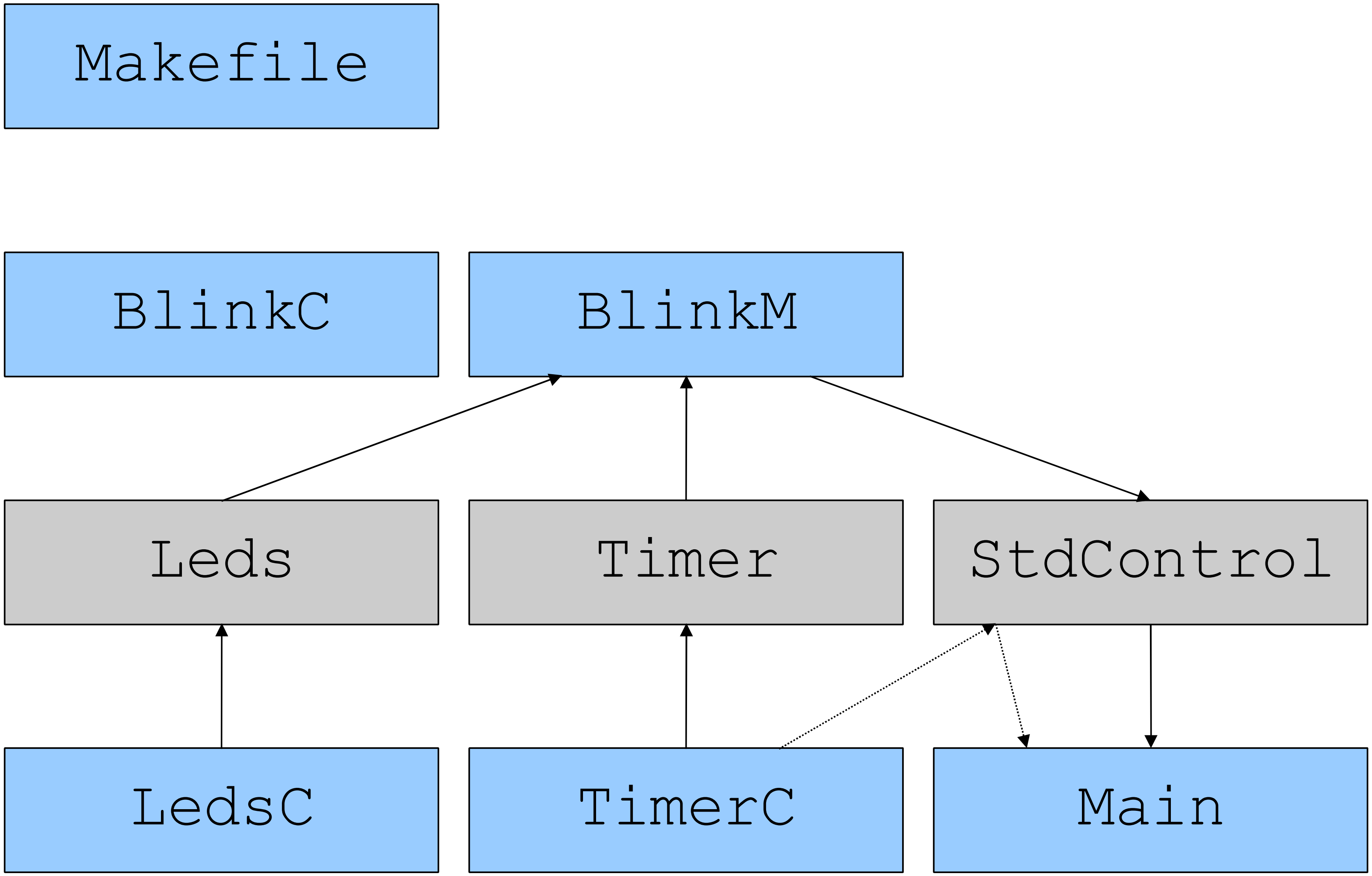
Lab 1

- Goal 1: Getting familiar with
  - Cygwin: a linux emulator for Windows
  - TinyOS: an operating system for motes (sensor nodes)
  - NesC: a programming language that extends the syntax of C with components, interfaces, tasks or events
- Goal 2: Compiling a first application
- Goal 3: Running a first application
- These goals will be achieved through a simple application

A simple application

- Problem:
  - Create an application called `Blink` that makes the red LED of a mote toggle every second
- Solution:
  - Raise a timer every second
  - Each time the timer expires, we need to toggle the red LED

Architecture of `Blink`



Makefile

```
COMPONENT = BlinkC

include /opt/tinyos-1.x/apps/Makerules
```

BlinkC.nc

```
configuration BlinkC {
}

implementation {
  components BlinkM, LedsC, TimerC, Main;

  Main.StdControl -> BlinkM;
  Main.StdControl -> TimerC;

  BlinkM.Leds -> LedsC;
  BlinkM.BlinkTimer ->
    TimerC.Timer[unique(“Timer”)];

}
```

BlinkM.nc (1/2)

```
module BlinkM {
   provides {
      interface StdControl;
   }
   uses {
      interface Leds;
      interface Timer as BlinkTimer;
   }
}

implementation {
   ...  // see next slide
}
```

BlinkM.nc (2/2)

```
implementation {
  task void blinkTask() {
    call Leds.redToggle();
  }
  command result_t StdControl.init() {
    call Leds.init();
    return SUCCESS;
  }
  command result_t StdControl.start() {
    call BlinkTimer.start(TIMER_REPEAT, 1024);
    return SUCCESS;
  }
  command result_t StdControl.stop() {
    return SUCCESS;
  }
  event result_t BlinkTimer.fired() {
    post blinkTask();
    return SUCCESS;
  }
}
```

`Blink` application (1/2)

- Create a directory for `Blink` in your home directory (say `muc/Blink`)
- With a text editor (such as `TextPad`)
  - create a `Makefile` (and write the code)
  - create the `BlinkM.nc` file (and write the code)
  - create the `BlinkC.nc` file (and write the code)
  - if those files have the `.txt` extension, it has to be removed (using the Windows `rename` command)

`Blink` application (2/2)

- Run `Cygwin`
  - `cd muc`
  - `cd Blink`
  - `make pc` (to compile `Blink`)
  - `cd build`
  - `cd pc`
  - `export DBG=led` (to filter the output)
  - `main.exe 1 | more` (to run the program with 1 mote only)

Explanation: compilation (1/3)

- The `Makefile` contains
  - `COMPONENT = BlinkC`
  - `include /opt/tinyos-1.x/apps/Makerules`
- Description
  - the `Makefile` is used by `make`
  - it tells us that the configuration file is called `BlinkC.nc`

Explanation: compilation (2/3)

- The `BlinkC` configuration file contains
  - `components BlinkM, Main, LedsC, TimerC;`
- Description
  - `BlinkM` can be found in the current directory
  - the others are basic TinyOS components
    - `/opt/tinyos-1.x/tos/platform/pc/Main.nc`
    - `/opt/tinyos-1.x/tos/platform/pc/LedsC.nc`
    - `/opt/tinyos-1.x/tos/platform/pc/TimerC.nc`

Explanation: compilation (3/3)

- The `BlinkM` module file contains
  - `provides { interface StdControl; }`
  - `uses { interface Leds; interface Timer; }`
- Description
  - all the interfaces can be found in
    - `/opt/tinyos-1.x/tos/interfaces/`
  - simply add `.nc` to the name of the interface to find the file

Explanation: execution (1/2)

- The program is compiled in
  - `muc/Blink/build/pc/main.exe` (from your home directory)
- Syntax
  - `main.exe -h` (for the help)
  - `main.exe <number-of-nodes>`
- But
  - running `main.exe` generates too many debug messages

Explanation: execution (2/2)

- The debug messages can be filtered using
  - `export DBG=led`
- Filters
  - the list is displayed with `main -h`
  - usually
    - `led` (for the LEDs)
    - `am`, `radio` (for the messages or the radio)
    - `task` (for the tasks)
    - `usr1`, `usr2`, `usr3` (for the user debugging messages)