Introduction to the Internet of Things

Session 10

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Outline

- More on the Internet of Broken Things

- Sensors and actors summary

- Lights and animations

- Project 2 presentation

Research Exercise: Fixable?

- Do individual research on if the Internet of Broken Things is fixable (8min)
  - Come up with 3 action points that when addressed will fix the IoBT
  - 1 argument for continuing to use and build the Internet of Things
- Discuss with neighbor (or in groups of 3) and integrate action points into common list of 7 points, merge arguments
- Prove my hypotheses wrong: "We should abandon all work with the Internet Of Things and only focus on classics (mobile devices and industrial building automation)."
- Everything into research report

Textbook Advice

- Emphasize security from day one

- Lifecycle, future-proofing, updates

- Access control and device authentication

- Know your enemy

- Prepare for security breaches

N Hajdarbegovic. *Are We Creating An Insecure Internet of Things (IoT)? Security Challenges and Concerns.* Toptal. https://www.toptal.com/it/are-we-creating-an-insecure-internet-of-things
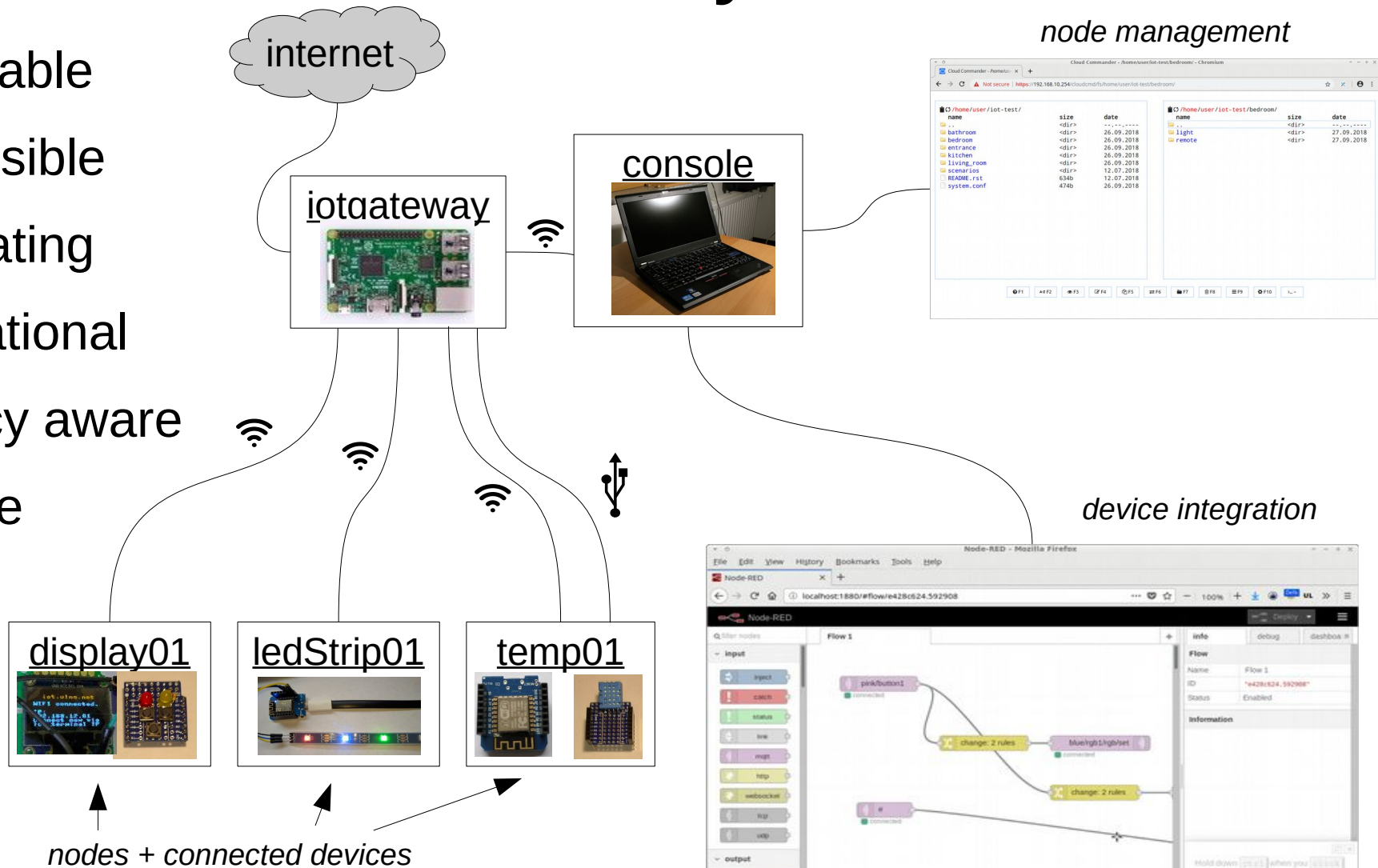
Counter Measures

- What can be done?

Counter Measures

- Awareness

- Layered architectures

- Avoid wireless

- Active and aware community

  - supporting and

  - auditing software and hardware

- Openness about core infrastructure

  - easy to audit

  - easy to update

- Build security into

  - life cycle management

  - maintenance

- Better symmetric encryption than insecure unvalidated asymmetric

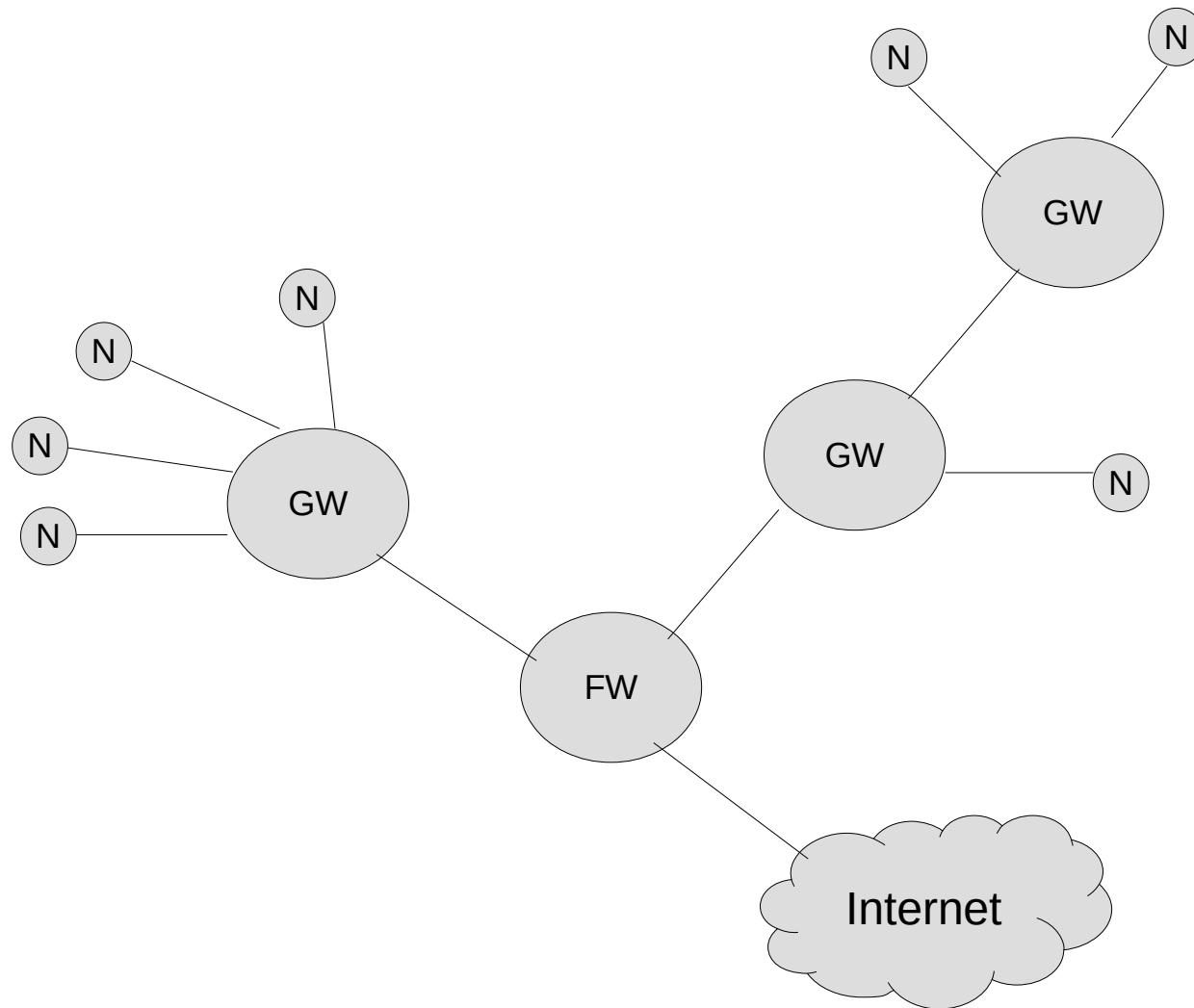# IoTempower (Layered Architecture) Framework and Ecosystem for IoT

- Affordable
- Accessible
- Motivating
- Educational
- Privacy aware
- Secure

internet

iotgateway

console

node management

device integration

nodes + connected devices

display01

ledStrip01

temp01

For more info:
- http://iot.ulno.net
- https://github.com/iotempire/iotempowe

Layered Architecture
(in IoTempower)

Summary

- Let's be aware of security issues in IoT.

- Let's take system architecture into account → think in systems!

- Let's prevent breaking the Internet of Things!

References

- **N Hajdarbegovic.** *Are We Creating An Insecure Internet of Things (IoT)? Security Challenges and Concerns.* Toptal.
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- **AJ Shipley.** *SECURITY IN THE INTERNET OF THINGS - Lessons from the Past for the Connected Future.* Security Solutions, Wind River, White Paper, 2013.
  https://www.windriver.com/whitepapers/security-in-the-internet-of-things/wr_security-in-the-internet-of-things.pdf

- **D Goodin.** Lenovo PCs ship with man-in-the-middle adware that breaks HTTPS connections.
  https://arstechnica.com/information-technology/2015/02/lenovo-pcs-ship-with-man-in-the-middle-adware-that-breaks-https-connections/

- **C Osborne.** Internet of Things devices lack fundamental security, study finds.
  https://www.zdnet.com/article/internet-of-things-devices-lack-fundamental-security-study-finds/

- **DA Hendricks.** *The Trouble with the internet of Things.*
  https://data.london.gov.uk/blog/the-trouble-with-the-internet-of-things/

Summary: Sensors/Actors

- Sensing
  - temp/humidity/pressure
    - ds18b20 (dallas)
    - Barometers BMP180, BMP280 (*)
    - Analog thermistor
    - DHT11
  - Buttons
    - MPR 121 capacative sensor
    - Ttp223b single capacitive touch button
    - Button KY-004
  - Distance
    - Acoustic Distance HC-SR04
    - Optical distance VL53L0X
  - Weighing with HX711AD
  - Gyroscope MPU6050/9250
  - Magnetic sensors
    - Analog light sensor
    - Analog hall sensor
    - Reed switch
  - Light lock
  - Tilt switch
  - Analog noise sensor
  - IR receiver (**)
  - Obstacle sensor
  - line tracking sensor
  - RFID-RC522
  - PCF8591

- More sensing
  - Gas Sensors
    - Smoke Sensor MQ-2
    - CO Sensor MQ-7
    - Alcohol-Sensor MQ-3
  - Digital Light Sensor TSL2561
  - Analog Rain Water Sensor
- Acting
  - Servo motor/hacked (360) servo
  - Relay (can attach solenoid lock)
  - RGB led
  - WS2812 RGB Strip
  - 2 types of I2C LCD displays
  - Small red laser
  - Dual color led
  - Flashing color cycle led
  - IR led (**)
  - Buzzer
- Hybrid: Computer, cellphone

Sensors/Actors
15min research task → report

- Pick sensors/actors, we haven't used in labs or discussed in lecture yet

- Distribute with neighbor (each takes half)

- Find function/features

- How are they connected/wired to microcontroller?

- Examples (applications) for using them

Lighting and Light Animation

- Demonstration

Project 2 (4-8 persons)

- Outline an IoT scenario covering at least 4 different domains, which mostly can be implemented with the existing hardware.

- Domains can be for example: logistics, comfort, entertainment, wearable computing, health, arts, security, privacy (residential home automation is excluded)

- Fully specify the scenario into a playable pitch which will be enacted by all team participants in final presentation.

- Realize the scenario in soft- and hardware, document all the development (including problems), specify who has done how much in respective portfolios.

- Wrap it into a sales pitch+presentation including the play-through with real hardware of the scenario, for non-working parts create respective mockups.

- Practice and record the scenario play-through as a video and link it in the portfolios.

- The project does not need to generate money, a community benefit is enough.

- The scenario has to be approved by the instructor and can be altered during the development process in accordance with the instructor.

- Share video on the final presentation day (15-25min) + up to 10-15 minutes story pitch + 5-10 minutes of extra technical explanation. (Share in a way that other class members can watch movie for a week to rank and rate it in their portfolios.)

Lab 10

- If not done yet, finish project 1
  - I am reviewing portfolios and project 1 reports today
- Project 2
- Build team with 4-8 persons (take time to match)
- If you are more than 5 persons, elect a leader (product owner) and a logistics master (scrum master)
- present ideas/scenarios to each other
- Start designing scenario(s) and ideas for project 2
- Try esp-now distance test with esp32s
- Rgb-strip + animation on wemos led shield (in IoTempower)
  - make 2x3 leds fade from one color to the other by command from mqtt
    - these two animations can run/triggered by mqtt independently from each other
  - all leds as lightning (random flashing in white) + thunder when triggering in node-red
- If not today than tomorrow in next lab (in IoTempower)
  - Control servo motor / implement example
  - Learn how to read and program RFID / implement example