Holistic view to IoT

Will start at
1 pm – 3 pm (CET)
2pm – 4pm (FI)

Peter Virtanen, Satakunta University of Applied Sciences

With the support of the Erasmus+ Programme of the European Union

TALENT JOURNEY

Holistic view to IoT

Part 2

Peter Virtanen, Satakunta University of Applied Sciences

With the support of the Erasmus+ Programme of the European Union

About this training

- Who
  Peter Virtanen, Full time lecturer
- When
  Dates: 18.1, 21.1 and 22.1.2021
  Time: 1 pm – 3 pm (CET),
  2pm – 4pm (FI)
- Where
  https://hill.webex.com/meet/peter.virtanen
- Let's connect!
  https://www.linkedin.com/in/peter-virtanen-99794b28/

Here are the topics that we will go through today (changes possible)

- Presentation about Data Analytics by Mathias Grädler from Wapice
- Continuation of the case study
- IOT in general / ecosystem
- Case study recap
- Solution 1 (self contained WIFI enabled)
- Solution 2 (self contained Bluetooth enabled with brain (edge computing like solution))
- What is BLE?
- Solution 3 (Grouped pressure sensor cluster with brain)
- Solution 4 (RFID pressure sensor)
- What is RFID?
- Group work (depending on if we have time, group work can be continued on **Friday**)

Mathias Grädler, Wapice

Image source: energyweek.fi

IOT ecosystem

What it consists of?

Part 2.

Sensor or sensors

Device connectivity

IoT devices application

Network

Cloud application

Data analytics

Security

Sensor or sensors

- captures data
- data can be digital or analog
- digital inputs: thermometer, IR-sensor, touch sensor …
- analog inputs: potentiometer, temperature sensor, 2-axis joystick …

Sensor or sensors

- Here is a very simple example of how to connect and read data from (digital) thermometer sensor

https://www.geeetech.com/wiki/index.php/Electric_thermometer_by_using_DHT11_sensor_module

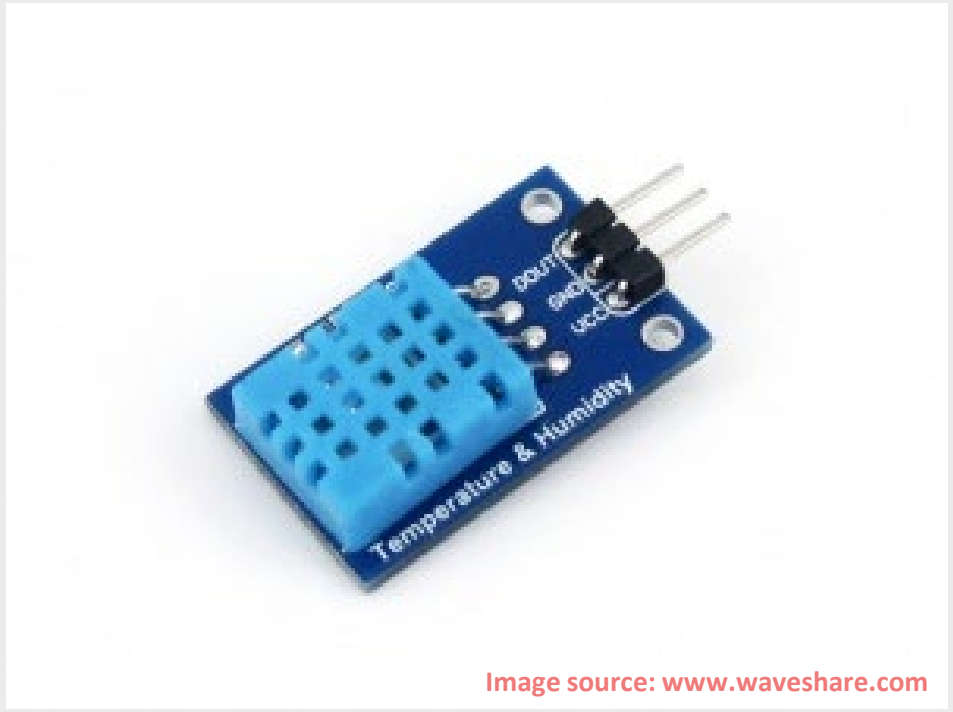

Image source: www.waveshare.com

Sensor or sensors

- What about analog?
- 0 – 1023

- Here is an article about how to read data from analog sensor with Arduino https://www.arduino.cc/reference/en/language/functions/analog-io/analogread/

Device connectivity

Sensors will have to be attached to some device that can communicate the read data further. Communication can concur using Bluetooth, WIFI or cellular network.

IoT devices application

Programmed part of the device that can make decisions

The network

Communicating the data further to server or some cloud service

The cloud application

- We on this training are going to look an example that is quite simplified. Here is a video by AWS about bigger scale and more complex IoT solutions https://youtu.be/bBJ2ISaGIyQ. Video will go trough the predictive analysis in IIoT applications.

- Also good video from Kai Wähner here https://youtu.be/kjSWh3Slmig.

- These both videos above are talking about IoT and IIoT in bigger scale. Here is one more video from **RealPars** that explains the IIoT ecosystem in 8 minutes https://youtu.be/HmbUJEShA-8 and also shows to difference between the IoT and IIoT.

Data analytics

- In this training we have / had a presenter from Wapice to talk about Data Analytics.
- For further studies here is also pretty good presentation from Mitsubishi Electric about the subject https://youtu.be/lNvo9zKXMN8. Video though is not straightly related to IIoT

And last but certainly not least

Security

Badly configured devices and gadgets create security threat

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Back to our training part 1. case study

Case study problem recap

I asked you to ideate

How would you solve this problem?

1. Solve how to read liquid levels of white transparent bottles from different manufacturers.

2. Solve how to read liquid levels of any bottles that are opaque from different manufacturers.

3. Solve how to read liquid levels of any bottles of size and color.

Case study problem recap

I asked you to ideate

How would you solve this problem?

1. Solve how to read liquid levels of white transparent bottles from different manufacturers.

2. Solve how to read liquid levels of any bottles that are opaque from different manufacturers.

3. Solve how to read liquid levels of any bottles of size and color.

Solution 1

Solution 1

Sensor used in this case could be proximity sensor or infrared sensor. Opaque bottle will probably create some problems to both sensors. We could also use sensor that reads liquid levels inside the bottle.

Liquid Level Sensor

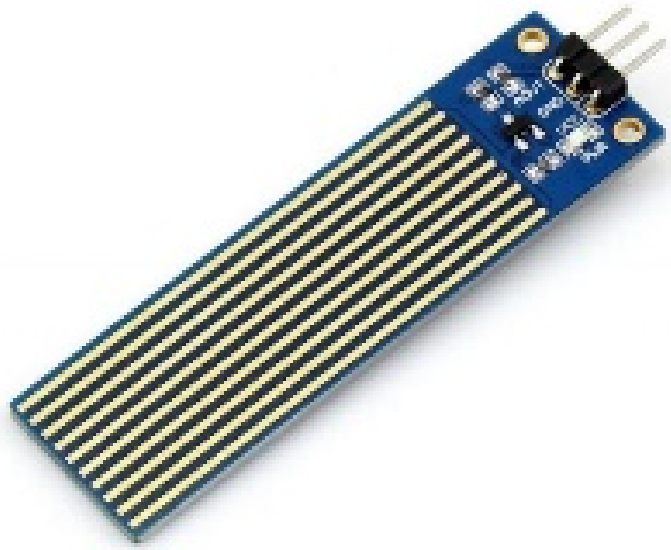
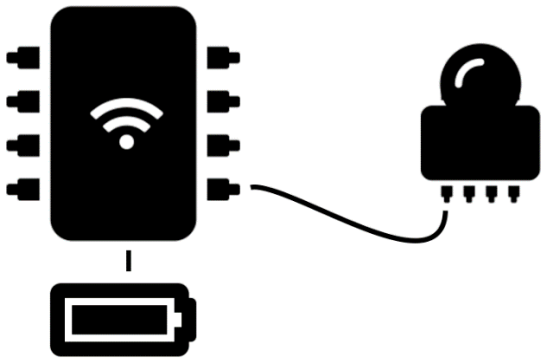


Image source: robotshop.com

Solution 1

This is a simple diagram of a WIFI enabled board that can read proximity of objects. The chip with WIFI icon is the “brain”.



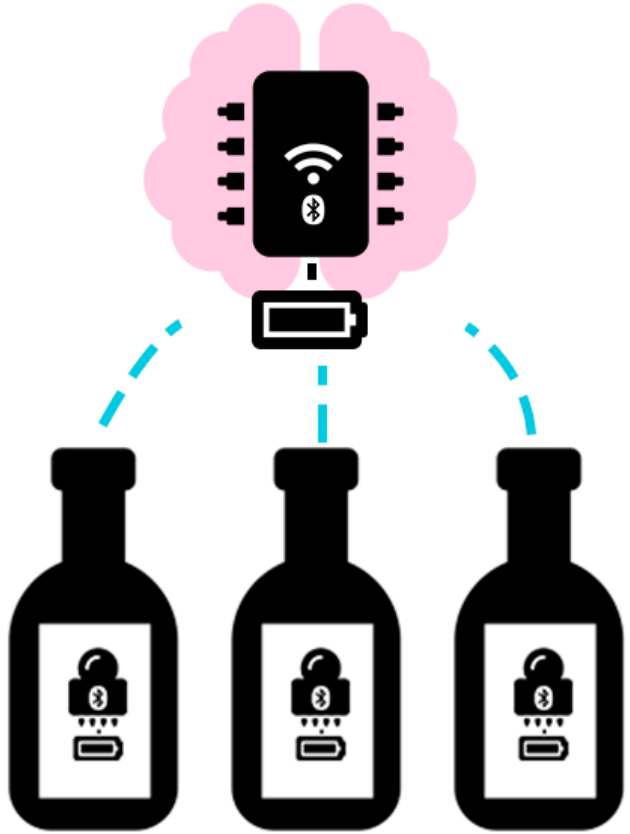
Solution 1

This solution to the problem is that every individual bottle needs to have this setup (costly, e-waste and need recharging).

Solution 2

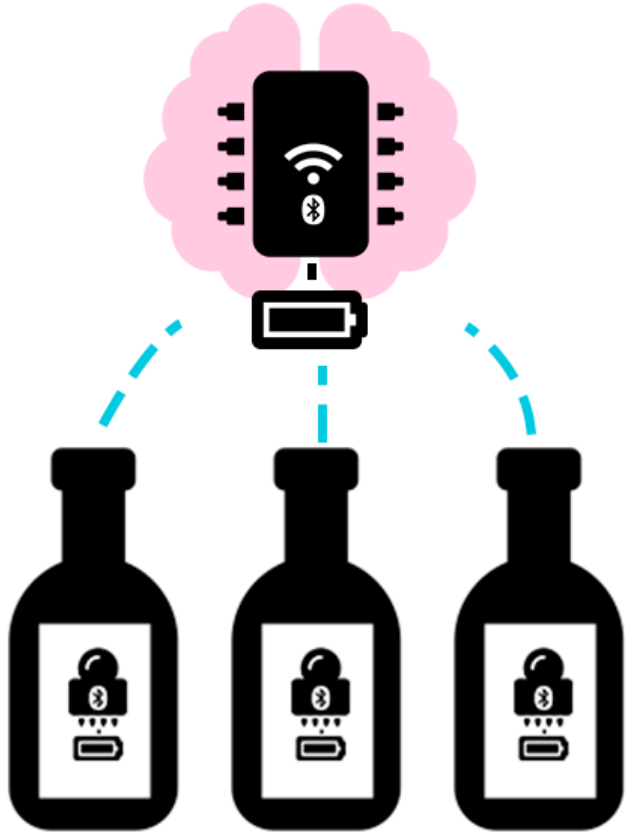
Solution 2

Centralized “brain”



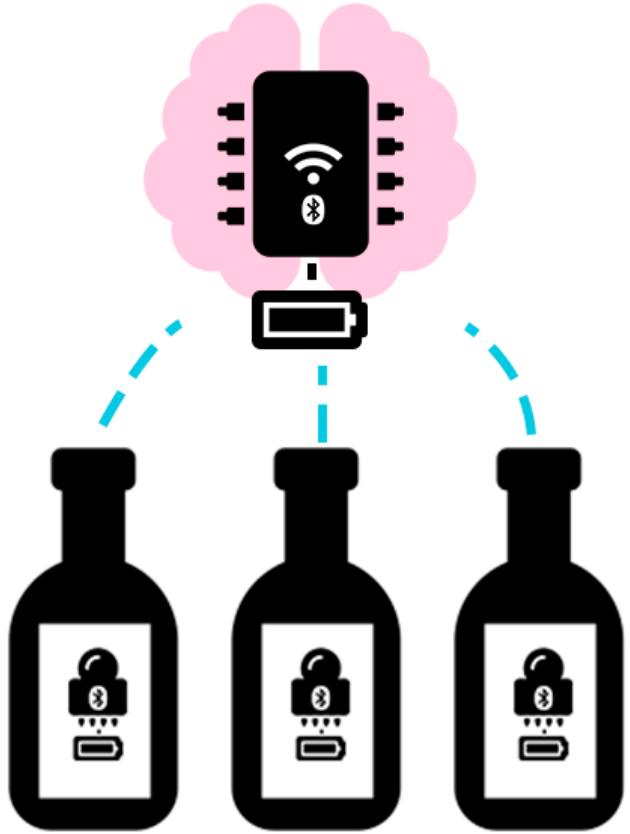
Solution 2

- More cost efficient
- Bottles consume very little energy
- Uses Bluetooth Low Energy (BLE)



Difference between regular Bluetooth and BLE

- Bluetooth is capable to handle lot of data
- At the same time Bluetooth consumes lot of energy
- BLE can run long times with battery power
- As long times as years without a need to change the battery



Difference between regular Bluetooth and BLE

- An example of BLE device that in right circumstances can run for long times just with a regular 3v coin battery

TI CC2650

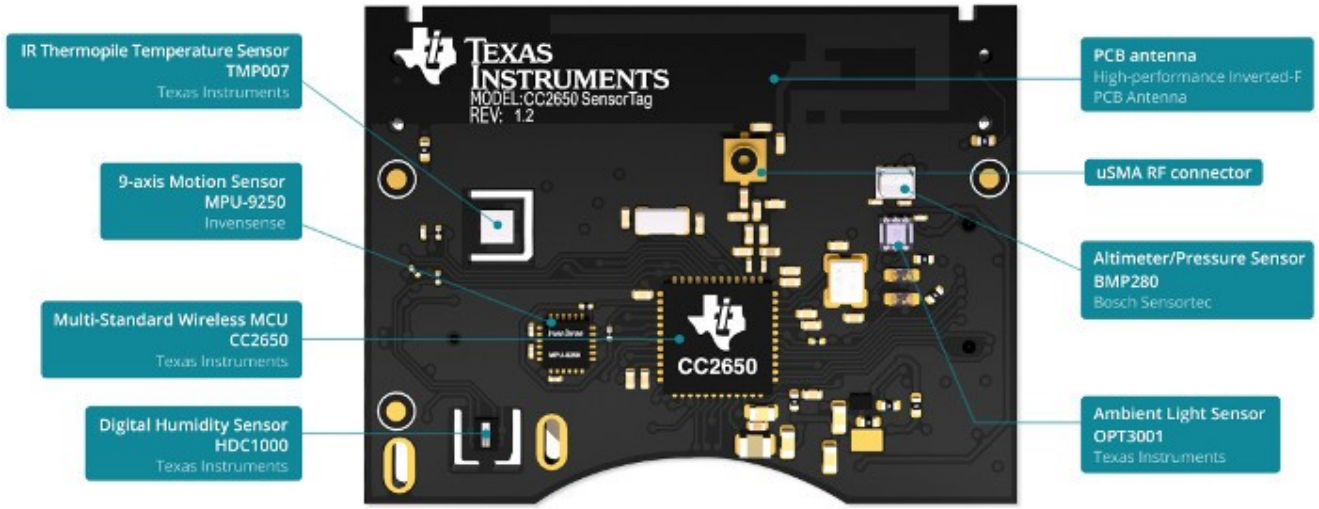


Image source: Texas Instruments Inc

Testing
TI CC2650

Testing the Cat vs Mouse game in China

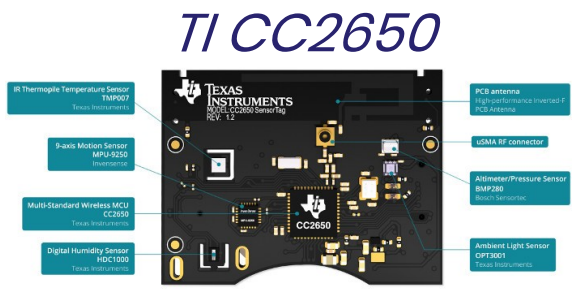


Image source: Texas Instruments Inc

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More about BLE technology

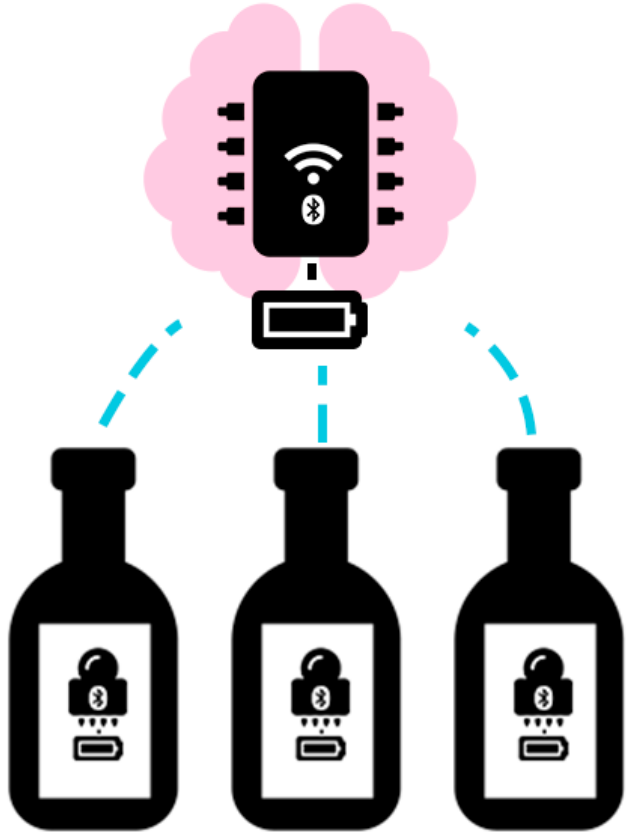
- If you are interested here is a Wikipedia article about the BLE https://en.wikipedia.org/wiki/Bluetooth_Low_Energy
- And here is an article about the differences between Bluetooth and BLE https://www.link-labs.com/blog/bluetooth-vs-bluetooth-low-energy

Any thoughts?

I hope some discussion and feedback about this matter that we can improve our material further

Solution 2

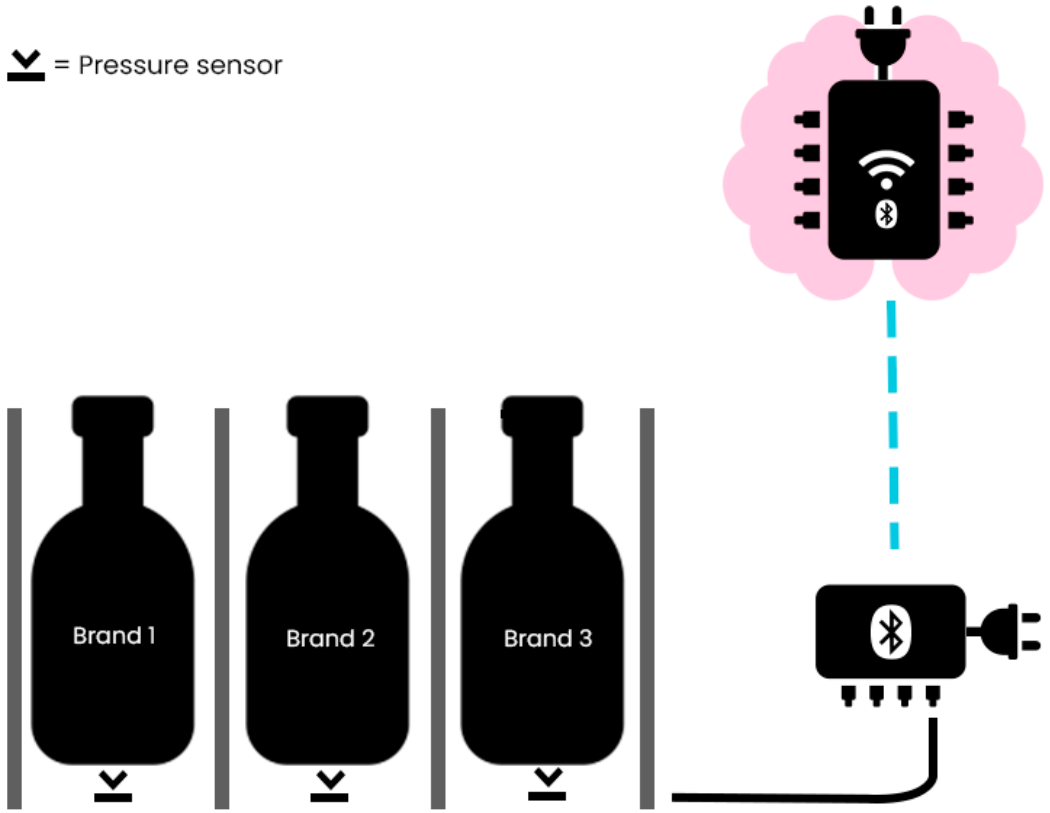
Centralized “brain” does not solve our original problems that were stated



Solution 3

Solution 3

Pressure sensors



Solution 4 

Solution 4

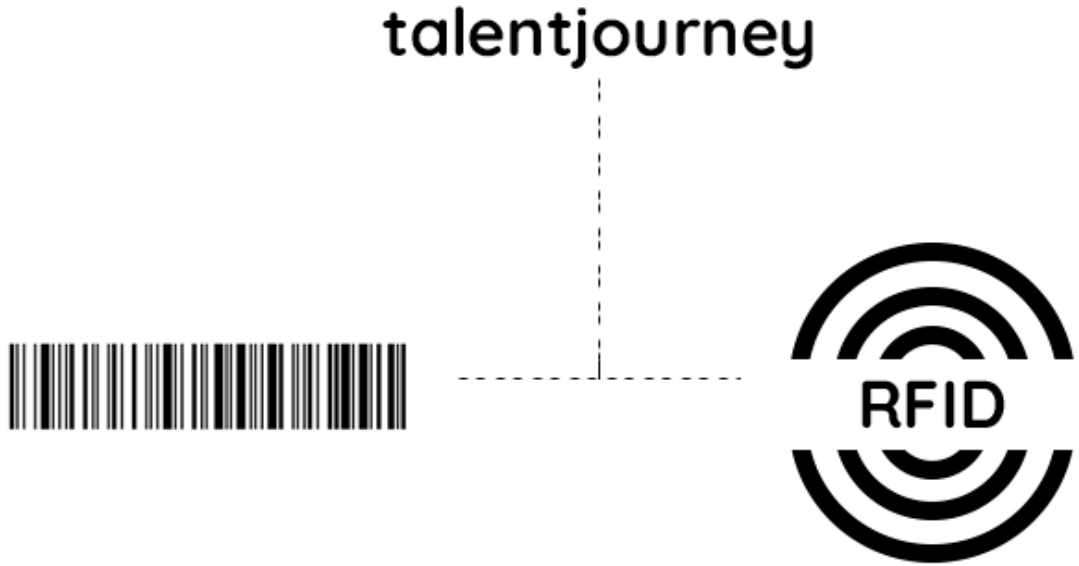
RFID Pressure sensors

Solution 4

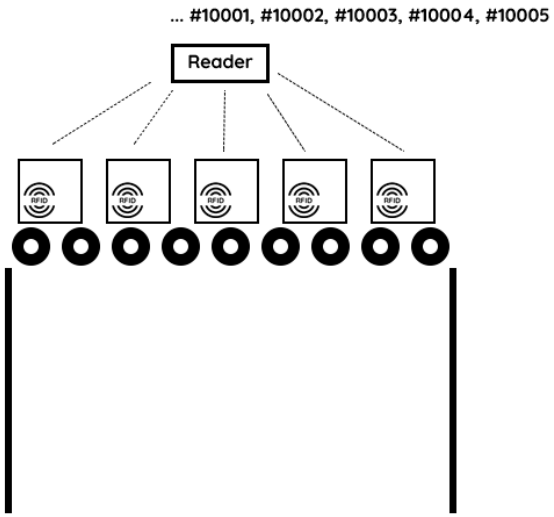
What is RFID?

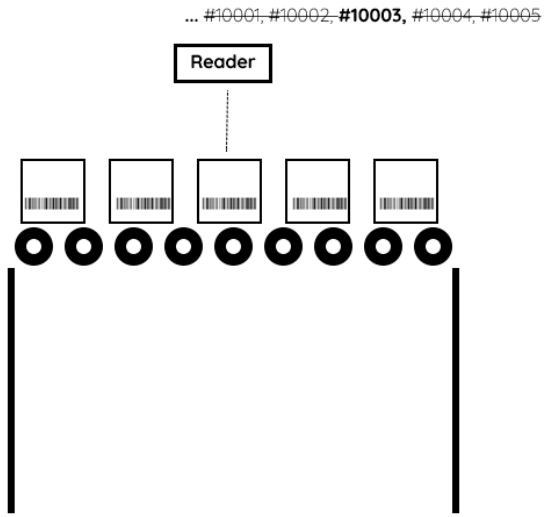
Solution 4

RFID vs barcode



RFID vs barcode

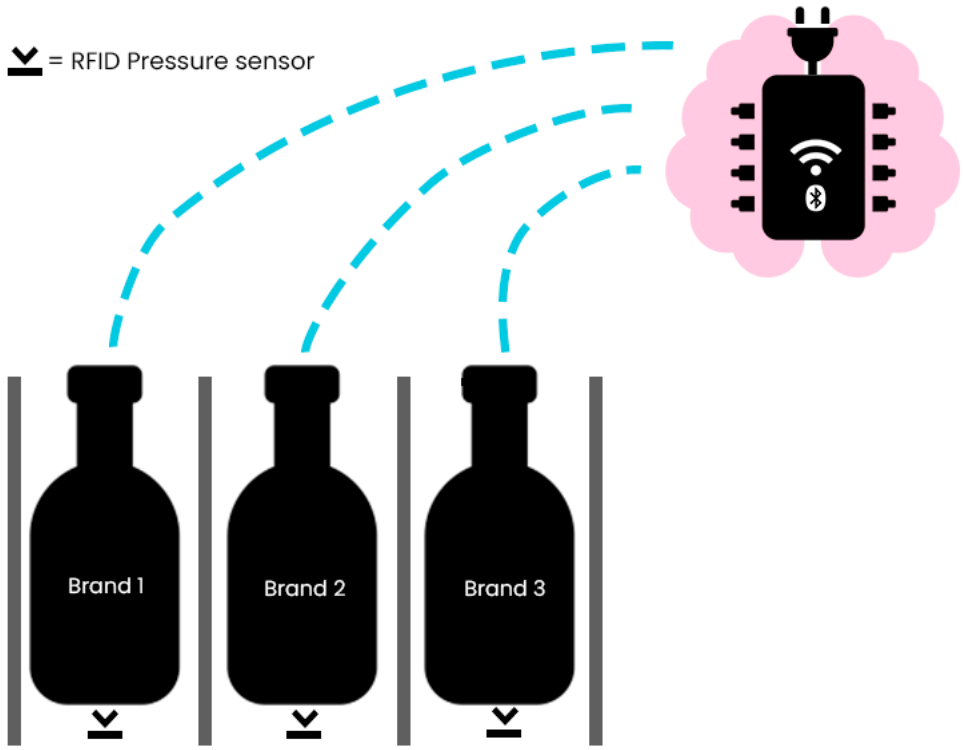




Solution 4

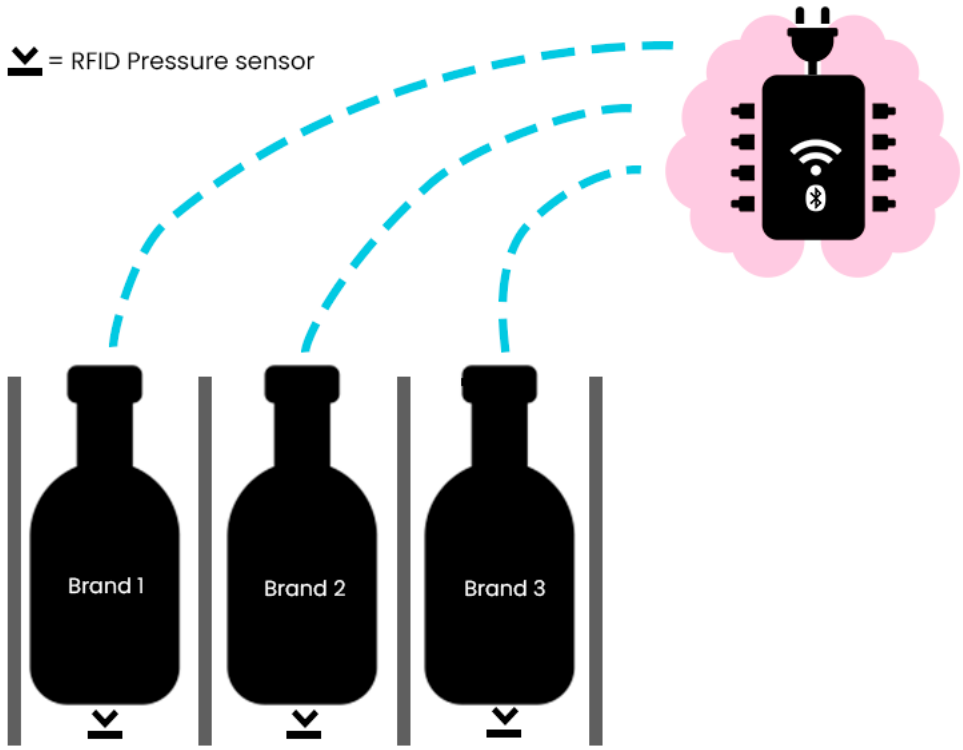
Here is a real-world example of that kind of sensor that also includes a temperature sensor:

http://www.farsens.com/en/products/eval01-fenix-vortex-rm/



Solution 4

- EVAL01-Fenix-Vortex-RM communicates from ranges like 5 meters away
- 2nd Gen RFID tags even from 16 meters away and semi-passive ones up to 50 meters away
- Cons: Readers are priced decently but they are not cheap
    - Decent reader costs at least 100€



WHICH SOLUTION IS THE BEST?

In your mind which solution is the best? Would you do something differently?

1. Please write down or make a video what do you think. Do not concentrate on a product itself or how useless it is. This has been just case study or a solution that shows how IoT can be applied to almost anything.

2. Design similar product. Plan and make a presentation of some IoT solution. Try to relate your design to your hobby or work life. For example, if you like fly fishing try to come up with a solution what useful or useless data you would like to get out of your fishing rod and how. Or if you are enthusiastic about solar power you can design something that relates to that. Be creative and have fun!

Ideate for 40 min. Please ask if any questions. Idea is to have fun ideation, nothing too serious.

This is your homework depending on how fast the training goes

Communication
Transferring data

Part 3.

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Here are the topics that we will go through in Part 3 of the training

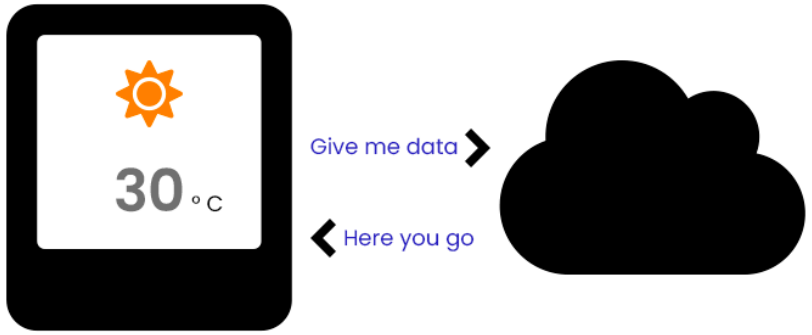
- Communication (read, send and read/send)
- DIY example
- Data and what it looks like
- Optimization case
- 5G
- Thanks, wrap up, feedback and homework

Communication

- Read
- Send
- Read and send

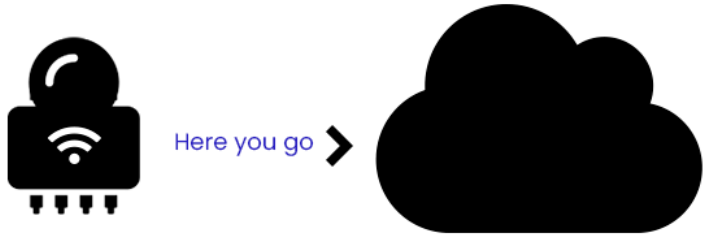
Communication

Read



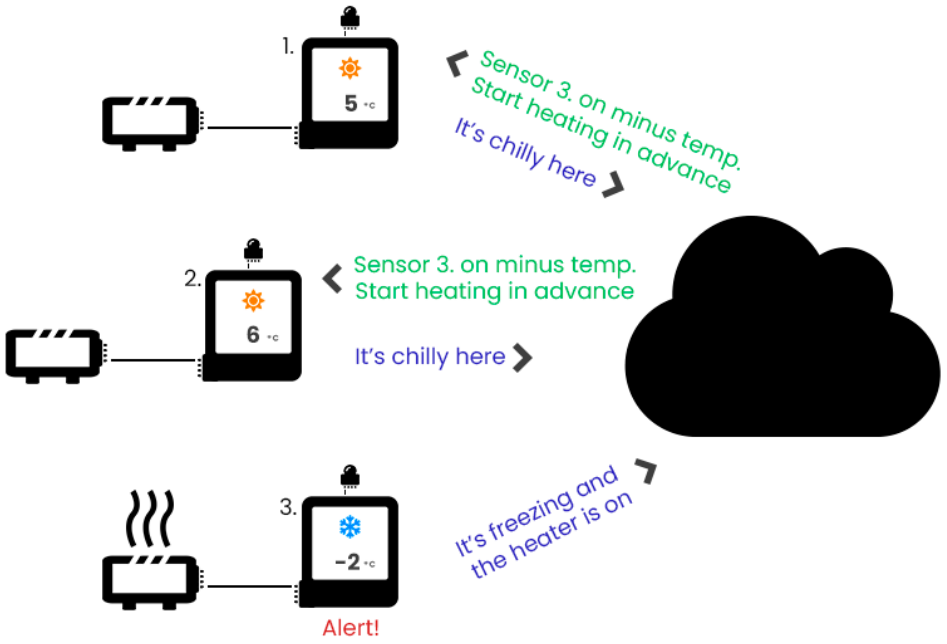
Communication

Send



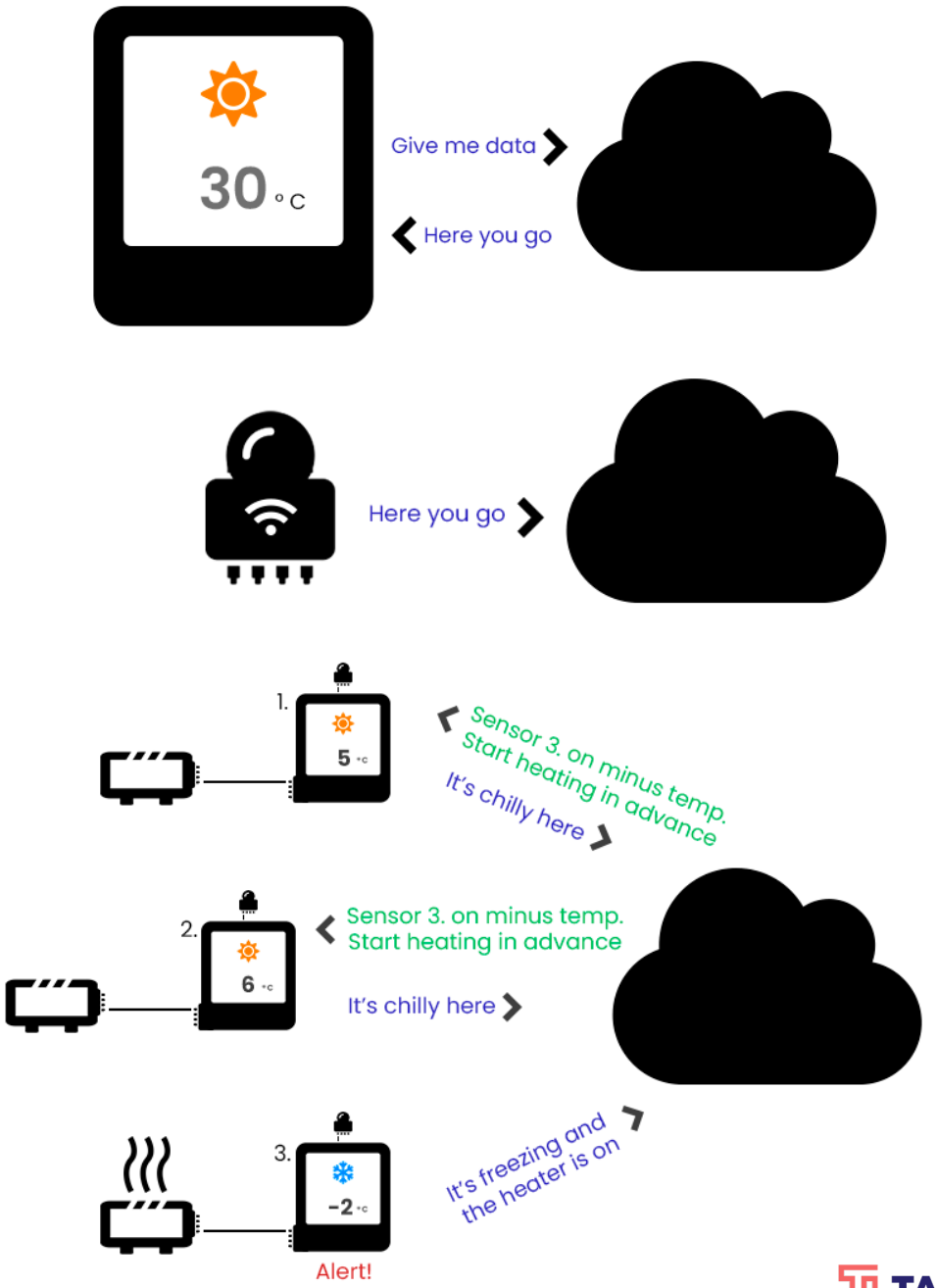
Communication

Read and Send



Communication

- Read
- Send
- Read and send



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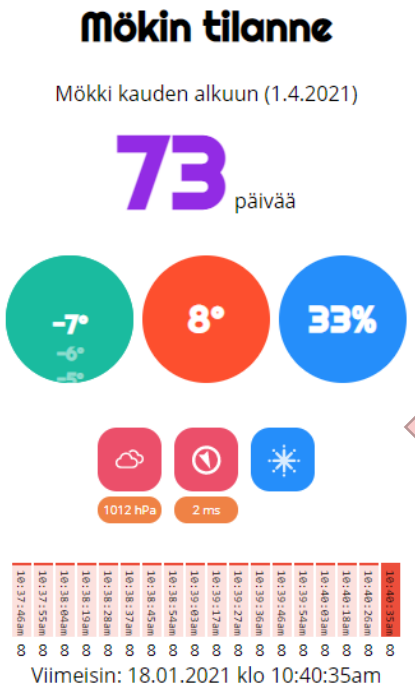
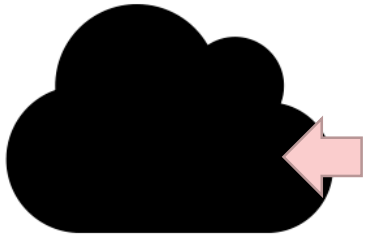
Real world example

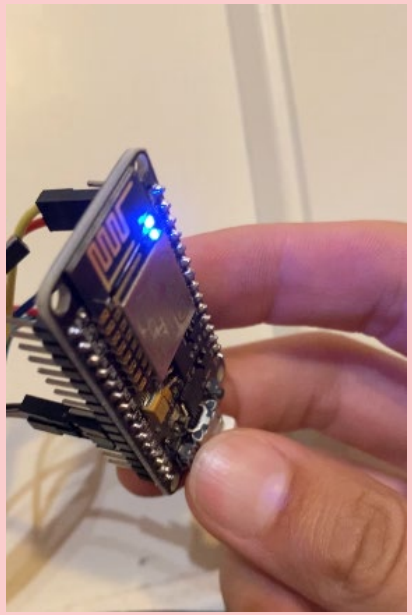
Monitoring app



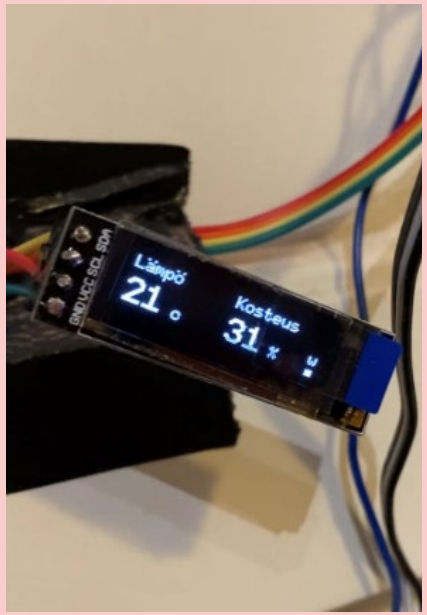
"Cloud"
Written in PHP



Brain
Application written in LUA



Local monitoring



Sensor

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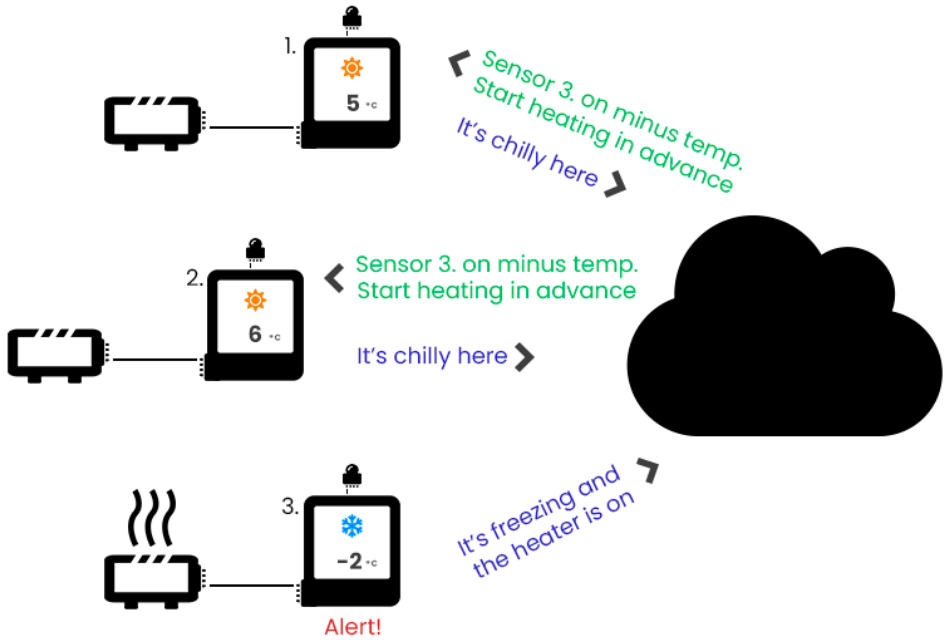
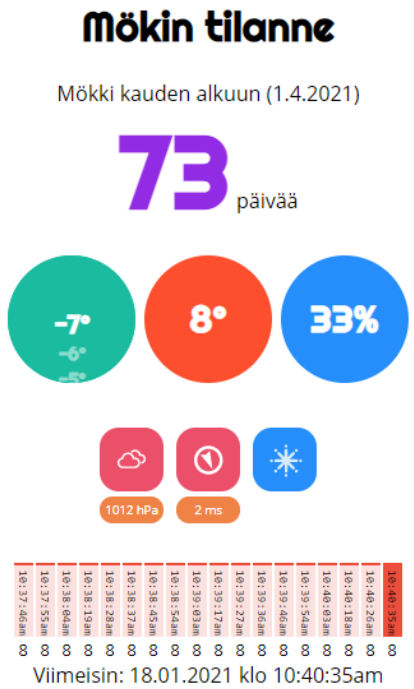
Real world example



Monitoring app



IFTTT

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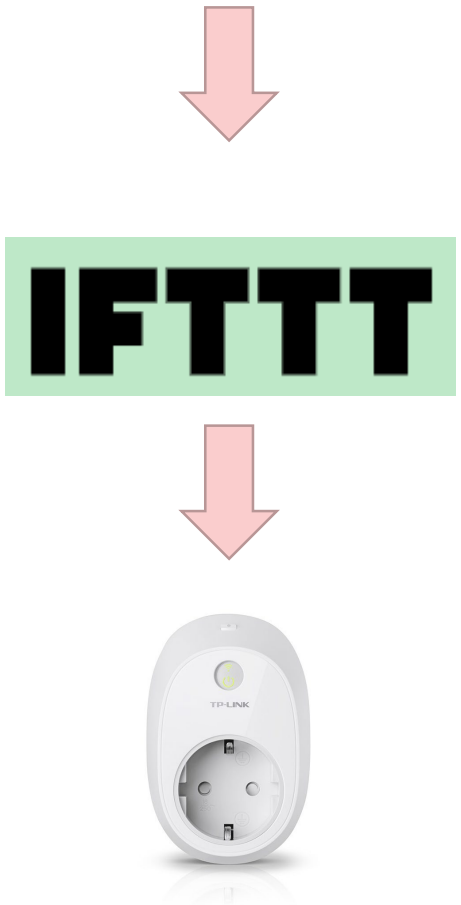
Real world example

(next stage)

- Currently heaters are manually controlled although scheduled
- **Plan**
  When ”cloud” service gets data that temperature is under 10 celsius degrees it sends command through IFTTT to smart plug which puts the heater on
- Why this has not been done yet?
  - Product is still in testing phase and I’m afraid that cabin where this system is in will burn down without enough testing
- This will lower heating costs



Data, Data, Data...

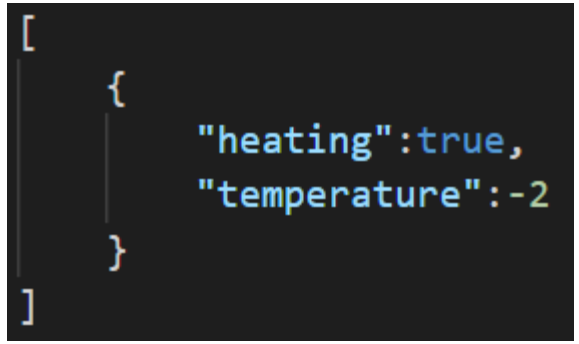
JSON data

- There are lot of standards how to transport data. One popular is JSON.
- You can read more about JSON here https://www.w3schools.com/whatis/whatis_json.asp.

JSON data

JSON data

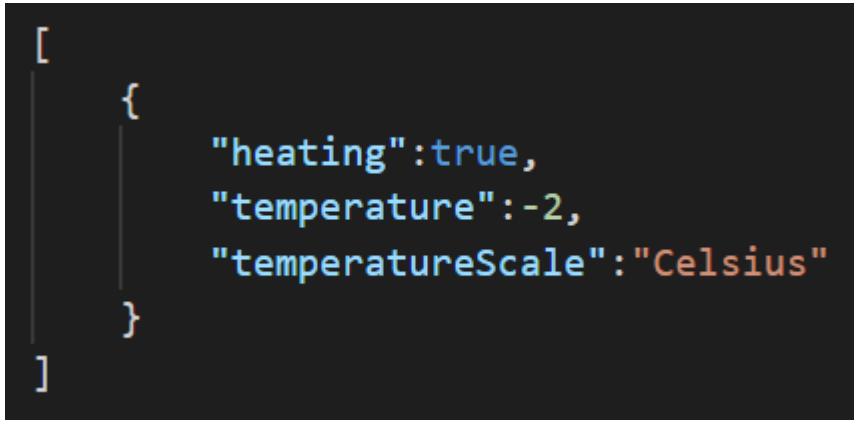
This is what data could look like



JSON data
Performance

Just transfer only the data that really is needed

- Data every 8 seconds
  - Adding temperature scale to the response (extra 200 bits) would in a year add only about 800mb
- Data every 100ms
  - Adding temperature scale to the response (extra 200 bits) would in a year add only about 60Gb



5G

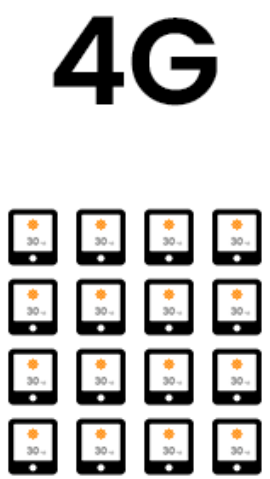
5G

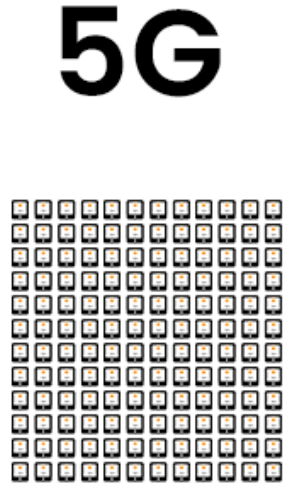
“The sheer numbers of devices that will now be able to connect has the potential to revolutionize everything from modern industrial practices and campus networks to industries such as agriculture and manufacturing. “

Source: tele2iot.com

5G
More devices

- 5g network is capable to handle more devices (more capacity)
- Uses new low frequensies
- Robust and reliable event to rural areas

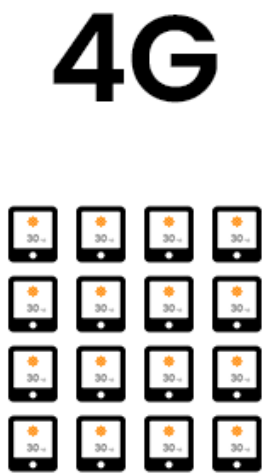


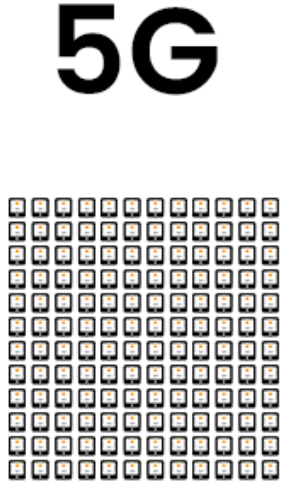


5G
Speed and latency

- Speeds from 100mb -> 1gb
- Latency from 30ms -> 1ms

- How latency affects us
  - https://w2g.tv/rzzqfcd0a9ubo5b5sq





5G

"IoT devices intended for industrial and other M2M applications are, unlike many consumer devices, better designed, better secured, and will, in many cases, connect to specific network slices or through IoT gateways, which will drastically reduce the potential for security breaches. That said, devices must be monitored to ensure they behave as intended."

Source: tele2iot.com

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Thank you!

Peter Virtanen, Satakunta University of Applied Sciences

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Feedback and self-reflection

- Any thoughts about this training?
- Open discussion about IoT, IIoT and the future of Industry 4.0. Hopefully we at Talentjourney will soon have **forum** where we all can start piling up data and discussions about Industry 4.0.

Please fill this form to give a feedback on black and white

https://forms.gle/apD62kayTtFWjhi37

List of videos viewed in this course

Homework (It is not over yet :)

This is the part where you become your own trainer. Life-long learning starts from here.

Take a look at videos that we already viewed and start to search more (Youtube will help you after watching these).

What is the Internet of Things (IoT)?

https://youtu.be/QSIPNhOiMoE

Using Predictive Analytics in Industrial IoT Applications

https://youtu.be/bBJ2ISaGIyQ

Consumer and Industrial IoT (IIoT / Industry 4.0)

https://youtu.be/kjSWh3Slmig

What is the Industrial Internet of Things (IIoT)?

https://youtu.be/HmbUJEShA-8

Data Analytics in manufacturing

https://youtu.be/lNvo9zKXMN8

Living with lag

https://youtu.be/_fNp37zFn9Q

What's next?

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Training	Training period	Learning objectives
Design Thinking	12. 11. 2020	History, main principles, methods and tools in Design Thinking process.
Holistic View of IoT	18. 1., 21. 1. and 22. 1. 2021	IoT state of the art with respect to smart manufacturing, devices and concrete examples.
Robotics	25. 1., 27. 1. and 29. 1. 2021	Robotics state of the art in smart manufacturing, collaborative robots, QA-oriented robots, examples of robots driving manufacturing growth.
Soft Skills	3. 2. and 4. 2. 2021	Problem solving, Critical thinking, Verbal and visual communication.
Digital Twins	8. 2. – 12. 2. 2021	Virtual replicas of physical devices, 3D simulation and optimization in smart manufacturing.
Green Skills	15. 2. - 19. 2. 2021	Sustainability, technical skills, knowledge, values.
Service Robots	8. 3. - 12. 3. 2021	Service robots state of the art, mobile robots driving versatile smart manufacturing and factory logistics, Exoskeletons empowering and supporting workers.
VR, AR and gamification in smart manufacturing	22. 3. - 26. 3. 2021	Virtual and augmented reality tools and gamification in smart manufacturing, application examples, learning by gaming.
IoT	12. 4. - 16. 4. 2021	Applied IoT project.
IoT and data enabled services	26. 4. - 30. 4. 2021	Cloud services, IoT and ERP.
AI	10. 5. - 14. 5. 2021	Data science, data analytics, deep learning, neural networks, AI in Education.
Cybersecurity	24. 5. - 28. 5. 2021	Cybersecurity elements, threats, benefits, challenges.

Hands on project

More information on https://talentjourney.si/

Holistic view to IoT

Icons from:
Fontawesome.com

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Thank you!

Again

and have a great weekend!

Peter Virtanen, Satakunta University of Applied Sciences

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