TinyOS Lab Exercise

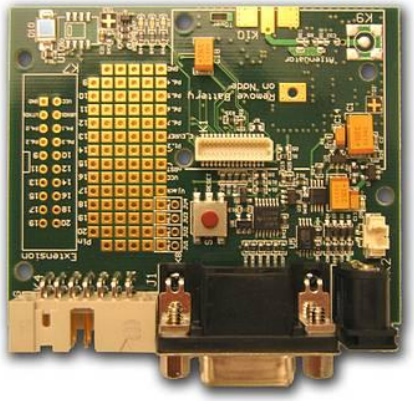
Introduction to TinyOS 2

TinyOS Lab Exercise in Ad Hoc and Sensor Networks

- **Sensor network programming in a nutshell**
  - Read ‘Getting started with TinyOS’ (at home)
  - Solve two Lab-style exercises on real hardware
    - Teams of two to three students are ideal
    - One lab working place is available in ETL F29
    - Reservation system on the course website

Wireless Sensor Nodes

- **Shockfish TinyNode**
  - Slow CPU
    - 8 MHz Texas Instruments MSP430 microcontroller
  - Little memory
    - 10 KByte RAM, 48 KByte ROM, 512 KByte external flash
  - Short-range radio
    - 868 MHz Xemics XE1205 ultra-low power wireless transceiver
  - Light sensor, temperature and humidity sensors



Extension Board

+

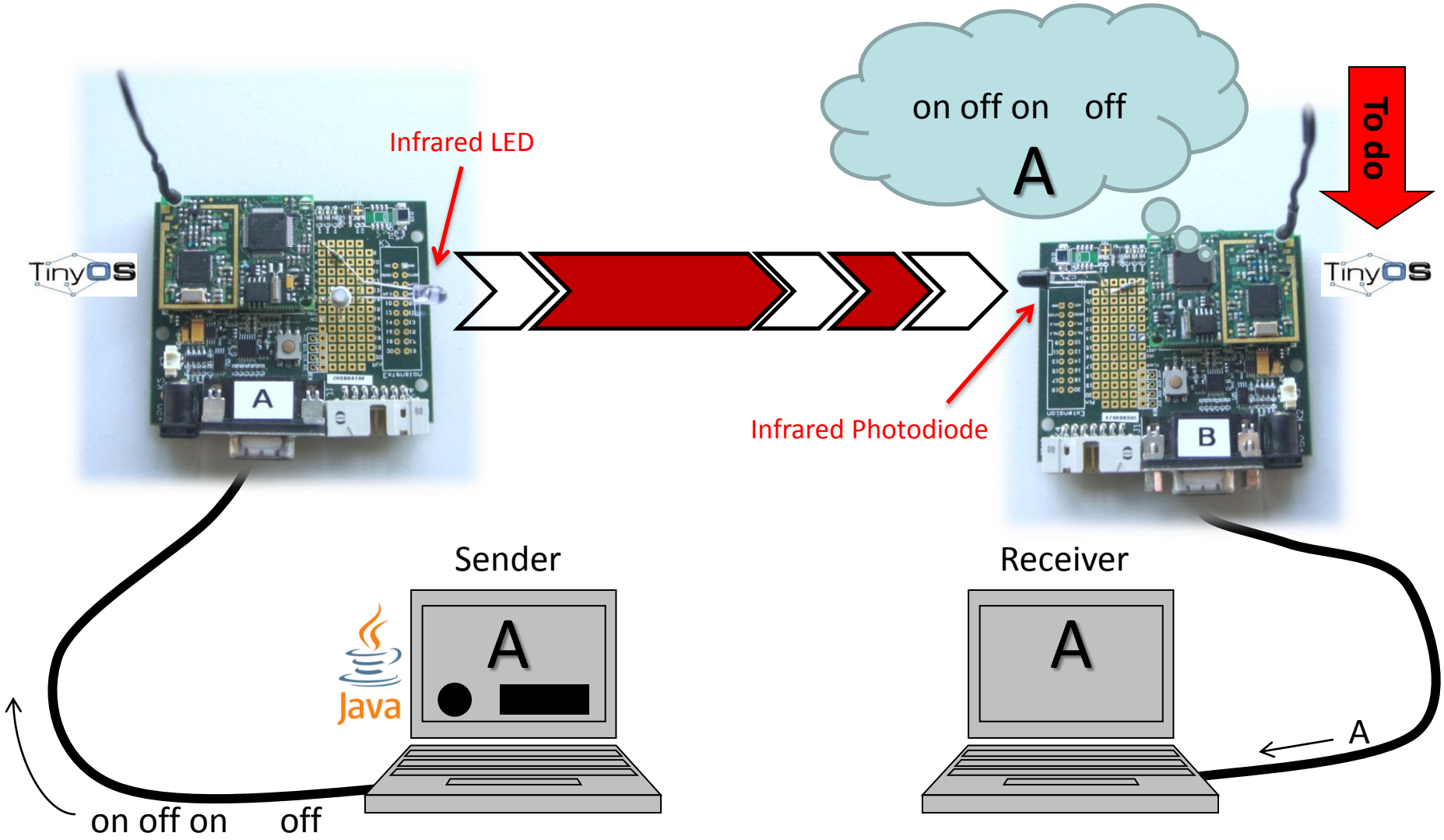
TinyNode 584

Exercise 1

- **Exchange of a sensor data**
  - Two sensor nodes are used for this task
  - One node periodically samples its light sensor and broadcasts the sensor reading over its radio
  - The other node listens for radio messages and signals if it is getting brighter or darker
    - Brighter → The green LED of the receiver is set
    - Darker → The red LED of the receiver is set
    - No significant change → The yellow LED is set

Exercise 2

- **Optical Communication using Morse Codes**



TinyOS

- TinyOS is an operating system for sensor nodes
  - Open source project with a strong academic background
  - Hardware drivers, libraries, tools, compiler

- TinyOS applications are written in nesC
  - C dialect with extra features
  - nesC compiler converts your application into plain C code

http://www.tinyos.net

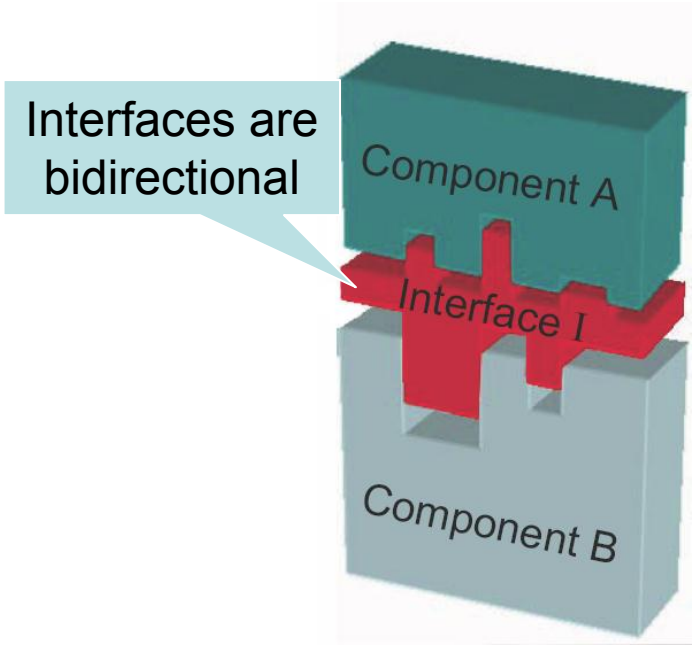
NesC/TinyOS Programming Model

- Programs are built out of components
- Components use and provide interfaces

```
interface Send {

  command error_t send(message_t* msg);
  event void sendDone(message_t* msg);

}
```



- Components are wired together by connecting interface users with interface providers

TinyOS Concurrency Model

- Tasks are executed sequentially by the TinyOS scheduler
  - only one task can be active at a time
  - Longer background processing jobs

```
post sendMessage();
```

```
task void sendMessage() {
  call Send.send(...);
}
```

- Events (callbacks)
  - Short duration (hand off computation to tasks if necessary)

```
event void Send.sendDone(...) {
   ... (do something)
}
```

Split-Phase Operations in TinyOS

Java

```
void sendMessage() {
  Message m = new Message();

  // send operation is blocking
  Send.send(m);

  // do next task
  nextTask();
}
```

TinyOS

```
task void sendMessage() {
  message_t* msg = &msgBuffer;
  // command is non-blocking
  call Send.send(msg);
  // do something here
 ...
}

event void Send.sendDone(...) {
  // send completed, post next task
  post nextTask();
}
```

Final Remarks

- Code skeletons for both applications are provided on the lab PC. All software required during the lab is already pre-installed.

- The lab work place is in the ETL building (ETL F29).
  Keys must be fetched in our office ETZ G64.1 when your lab slot starts.

➡ Register for your lab time slot on the course website