Kiel University
Christian-Albrechts-Universität zu Kiel

Research Group
Distributed Systems

Internet of Things & Wireless Networks

Updates and Projects

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Summer Term 2020

Updates

- We received some questions
  - Why do you use all the videos from Berlin? Was this planned?

No, this was not planned

- But is was the only to make this course work
  - Due to Corona
    - The time I was planning to use to prepare the course just disappeared: we had to figure how to teach
  - Due to the size of the course
    - So my next plan was to prepare the slides during the semester, but….
      - I had to get deeply involved in lab grading etc.
    - We have roughly 120 registered participants (and had planned for 30)
- The videos cover 90% of what I was planning to do
  - I would have done some more on routing
  - Instead, you have now some more cellular networking than originally planned
    - This is actually good, as cellular systems will be very important for IoT
- So, I am sorry,
  - but this was the only way to be able to offer the course this term

Project

- Suggest your own project
  - Pick a topic in/related to the course
    - And make a small project from it
  - Or extend the lab tasks
  - Or combine it with a topic from another course you have taken
- Our suggestion: Build a simple, IoT Corona Contact Tracker
  - Details follow on the coming slides

- How much? Roughly two normal labs
  - Remember the course is V3, Ü2, P1
  - The project is the “P1” is notation

Why

- Get experience in defining your tasks yourself
  - Estimate complexity, feasibility, and workload

- Key learning experience
  - For bachelor and master thesis
  - For projects
  - For real-life
    - You: Let’s do the following
    - Boss: How long will it take?
    - You: One week.
    - *Two weeks later.* You: Boss, there is a problem…

Part 1: Project Idea

- Pick a topic, research it a bit

- Present it as a Video
- 5 minutes, suggested: 4 slides max
  - Content
    - Motivation
    - Goal
    - Approach
    - Expected Result
      - For 5 points we do this, for 10 points we do this, for 15 points we do this…
        - You need to state these three milestones! They will be used for the final grade
      - Add challenging scenarios to make it worth 15 points!
- We will make all video available online on iLearn or OLAT
  - So you can see what the other teams are planning

Part 2: Project work

- Do the work
- Present it (10 to 15 min)
  - Motivation
  - Restate goals
  - Results (goals achieved)
  - Demo / Video
  - Approach
  - Lessons Learned
  - …
- Presentation: we are working on this
  - Most likely either video or Zoom
- If video: We will make all videos available online on iLearn or OLAT
  - So you can see what the other teams have done

Grading criteria

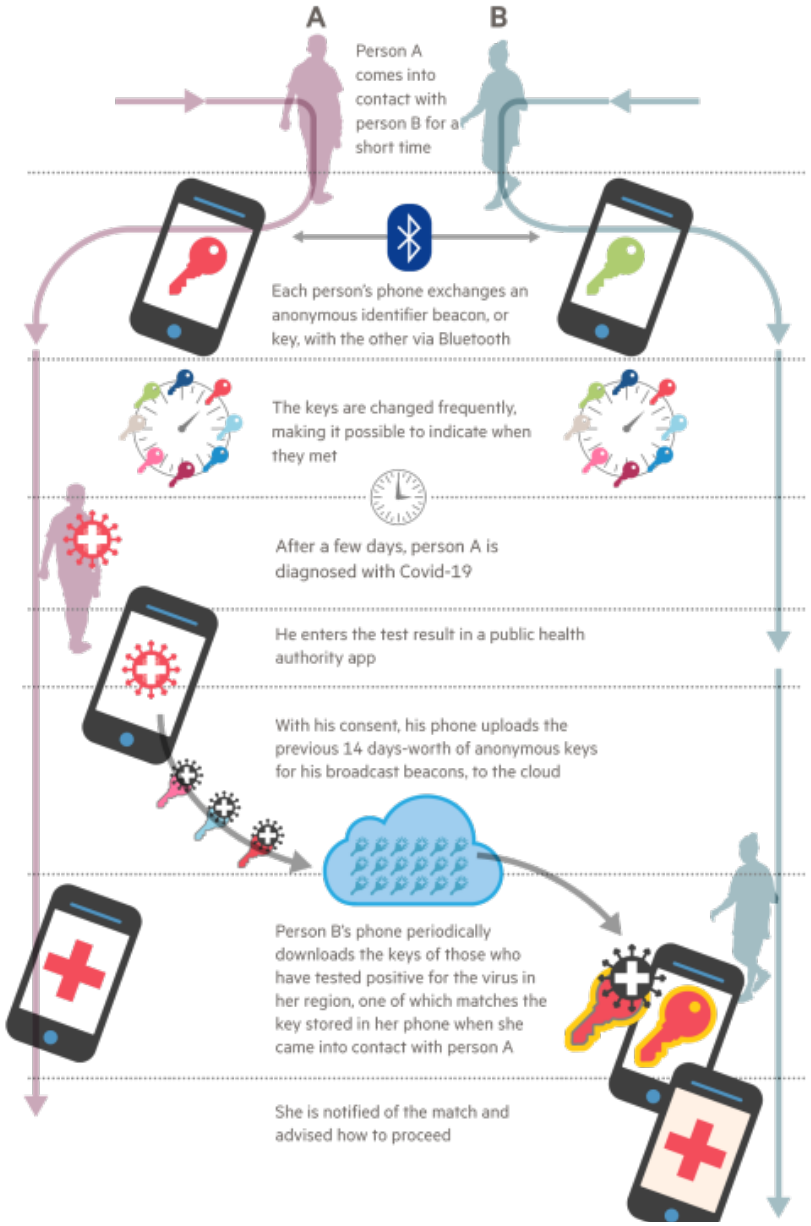
- Project proposal (5 points)
  - Presentation
  - Level of ambition (not too much, not too little)

- Project (15 points)
  - Quality
  - Presentation
  - Goals reached vs goals claimed
    - 5 points milestone, 10 points milestone, 15 points milestone?

Corona contact tracing

Basic Idea via Smartphone

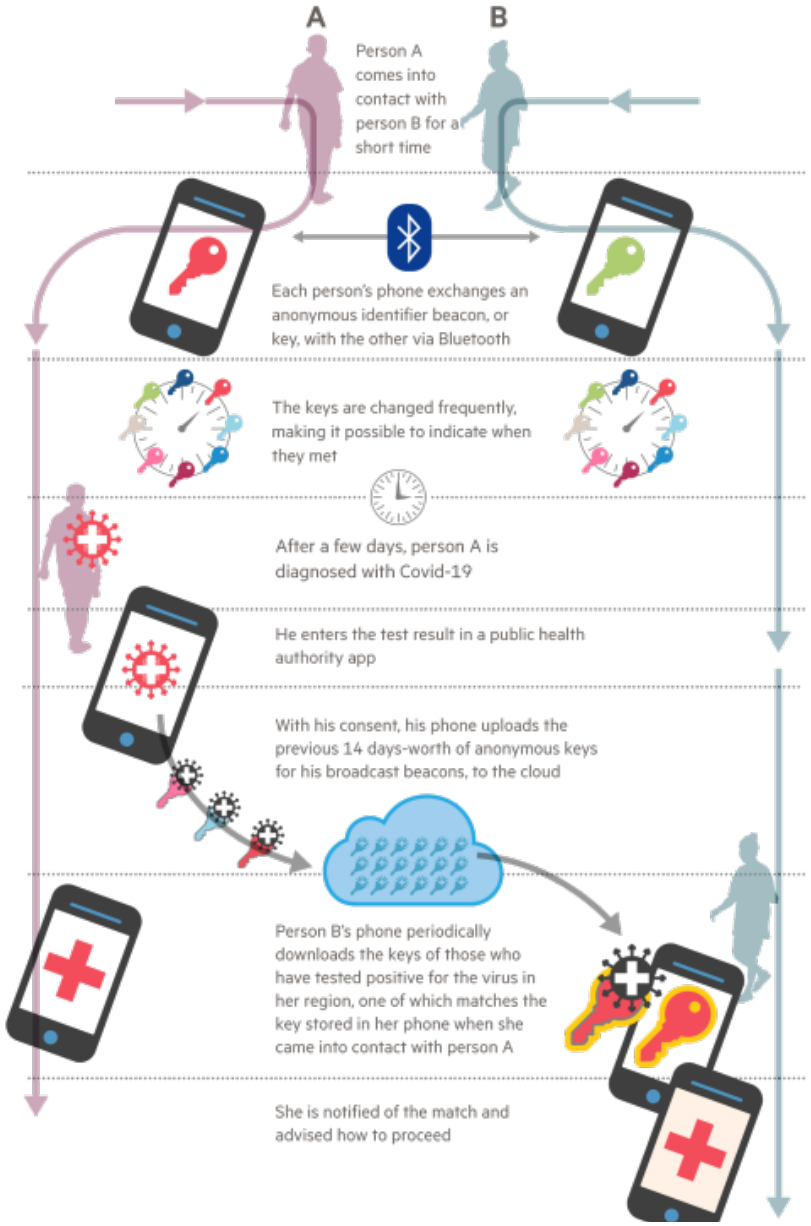
- App on a smartphone
- Sends out Bluetooth (BLE) beacons
  - App changes own beacons frequently to avoid tracking of people
- Records beacons it receives from others



Corona contact tracing

Basic Idea via Smartphone (cont.)

- Up on infection
  - Upload beacons the phone sent out in the last 14 days to database
- Others, once a day (or so)
  - Check database if it contains beacons that I also received



Motivation

- Why do we need a smart phone for this?
- We can send beacons and receive beacons via an small IoT device!

- Ok, Cooja focuses on ZigBee/802.15.4
  - But that should not matter this project
  - And, btw, Cooja can simulate mobility

Base Task

- Check Corona contact tracing documentation (see next slide)
- Implement sending, receiving and logging of beacons similar to the real devices
- Use mobility model in Cooja to let nodes walk around (see below)
- Add a backend via serial ports (see below)
  - Where nodes can upload their keys upon infection
  - And can check whether they had contact to infected nodes

Base Task (cont.)

- Let the virus spread:
  - Define some nodes as infected
  - Infected nodes will spread the virus
    - when they are close to other nodes for a certain duration (maybe following some random distribution)
    - will feel symptoms eventually and go home (just turn the node off for a while until eventual recovery)
    - Upload their keys to the database, see previous slide
  - Other nodes will check database
    - And go to quarantine accordingly if they have been exposed according to the contact key: just turn the node off for a while
- Notes:
  - There shall be false positives and false negatives:
    - Some nodes had contact according to your logs but did not get infected and vice versa
  - Recovered nodes cannot be infected again
- Use proper visualizations via LEDs

Even more on the base task

- Key question!
  - Can you stop the Virus?
  - Or just slow it down?

- What properties does your system need to achieve this?
  - When is a contact a contact?
  - How many people do your send to quarantine that are not infected?
  - How many infected people does your system miss? I.e., people that should have gone to quarantine but your system did not record a contact, as it was, for example to short?
  - What if some people do not listen: go out although should be quarantine
    - i.e., they are infected and do not know about it (yet) and your contact tracing sent them to quarantine but they did not listen?
- Extend base task (see below)

Corona Tracker Documents

- https://medium.com/@OpenTrace/review-of-new-apple-and-google-contact-tracing-protocol-7696c9203967
- https://www.weforum.org/agenda/2020/04/apple-google-working-technology-for-coronavirus-contact-tracing/
- https://www.wsj.com/articles/curbing-coronavirus-with-a-contact-tracing-app-its-not-so-simple-11588996809

- https://covid19-static.cdn-apple.com/applications/covid19/current/static/contact-tracing/pdf/ExposureNotification-FAQv1.1.pdf
- https://denken.io/2020/04/06/dp3t-the-technology-behind-corona-apps-and-pepp-pt/
- https://github.com/corona-warn-app/cwa-documentation
- https://www.republik.ch/2020/04/16/so-funktioniert-eine-corona-tracing-app-die-ihre-privatsphaere-schuetzt

Possible things to focus / extend on?

- What is contact?
  - Duration? Signal strength?
- Compatibility: get your beacons and database as similar as Google, Apple / how the governments do it.
- Privacy: can you break it? Trace people throughout the day?
- Energy duty cycling (see next slide)
- Backend: via serial port (see below)
- Spreading of the Virus
  - False positive, false negative

Serial Port and Backend

- Cooja allows you to connect to each of your nodes
  - Via the “serial socket” in server or client mode
- Implement a “database” in some high-level language outside of Cooja
  - where you store the keys (could be a simple dictionary or map)
  - And connect to each sensor node
    - Use socket programming and TCP to connect to the serial socket of Cooja
    - One TCP connection per node in Cooja
    - So that nodes can send data to the database and query it

Duty Cycling?

- Devices have small batteries.
  - Cannot have radio on all the time!
- Reading
  - Check out duty cycling in Bluetooth!
  - Read about duty cycling in Wireless sensor networks
  - How do nodes sleep? How do they send advertisements?

- Contiki Energest: helps to track CPU and Radio on-time
  - https://github.com/contiki-ng/contiki-ng/wiki/Documentation:-Energest
- You can turn the radio of a node on and off
  - https://contiki-ng.readthedocs.io/en/develop/_api/radio_8h_source.html
- Task: Can you improve energy efficient, while not missing too many contacts? How frequently should nodes send out beacons? How often shall they wake up to receive

Cooja notes

- Mobility Plugin
  - https://anrg.usc.edu/contiki/index.php/Mobility_of_Nodes_in_Cooja
  - http://contikiemj.blogspot.com/2018/03/mobility-plugin-in-contiki-30-cooja.html
- Random Way Point Model
  - https://github.com/msloth/RWMMSim
- Crypto in Cooja
  - Cooja does not support hardware acceleration for crypto
  - Use the software libraries, or send without encryption

Do you have access to some IoT hardware?

- Usually, we would hand out some hardware
  - But we are not allowed to do so this these days
- But if you have access to
  - Arduinos and similar
  - Raspberry Pis and similar
  - Or want to use to smartphone

  - You are welcome to write code for such platforms

If you remember the labs presentation…

- Project is mandatory
- For the exam
  - You need 50% of the lab points and 50% of the project points
  - Both can help to improve your exam grade
- The project is worth 20 points:
  - 5 for proposal
  - 15 for project itself
- Project workload: roughly two labs
- Same teams as in the labs

Proposed topics are…

- …Just hints!
  - Not specific on purpose
  - We want you to make your interpretation of the topic
  - Allows for multiple groups on similar topics

- Again, your own ideas are very welcome!

Project Feedback & Questions

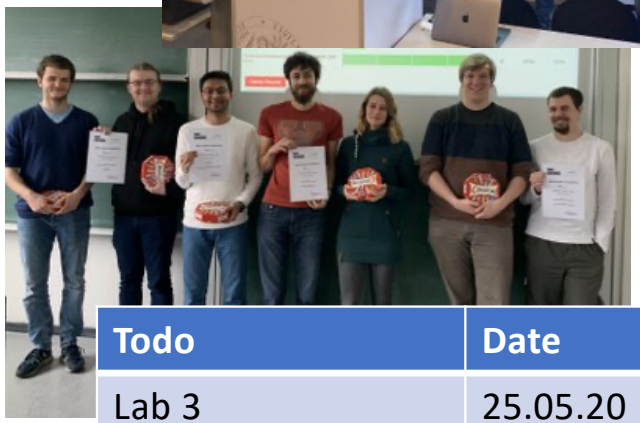
- You submit your proposal
  - We will check it and let you know if there is a need for changes

- We are available during the project for discussion and feedback if needed

Submissions, Presentations, Awards

- Project Proposals (due 29.05.20)
  - Submit presentation in iLearn
  - Video of your presentation via dropbox etc. (max 5 minutes, see above)

- Project (due 29.06.20)
  - Submit slides in iLearn
  - Presentation itself: we are working on this, likely
    - Present via Zoom
    - Or submit as video via dropbox
  - Best project awards
    - On popular vote: From the students for the students



Todo	Date
Lab 3	25.05.20
Project Idea	29.05.20
Project	29.06.20

Questions?

Please stay safe and healthy!