📄 **README.md** 9.54 KB

Introduction phase

In the first 6 weeks of this semester you will work on a short group and personal project. The goal of this phase is to get you up and running with some of the basics (development setup, terminal use, git version control) and experience what is needed to build a basis embedded system.

Please consult your teachers for additional support on how to realize the described milestones. They will be more than happy to point you in the right direction.

Milestones

Target	Note
wk1	Basic development skills and setup
wk2	Personal Embedded Showcase Concept
wk2	Rondo network - PC Ethernet Network
wk3	Rondo network - Arduino Serial Network
wk4	Personal Embedded Showcase Prototype
wk5	Rondo network - Full Integration
wk6	Party time - Network of Personal Embedded Showcases

Group project

You will experience what is needed to build a basic network of embedded devices. In this phase we will use network and serial communication to got connected.

A network overview of the embedded system is shown below. You will work on this system with your project group. Together you decide how the protocols for network and serial communication will look like, and what rules the participants of the network will follow.

Figure: A network of PC and Arduino devices using ethernet and serial communucation.

Personal Embedded Showcase

Think of an embedded device that tells us a bit more about you. This can be anything: a digital camera, a bicycle computer, a sophisticated game controller, plant watering system, medical devices or possibly a rocket launch installation system.

Try to recreate the essential parts of this device with use of an Arduino and PC application. The Arduino device will control the hardware (think sensors, displays, buttons, rockets). The PC application can then for instance be used to configure, control and monitor the Arduino device. You connect PC application and Arduino by using serial communication.

Towards the end of introduction phase you will try to discover ways to integrate your personal project in the network that you created with the group project.

Milestone wk1: Basic development skills and setup

Deliverable	Note
Repository	You will have basic Arduino, C and C# project in your personal git repositories. The repository also contains a directory structure for committing work this semester.
Skills	Cheatsheets for terminal and use. You will be able to use a linux terminal, build and run executables, and commit changes to your git repositories.

Development setup

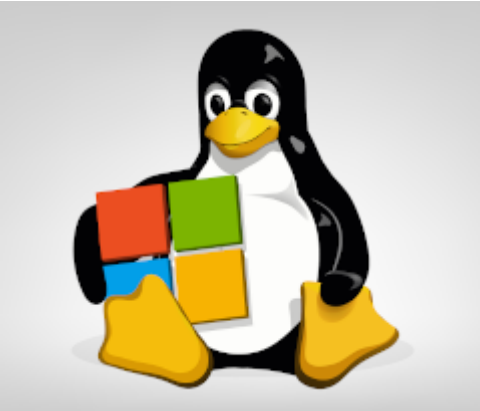You have installed all necessary software for this semester.

Figure: Combination of Windows and Linux operating systems.

Please check out the available information at the t-oer-oop2 and t-oer-prc2 repositories.

Linux terminal

Figure: Example of commands in a Linux terminal.

Create your personal cheatsheets with for example:

```
+ nagivating directories
+ create directories
+ copying, moving and removing files
+ executing programs
+ usefull linux commands
```

Git version control

Figure: git version control logo

Create your personal cheatsheet with for example:

```
+ Cloning a local repository from a server
+ Pulling changes from the server to your pc
+ Committing changes to the version history
+ Pushing changes to the remote server
+ Resolving file conflicts
```

Personal git repository setup

- Your git must be configured as private. Please grant access to all the teachers of this semester.
- Please list your name and repository at this TODO: location
- An initial directory structure for your work during this semester:
  - C programming (prc)
  - C# programming (oop)
  - Personal projects
  - Planning (planning)
  - Logbook
  - etc.

Milestone wk2: Personal Embedded Showcase Concept

Deliverable	Note
Presentation	Slides (max 3) that tell use about your personal showcase. Visualize what hardware will be controlled, and what the PC application can do.
Document	Protocol description of the PC and Arduino Serial communication

Please consider the following questions:

```
+ Can you visualize your Personal Embedded Showcase?
+ What kind of hardware will you need (display, buttons, sensors, motors, etc.)?
+ Can you simulate some of the hardware?
+ Will your device be collecting data? Is it necessary to filter, store or modify this data?
+ Can your device be configured? Does this configuration need to be stored? (Tip: [Eeprom](https://www.arduino.cc
+ Does the device need to react quickly or real-time to events? Does it have different states?
+ What is the power consumption of different parts of the device? Can you optimize it?
+ How will you design the software? The answer: `put all code in the Arduino loop` will not be sufficient. Can yo
+ How will the functionality be distributed over Arduino and PC application?
```

Milestone wk2: Rondo network - PC Ethernet Network

Deliverable	Note
Document	Network overview and protocol definition.
Code	Implementations (each member creates own version).

It's time to get connected. With your project group you will create a set of C# applications that are connected via an ethernet network. Discuss within your project group what the protocol will look like and document this (A4 specification should do the job). Each project member will write their own application respecting the agreed protocol.
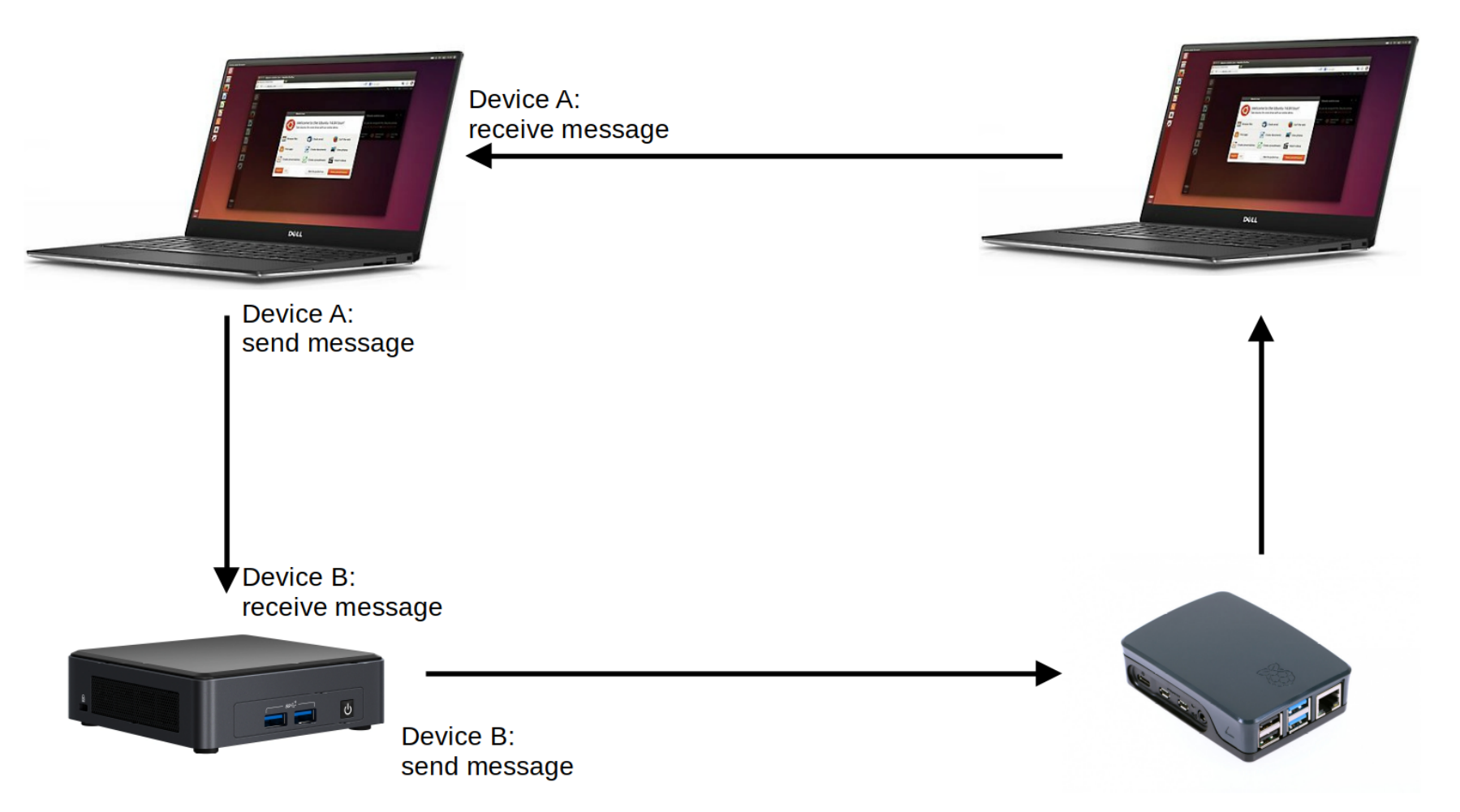

Device A:
receive message

Device A:
send message

Device B:
receive message

Device B:
send message

Figure: PC applications sending and receiving messages.

We would like to follow a (the simplest thing that could possibly work)[https://ronjeffries.com/xprog/articles/practices/pracsimplest/] approach. The advantage of this approach that the order of messages can be predicted. Please consider using the following possible solution of a Ring of applications:

```
+ Each application can only send to messages to the next connected application in the network, and received messag
+ The application will either check if the message received is meant for them.
            + If not: resend the message
            + If so: send an appropriate answer
```

Milestone wk3: Rondo network - Arduino Serial Network

Deliverable	Note
Document	Network overview and protocol definition.
Code	Implementations (each member creates own version).

The next step is to connect Arduino devices via Serial communication. This is done in a similar way as used for the ethernet network of the previous milestone. Discuss in your project group how the protocol should be used.

It is also advised to think about the startup behavior of the network applications. In practice the applications will startup at different times. Some thinking is therefore needed on provided means for some elegant behavior. Don't forget to think about T.S.T.T.C.P.W.
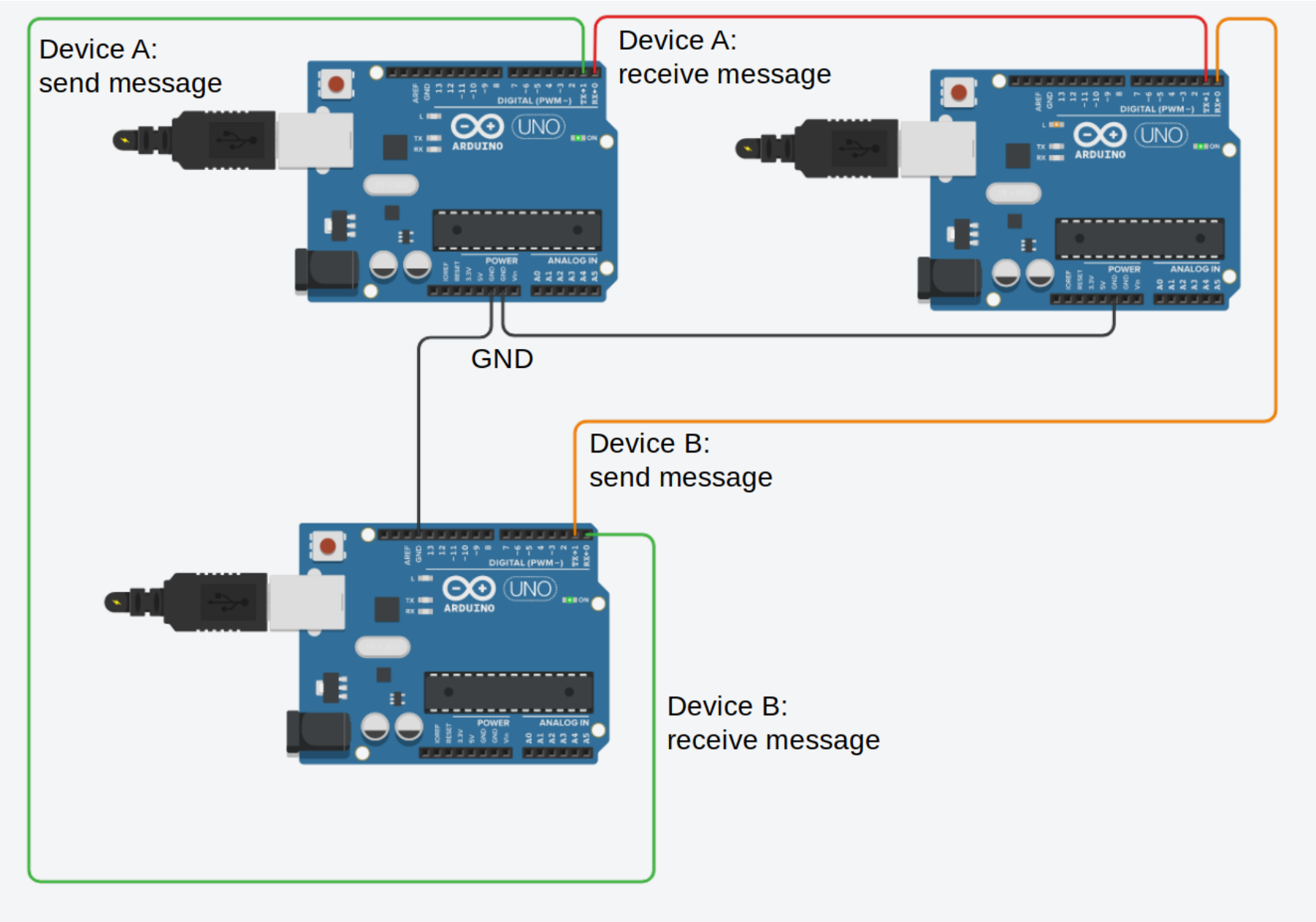

Figure: Ring of Arduino devices connecting via serial communication.

Milestone wk4: Personal Embedded Showcase Prototype

Deliverable	Note
Presentation	Provide an overview of your P.E.S.
Code	Implementation of your project. Focus on basic communication and prototyping interesting parts of your showcase.

You demonstrate your personal device. With use of the PC application you can configure, control and monitor your personal devices. Some functionality of the embedded device may be real using real hardware, other date may be faked. In this phase of product development don't be afraid to use simulated data for some hardware parts.

Things that will get you a guru engineer badge:

```
+ Picture with a system overview.
+ A Console based application (cool for remote use, and no time needed for UI struggles).
+ I/O with real hardware connected to your Arduino.
+ C# application: a proper use of classes.
+ Arduino application: use of modules using header files with cool hardware abstractions.
```

```
+ Clean code: use of coding guidelines, meaningful names for methods and variables.
+ Test strategy (overview of test-cases and results, unit-tests).
```

Milestone wk5: Rondo network - Full Integration

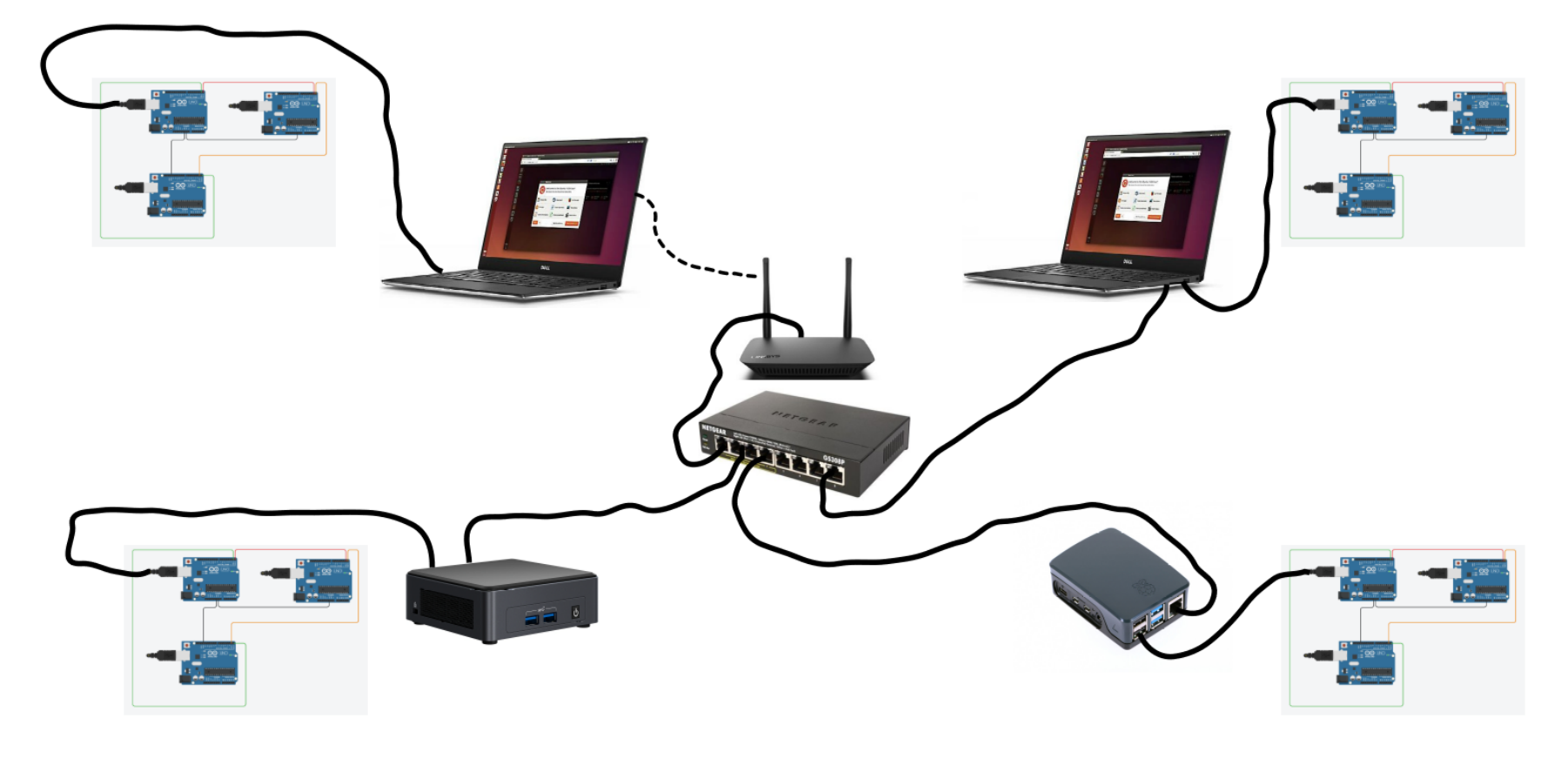| Deliverable	Note
Presentation	Show a number of possible use cases where Arduino devices show some kind of cool behaviour. Think about cases on how your personal devices can work together and provide some synergy or crazy unmatched behavior.
Demo	You demonstrate basic communication so that Arduino devices can communicate to any device on the network.

Figure: A network of PC and Arduino devices using ethernet and serial communucation.

In this milestone you connect the Arduino and PC networks from the previous networks. By this it will be possible to communicate between Arduino devices connected to the network.

Milestone wk6: Party time - Network of Personal Embedded Showcases

Deliverable	Note
Presentation	Performance metrics: network response time, typical number of bytes per seconds.
Presentation	The results of the group peer review: what went well, what will be improved for the next project.
Demo	You demonstrate some of the previously presented use cases.
Demo	Robustness: how does your network recover from physical connection failures in the network (wires / connections are interrupted).

At this milestone you will demonstrate how the 'Personal Embedded Showcase' can be combined.