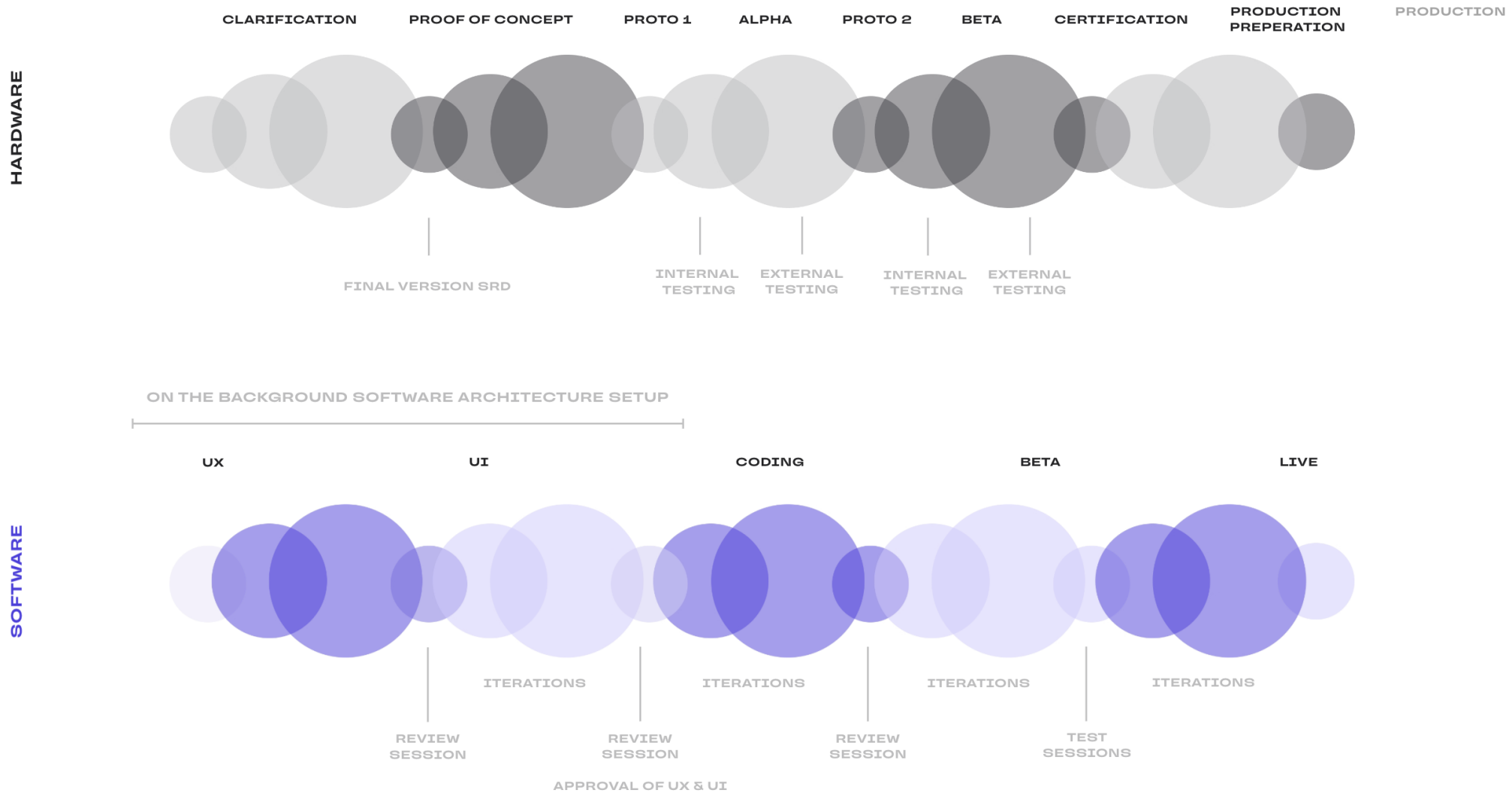
1. Protocol / Data / Technology
2. Translation Logic
3. Data storage
4. Business Logic
5. API / Endpoint documentation



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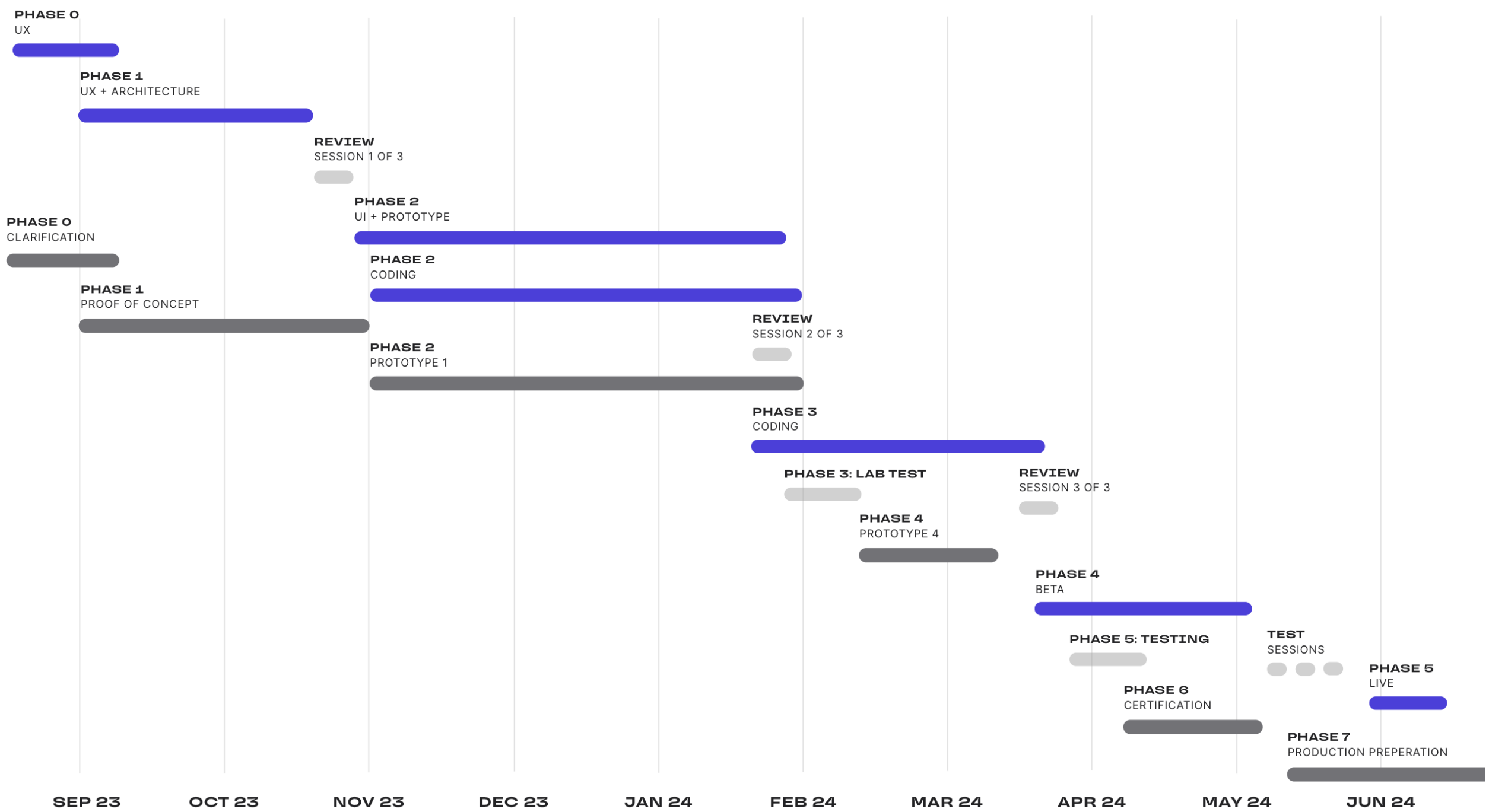
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IOT – DEVELOPMENT PROCESS



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TAKEAWAYS – DEV PROCESS

- Embedded devices often are individual "**simple**" devices
- IoT Cloud is often a "**simple**" cloud application
- Many different technologies make it **complex**

- **Project manager** with tech expertise with overview of both Hardware, Software, Cloud
- Incorporate enough **testing** / feedback sessions.
Testing is part of the development.

- The first phase clarification is the most important! (before engineering)



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TAKEAWAYS FOR IOT DEVICES

- Many IoT devices are used for obtaining sensor data.
- IoT devices are only cost efficient if no manual labour is involved in the maintenance for a specific sensor

Therefore:

- Make sure that debugging is possible on every separate component.
- Never release a device that cannot be remotely updated
- Try to keep everything as simple as possible



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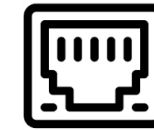


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IOT DEVICES – CONNECTIVITY: WHAT TO COMPARE?

Important selection criteria

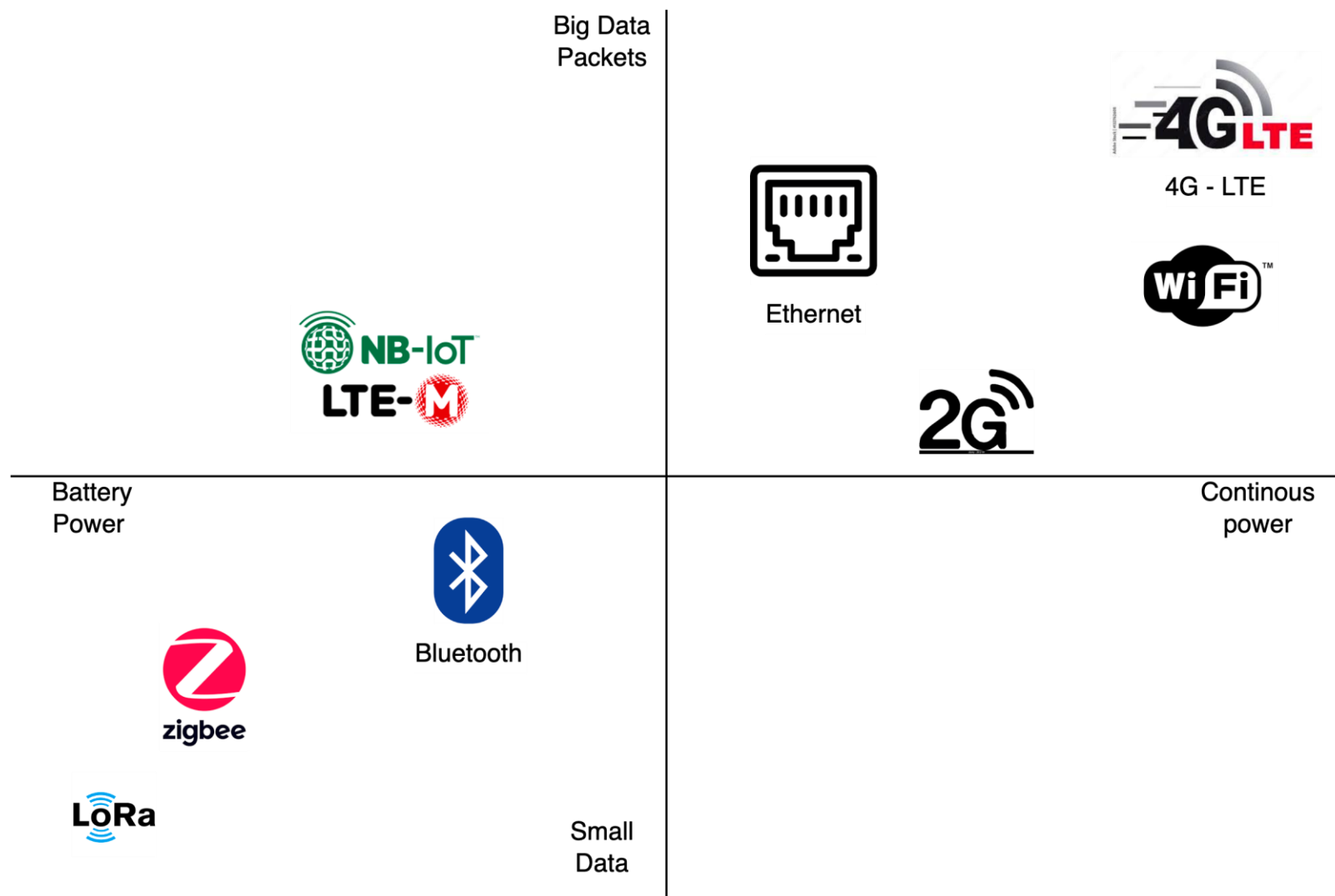
- What kind of data?
- Data: How much and how often?
- Power consumption
- Responsiveness
- Existing network infrastructure
- Cost structure
- Own knowledge/experience



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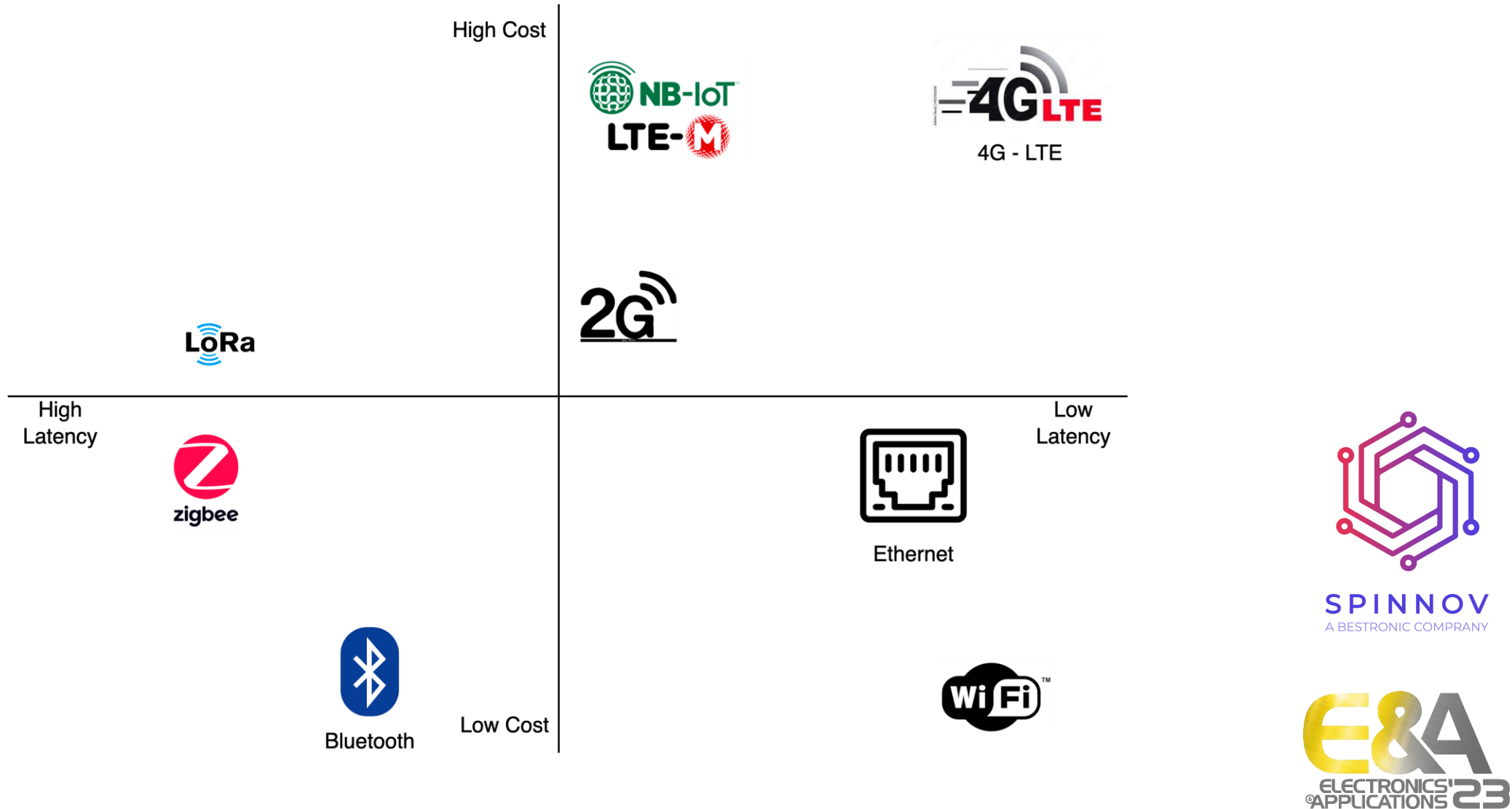
IOT DEVICES – SELECTION MATRIX



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IOT DEVICES – SELECTION MATRIX



IOT CLOUD – ARCHITECTURE

WHAT TO CONSIDER?

Important considerations:

- Expected amount of devices
- Which Data/ how much data?
- Responsiveness
- Costs structure (monthly / device)
- Storage space
- Own knowledge/experience



Azure IoT Hub



AWS IoT Core



kubernetes

cloud vps

Try to choose the most simple solution!

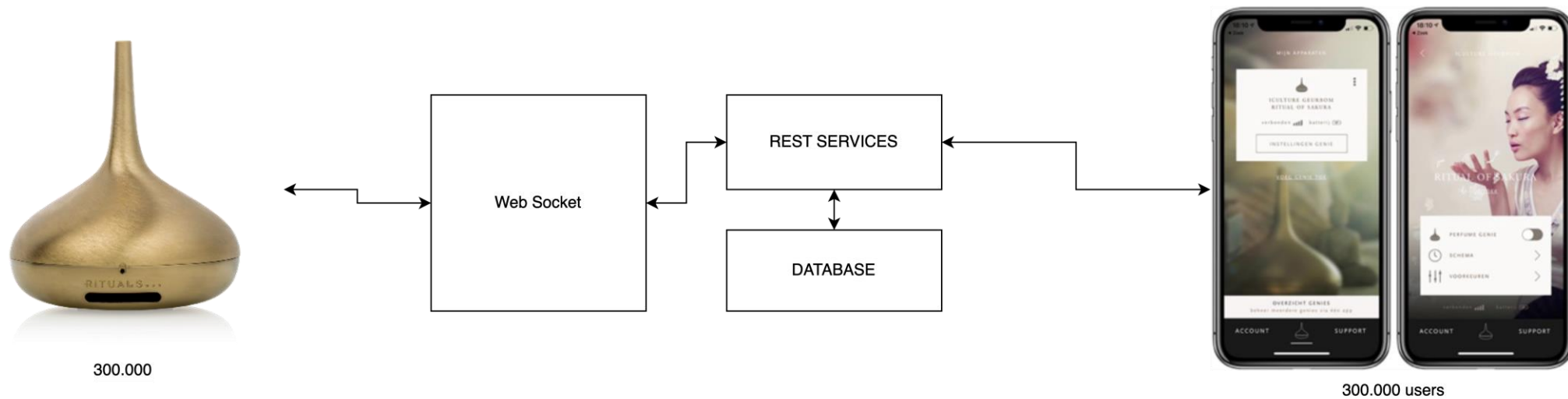


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CASE STUDY 1:

- How do you update a websocket with 300.000 connections?



300.000 devices connecting to 1 IP is considered a DDOS!

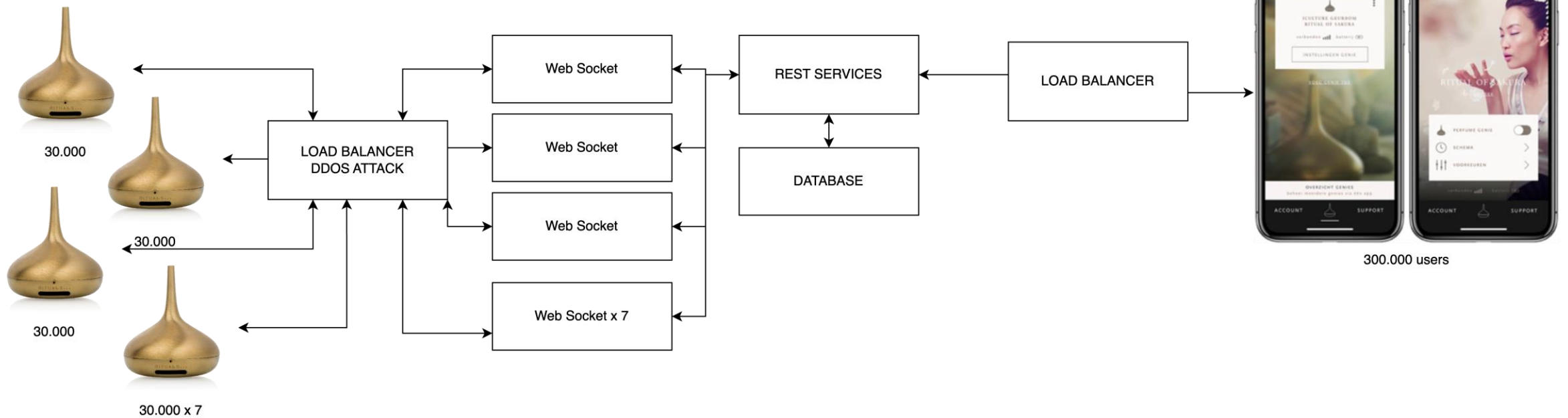


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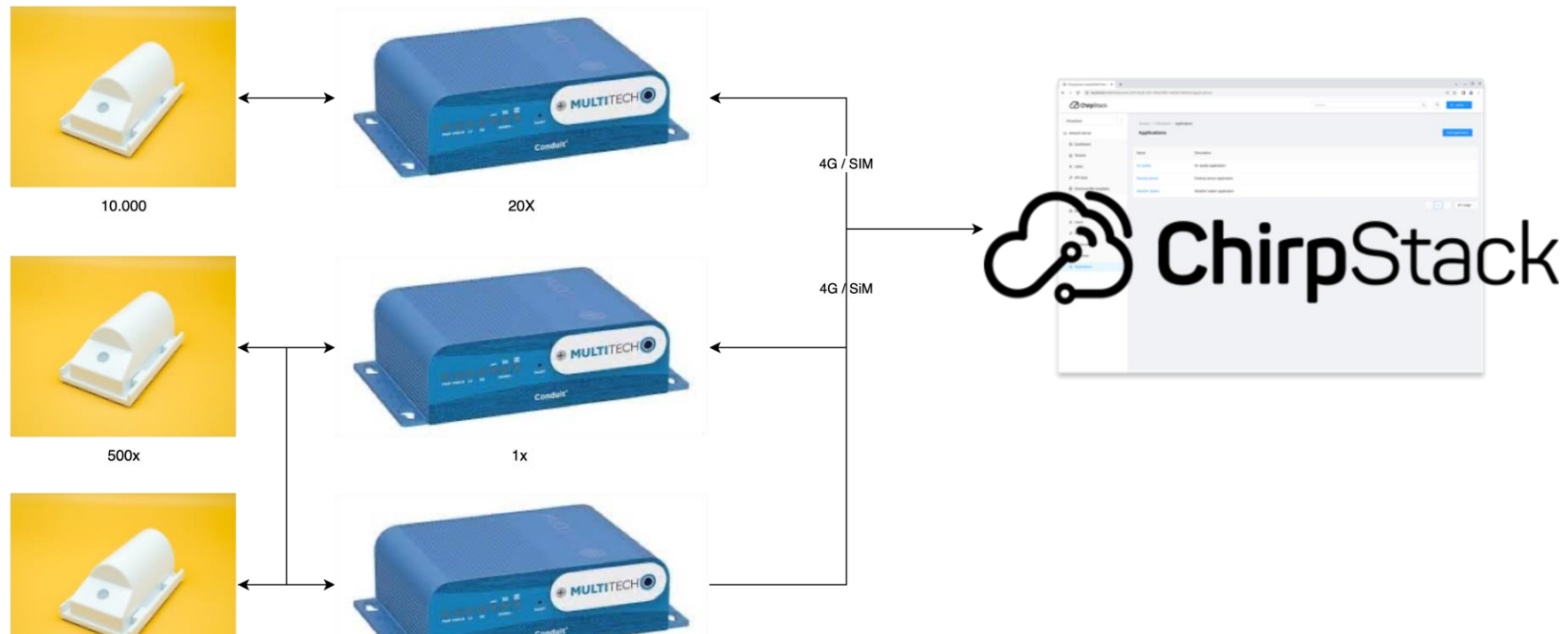
CASE STUDY 2:

- Apply Load balancers
- Use multiple sockets



CASE STUDY 2:

- LoRa network - Scalable
 - Should we have an acknowledge message?

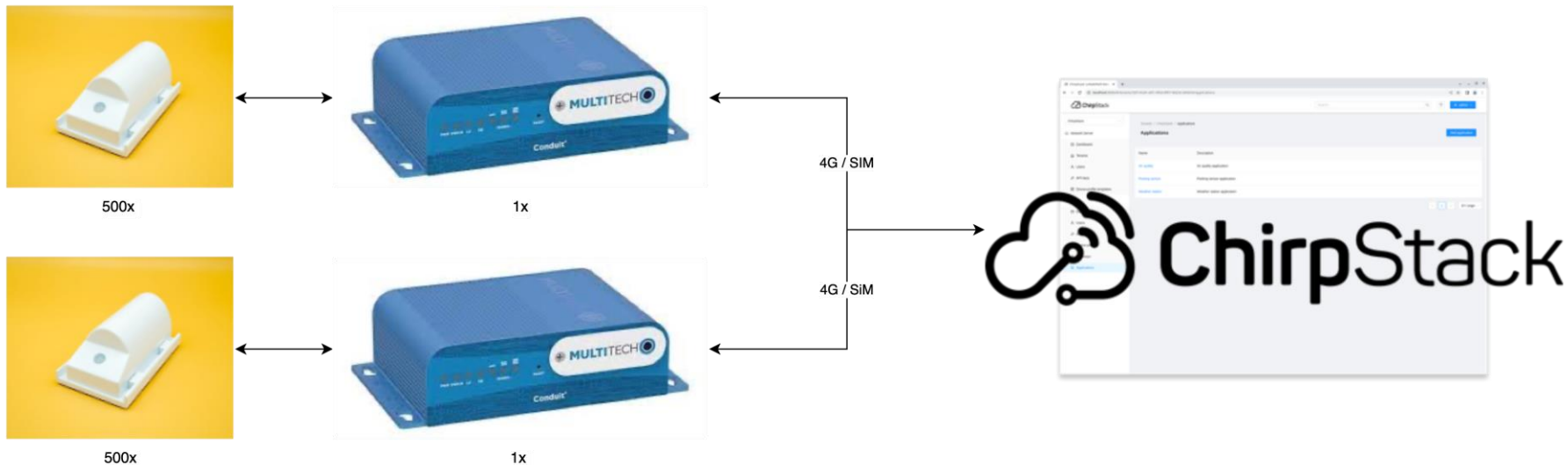


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CASE STUDY 2:

- With Acknowledge: More certainty the message arrives. (i.v.m. collision)
- No Acknowledge: Less messages, less drainage of battery, less timing issues.

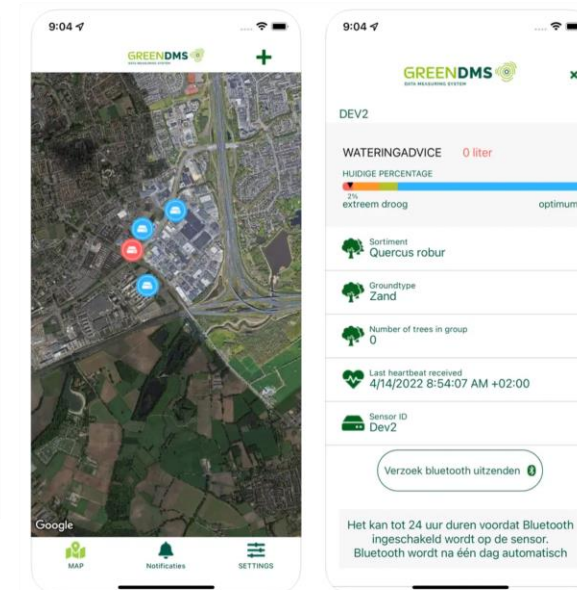
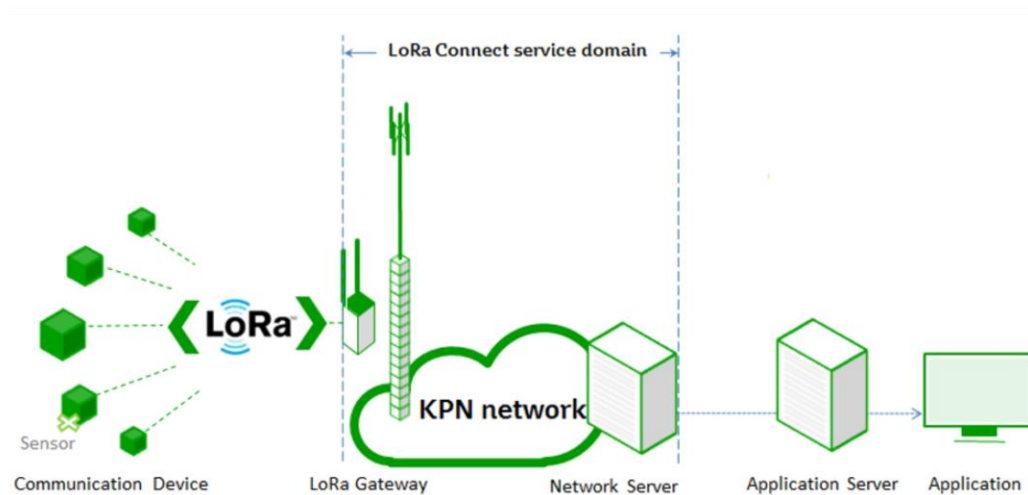


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CASE STUDY 3:

- How to create real-time time system that needs to be in the ground for 3 years on battery power?

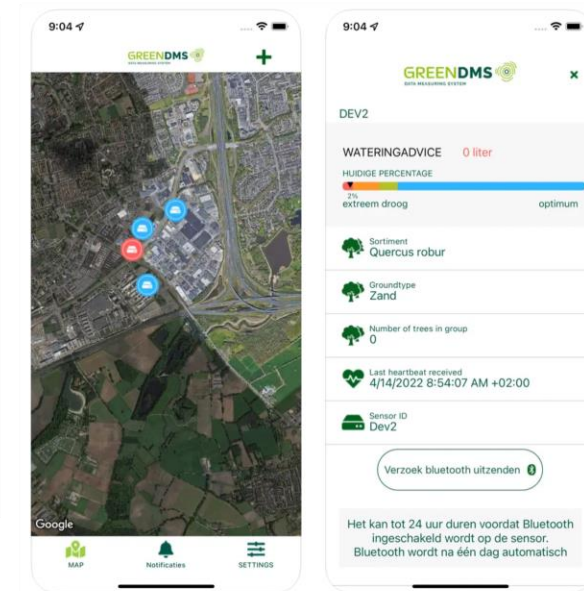
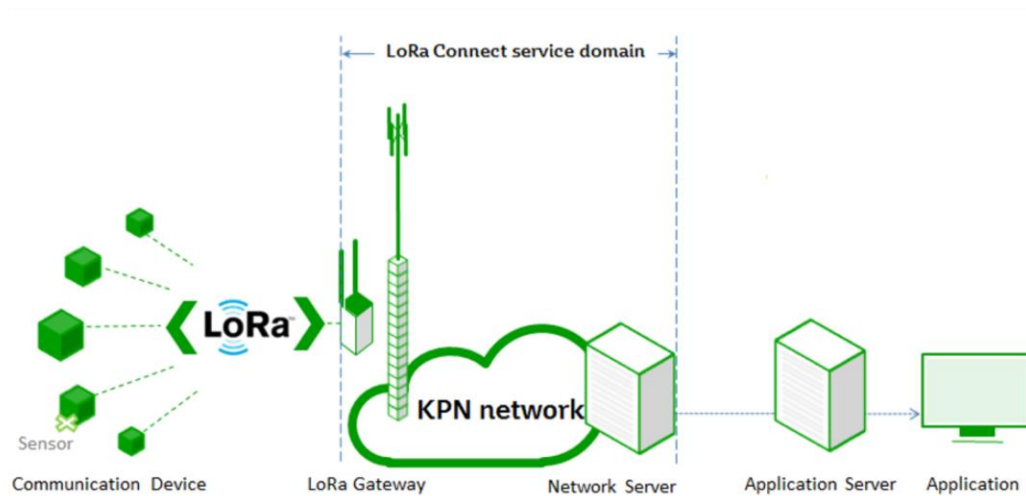


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CASE STUDY 3:

- What is real-time? Align with the customer what is Real-Time.
- Set the right interrupts and only send information that is relevant.
- Optimize energy by finding the energy drainage. - Antenne optimalisation.

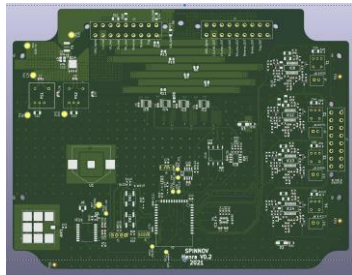


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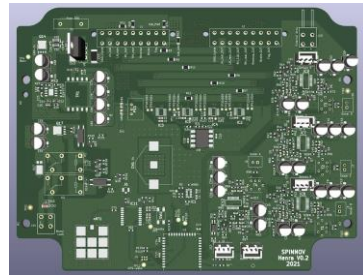
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CASE STUDY 4:

- How to update and maintain many different IoT hardware devices over time?



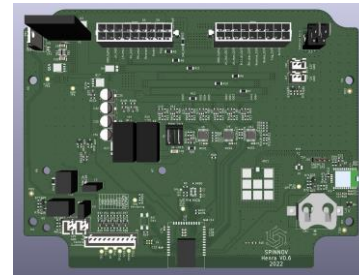
V1.0



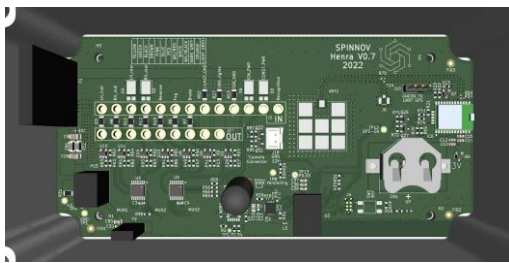
V1.1



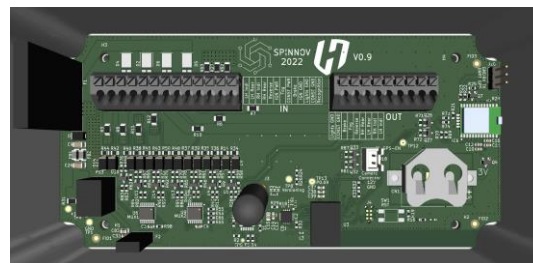
V1.2



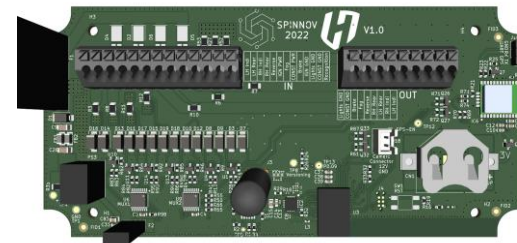
V1.3



V2.0



V2.1



V2.2



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IOT EMBEDDED DEVICES

- Try to keep 1 firmware for all devices.
- With Flash/Eeprom/versioning resistors detect hardware version
- Always include: Hardware & Firmware versions
- Prevent in firmware to load wrong unsafe firmware
- Try to apply dual banking



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IOT, NOT DIFFICULT, BUT COMPLEX!



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