Aalto University
School of Science

T-110.6120 Special Course in Data Communications Software P (5 cr), Spring 2014

WELCOME!

Department of Computer Science and Engineering
Yu Xiao, Antti Ylä-Jääski and Teemu Kämäräinen

WELCOME TO THE COURSE

Responsible teachers:

Dr. Yu Xiao yu.xiao@aalto.fi

Prof. Antti Ylä-Jääski antti.yla-jaaski@aalto.fi

Course assistant:

Teemu Kämäräinen teemu.kamarainen@aalto.fi

Invited lecturers:

Prof. Sasu Tarkoma sasu.tarkoma@helsinki.fi

Dr. Matti Siekkinen matti.siekkinen@aalto.fi

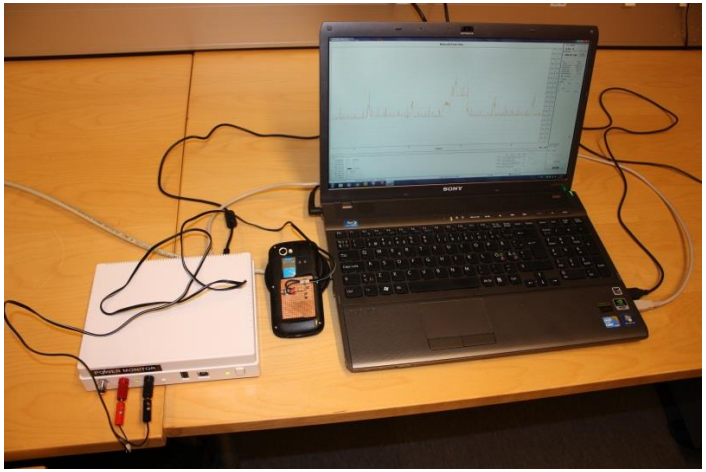
Agenda Today

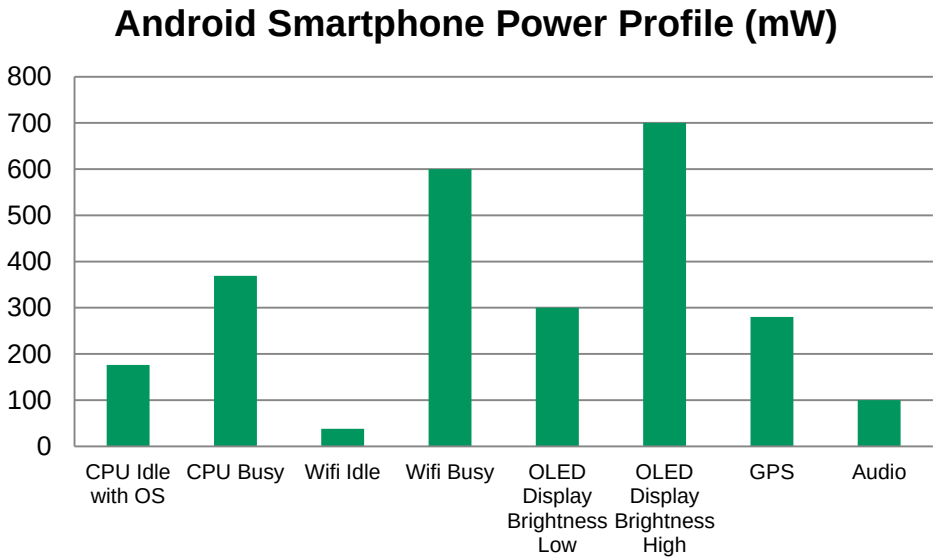
- Learning outcomes
- Learning methods and study materials
- Assessment and important dates
- Practical guidelines for individual/group assignments
- Q & A

Learning Outcomes

After the course, participant can:

1) **measure power consumption of smartphones and identify the impacting factors of power consumption**





Learning Outcomes

2) **describe the power management strategies implemented in mobile OSs(e.g. Android, iOS), and the power saving mechanisms defined in wireless network standards (e.g. 802.11, 3G, LTE)**

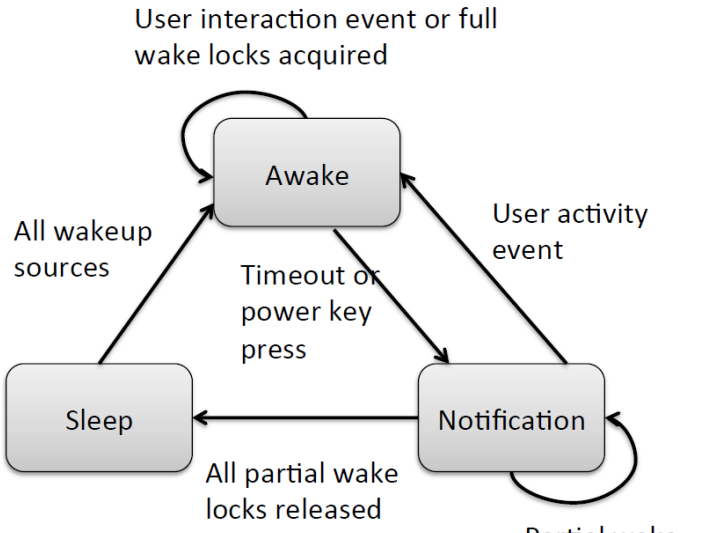


Fig. Android Wakelock

Learning Outcomes

3) **gain an overview of current research issues in the area**

e.g. power modelling techniques, energy-efficient mobile sensing/streaming/offloading

4) **implement the power saving mechanisms presented in the literature, and recognize challenges in designing and implementing energy-efficient mobile applications**

Which power saving mechanisms can be applied to my application? How to apply these mechanisms properly?

Learning Methods and Study Materials

- **Lectures**

1) 15.4.2014 14.15-16.00 T5 **Power measurement and analysis**
2) 16.4.2014 13.00-14.00 A106 Tutorial on power measurement

3) 23.4.2014 14.15-16.00 T5 Wireless networking
4) 28.4.2014 14.15-16.00 T3 Mobile sensing
5) 29.4.2014 14.15-16.00 T5 Computation

How to save energy?

6) 13.5.2014 14.15-16.00 T5 Toolkits and other practical issues

If you have not completed the online survey, please submit it by 6pm today.

Here is the link:

https://www.webropolsurveys.com/S/7615E2E2C48BE06E.par

We will make necessary adjustment to our lecture content according to your feedback.

Learning Methods and Study Materials

- **Independent study**

Textbook: “Smartphone Energy Consumption: Modelling and Optimization” by S. Tarkoma et al, Cambridge University Press, 2014.

(A draft of this textbook can be downloaded from Noppa.)

Lecture slides: will be published on Noppa after each lecture

- **Choose 3 lectures and write reflections of them in lecture diaries.**

Learning Methods and Study Materials

- **Group Work (Learning from Practice)**

Each group includes 2 to 3 students. The role of each member must be clearly defined.

Part I (16.4.2014~6.5.2014): Select an opensource Android app from the list given by the teachers, and analyze the energy-efficiency of the selected app based on physical power measurement.

List of OpenSource Apps

1) Spydroid-ipcamera (streams the camera and microphone of your phone to your browser or to VLC)

2) Frozen bubbles (Game)

3) MIT funf sensing framework

4) Toolkit for speech recognition: CMU Sphinx

5) OSM HTML5 video player

6) Twitter client for Android: twimight

The application list is published on Noppa. If you would like to work on other apps, please send your request to yu.xiao@aalto.fi and ask for permission.

Learning Methods and Study Materials

Part II (16.4.2014~27.5.2014): Find a solution to improve the energy-efficiency of the selected app, implement the solution, and evaluate it with power measurement.

You can apply the power saving mechanisms described in the literature, or propose your own solution.

- **1st feedback session (6.5.2014 13.00-17.00 T5)**

Discuss with teachers and other groups about your findings of Part I and your proposal for Part II.

- **2nd feedback session (27.5.2014 13.00-17.00 T5)**

Present the final results of Part II and get feedback from teachers.

- **Write a report (including Part I and II)**

Learning Assessment and Important Dates

- **Course grading (scale: 1-5) is based on the final report of the group assignments.**
  - ✓ Part I: 30%
  - ✓ Part II: 70%
- **It is mandatory for each group to make presentations in feedback sessions (6.5.2014 and 27.5.2014). You can improve your report based on the feedback you receive.**
- **Lecture diaries will be evaluated with pass/fail. If you fail to submit 3 lecture diaries, you will not get any credit from this course.**
- **Deadline for groupwork report and lecture diaries is 30.5.2014.**

Assessment Criteria for Group Work

We will evaluate

- **you can conduct power measurement and consumption analysis**
- **you understand the power saving mechanisms**
- **you can apply the power saving mechanisms**
- **the results have been presented clearly**

Energy savings can vary with the apps you select. Your grade is not determined by how much energy you save. Invention of new solution is encouraged, but is not necessary for getting better grade.

Estimate of Workload

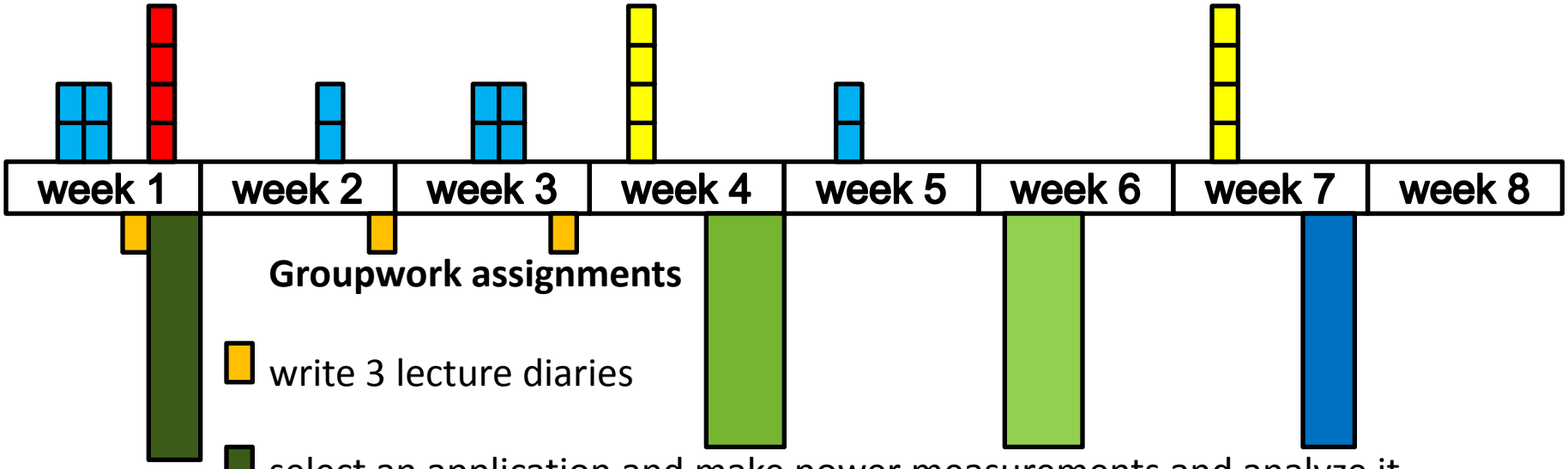
- **Lectures(incl. Feedback sessions) 20h + Tutorial 1h**
- **Individual study (incl. reading textbook and other references, writing lecture diaries) 34h**
- **Part I of group assignment 20h**
- **Part II of group assignment 60h**

Contact teaching

6 times 2 hour lectures

students present their measurement results in two seminars

assistants available to help making power measurements



Groupwork assignments

write 3 lecture diaries

select an application and make power measurements and analyze it

propose a solution to improve energy efficiency

implement the proposed solution and measure power usage

write a final report

Practical Guidelines

How to Write a Lecture Diary

- In a lecture diary, identify (about) **3 to 5 main points** of the lecture, and shortly describe why you selected them and why these points are relevant for this course with a title "energy-efficient mobile computing"

For example, if you choose power measurement and power modelling, you can describe the key ideas of these techniques, and explain for what purpose these techniques can be used, how the results of measurement/modelling can be used for building energy-efficient mobile applications, and how power measurement is related to power modelling.

How to Write a Lecture Diary

- You are expected to glance through parts of the textbook and write in your own words a bit more than what was lectured. (We do not expect you to spend time in searching for more references when writing lecture diaries.)

- Write altogether **about one paragraph on each point**, about 50-100 words, so that one lecture diary is **max one A4 page of text**

How to Write a Good Report (Part I)

A good report is expected to cover:

1) **Overview of the selected application(e.g. functionality, requirement for network connectivity, access to local sensors)**
2) **Design criteria and description of test cases (e.g. what kind of power consumption behavior do you want to study through these test cases? Are your test cases sufficient?)**
3) **Measurement metrics you choose(e.g. Power(W), Energy(J), unit cost, energy utility)**
4) **Experiment setup (e.g. how do you measure power consumption? How do you set up network connection? How do you monitor network traffic?)**
5) **Experiment results (you can use figures and tables to present your results)**
6) **Discussion(e.g. findings from your study, lessons you learn)**

Presentation in 1st Feedback Session

- **Each group has in total 20 min to present (10min)and discuss(10min) about their work**

- **It is not a formal presentation. It is just for internal discussion. So do not spend too much time in decorating your slides. Try to allow more time for discussion.**

Presentation in 1st Feedback Session

- **4-5 slides would be enough. Just list the key findings from your experiment, and remember to list questions or issues that you would like to discuss with teachers and other students**

  - *Slide 1: overview of the app*
  - *Slide 2: test cases*
  - *Slide 3-4: results*
  - *Slide 5: discussion of your findings*

How to Write a Good Report (Part II)

The report is expected to cover

1) **Description of your proposal (e.g. explain which power saving mechanism to apply and why you choose that mechanism)**
2) **How do you implement your proposal(incl. modification to the given app, and implementation of extra software components)**
3) **How do you evaluate your solution? (e.g. how much energy has been saved compared to the original version? Under what conditions energy savings can or cannot be gained?)**
4) **Discussion(e.g. why your solution can or cannot save energy? What do you think can be done in future to improve the energy-efficiency?)**

Example of Technical Report

Final report(incl. Part I and II): about 10-15 pages

If you want to find examples of technical reports, the best way is to read one to two scientific papers and see how the authors present their work.

For example, you can read through Section 3-5 in the following article

Niranjan Balasubramanian, Aruna Balasubramanian, and Arun Venkataramani. 2009. Energy consumption in mobile phones: a measurement study and implications for network applications. In *Proceedings of the 9th ACM SIGCOMM conference on Internet measurement conference* (IMC '09). ACM, New York, NY, USA, 280-293. DOI=10.1145/1644893.1644927 http://doi.acm.org/10.1145/1644893.1644927

Presentation in the 2nd Feedback Session (Final Presentation)

- **Each group has 25 minutes to present your work and to answer questions**
- **Slides: You can follow the structure of your final report, but focus more on the results of Part II**
- **Teachers may arrange an open discussion and give feedback to all groups at the end of the seminar**

Practical Arrangement of Labwork

- **Send the name list (name, student number, univ., email address) of your group to course assistant by 16.4.2014(before the tutorial starts). Send the topic you choose to course assistant by 21.4.2014.**

- **Make sure that at least one member from each group will attend the tutorial. You will learn how to set up power measurement and how to collect data.**

Practical Arrangement of Labwork

- **We provide power meters and Android phones for power measurement in room A243 (T-building). It is open during office hours from 16.4.2014 to 27.5.2014.**

- **We have only 2 power meters in the lab. Please reserve time at least one day earlier.**

Here is the Doodle Link:

https://aaltouniversity.doodle.com/7nc4hkfq9r94npir

Practical Arrangement of Labwork

- **You can use the PCs in the room, but remember to backup your data before you leave.**
- **You can use the private Wi-Fi AP in A243 and the public Wi-Fi ”aalto open” for experiment.**
- **If you wanna use the closed LTE network “NetLeap” for experiment, you can get a sim card from Aalto IT servicedesk. (servicedesk@aalto.fi)**

Group Discussion(15 min)

3 Groups (5 students per group):

1 2 3 4 5 (10 min)

1 2 3 4 5 (10 min)

…

5 Groups (3 students per group)

1 1 1 (5 min)

2 2 2

Self-Introduction

- your name
- home university
- previous experience (related to energy-efficient computing)
- preferences of topics/programming languages
- Preferred role (coding, measurement, writing, etc)
- …

1) Spydroid-ipcamera (streams the camera and microphone of your phone to your browser or to VLC)
2) Frozen bubbles (Game)
3) MIT funf sensing framework
4) Toolkit for speech recognition: CMU Sphinx
5) OSM HTML5 video player
6) Twitter client for Android: twimight

Q&A

- **If you would like us to find you a partner for your group assignments, please leave a message to our course assistant**

Contact:

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Teemu Kämäräinen teemu.kamarainen@aalto.fi