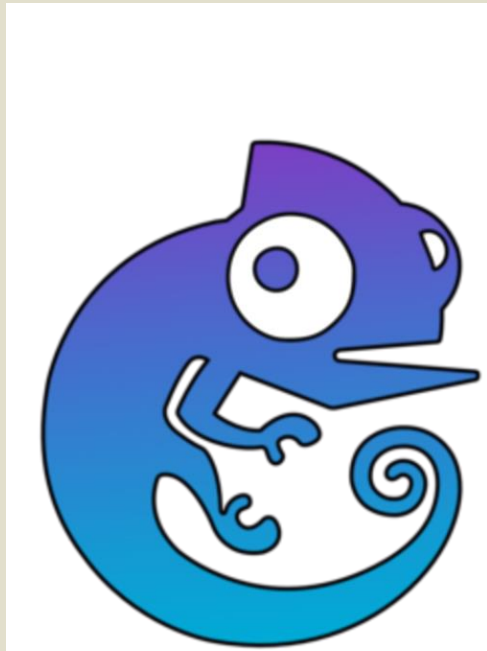
Final Project: Internet Radio Application

COMPUTER NETWORKS 2 – LABORATORY



Internet Radio Application

Final project of this course!

More Advanced use of sockets.

Multithreaded programing.

Implement a simple server-client protocol.

Stream audio over UDP.

Runs on your own
GNS3 topology (from lab 6/5/4).

Best programing project.

Internet Radio Application: Radio over Multicast

You will write two main programs:

1. Client
2. Server

We will provide binaries of them(Working examples) so you can test your programs step by step.

- The example programs are not perfect.
- Some errors may exist …

Internet Radio Application: Radio over Multicast

FUNCTIONALITY AND PROTOCOL

Server

- Multicast stations: each station a different multicast group, all use same port (UDP)
- Sends info to clients (TCP).
- Handles multiple clients connections(TCP)

Client

- Plays music! (acting as a simple UDP receiver).
- Communicates with the server for data(using TCP) .
- Can upload songs to the server (using TCP).
- Interacts with a human (using English).

Client -“Controller”

- Two sockets, one TCP one UDP.
- User input, and the user’s interface with the server.
- Handshake with the server to learn the multicast address.
- Can ‘ask’ about songs.
- Receives audio packets from the server and plays music.
- Changes the multicast stream(station) to change songs.
- Can upload new songs to the server.
- Interacts with a server using a protocol.

Server

Many TCP and UDP sockets

Maintains control connections with clients.

Transmits stations via UDP to multicast

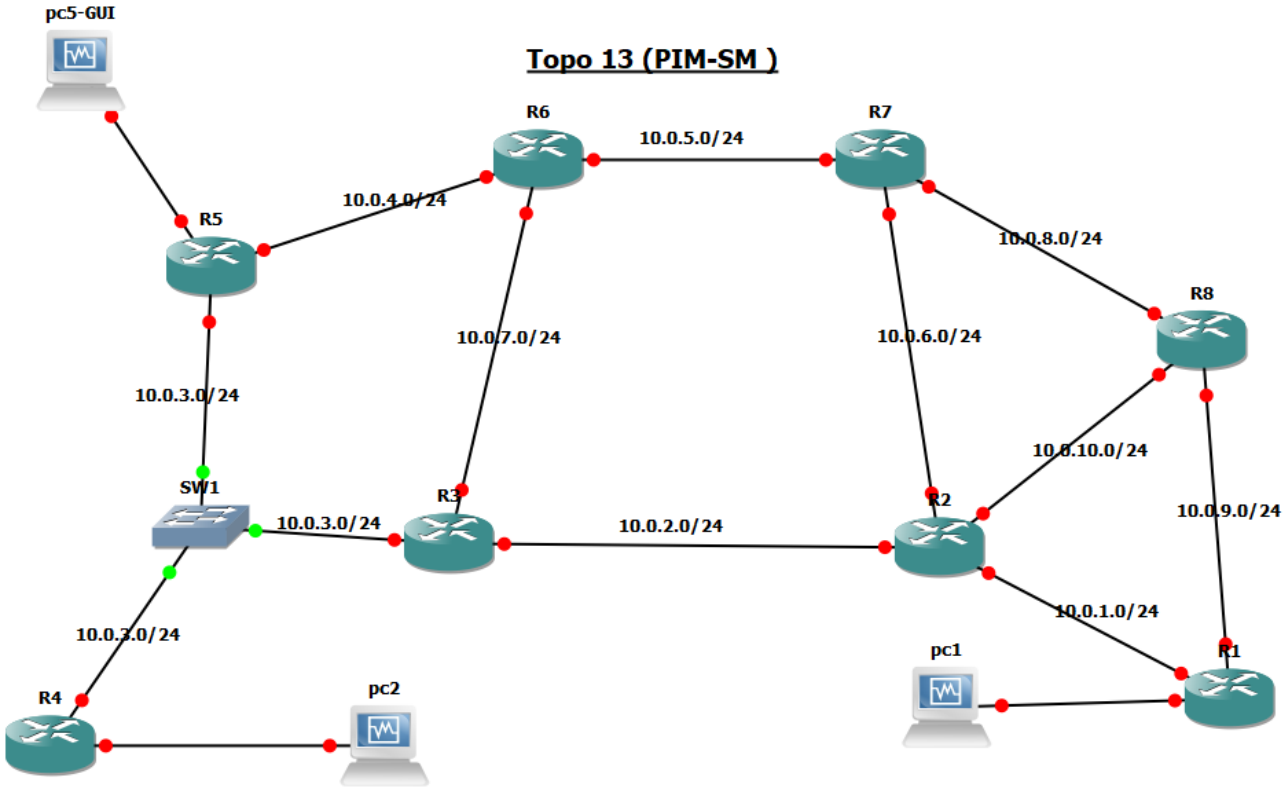
Maintains several stations

Notifies the clients about a new station.

Interacts with clients using a protocol.

Server is stateful.

Demo


Topo 13 (PIM-SM)
pc5-GUI
R6
R7
10.0.5.0/24
10.0.4.0/24
R5
10.0.8.0/24
R8
10.0.7.0/24
10.0.6.0/24
10.0.3.0/24
10.0.10.0/24
SW1
R3
R2
10.0.3.0/24
10.0.2.0/24
10.0.9.0/24
10.0.1.0/24
10.0.3.0/24
pc1
R1
R4
pc2

Server – Client Protocol

HOW DO THINGS CONNECT

Server – Client Protocol

The server and client interact using a simple protocol.

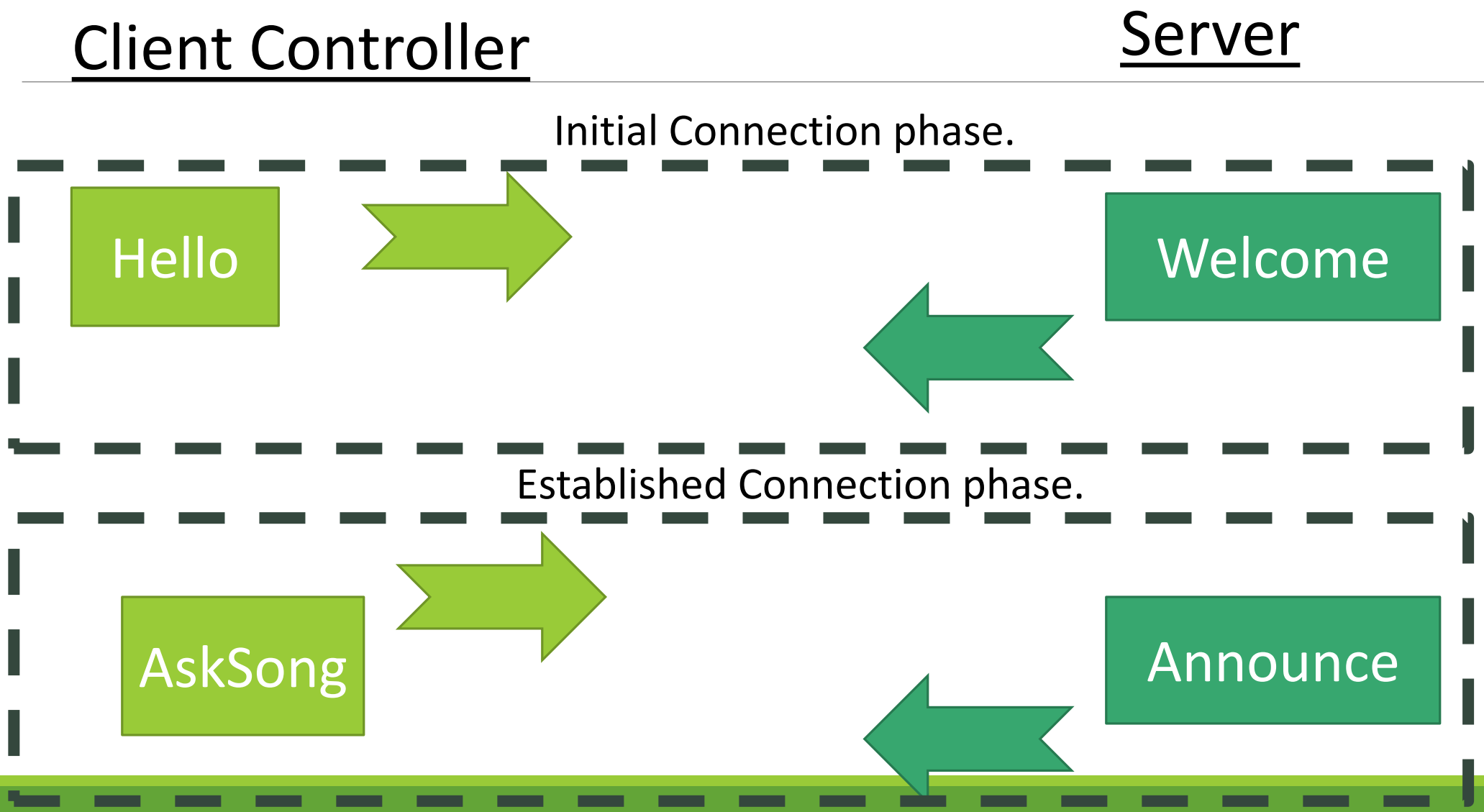
The protocol is a set of rules, messages, timeouts, etc, that both the server and client agree on.

The protocol is what makes communications possible! Any pair of client server program can successfully connect!

If either the client or the server behave in a way that is contrary to the protocol someone has to quit.

- If the server misbehaves, the client will disconnect itself
- If the client misbehaves the server will disconnect the client .

Server – Client Protocol: basics



Server – Client Protocol: messages

Lets take a closer look at the two most basic messages we saw earlier:

First, “Hello”:

```
uint8_t    commandType = 0;
uint16_t   reserved = 0;
```

Second, “Welcome”:

```
uint8_t      replyType = 0;
uint16_t     numStations;
uint32_t     multicastGroup;
uint16_t     portNumber;
```

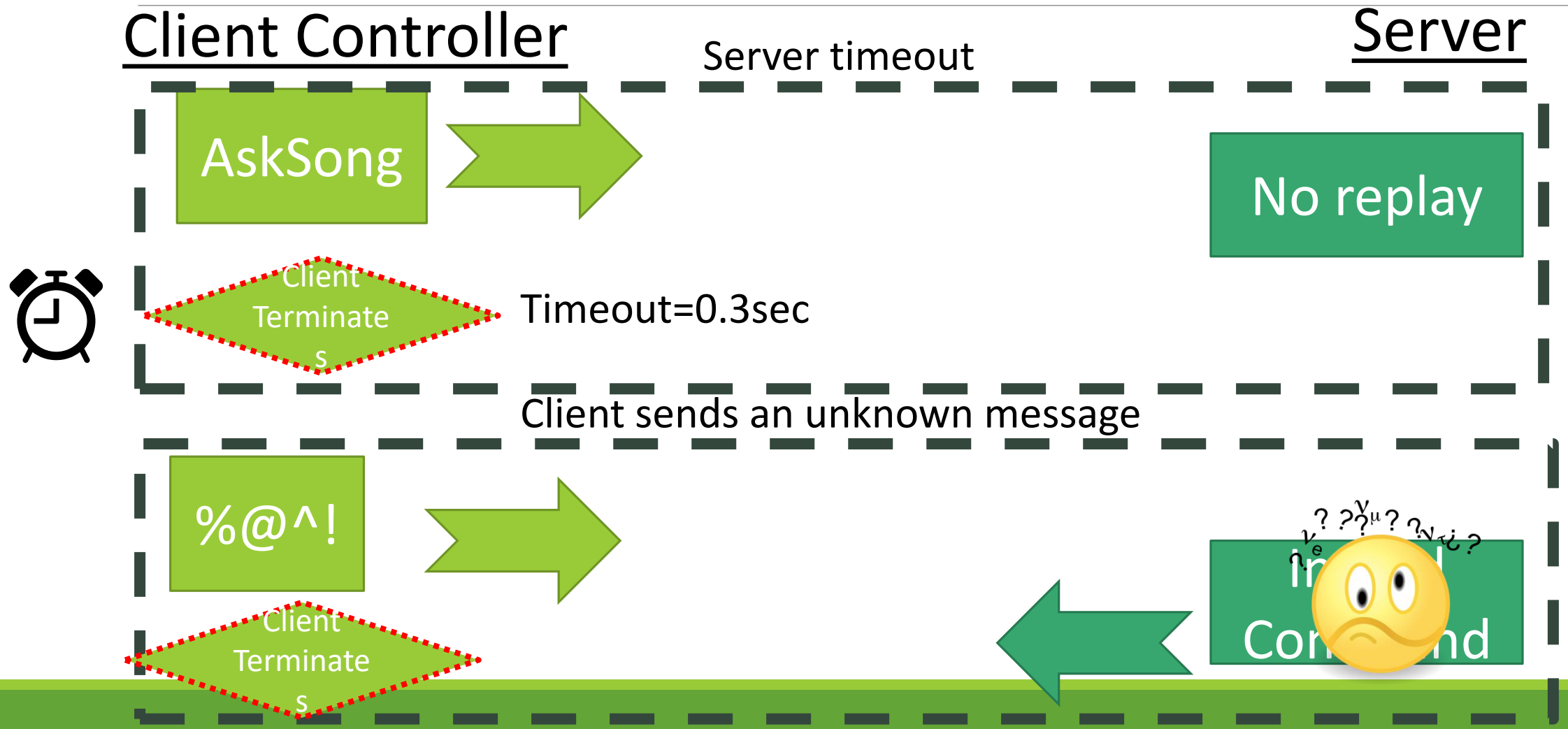
Each message has a known size.

‘Simply’ fill a buffer with the right fields and send!

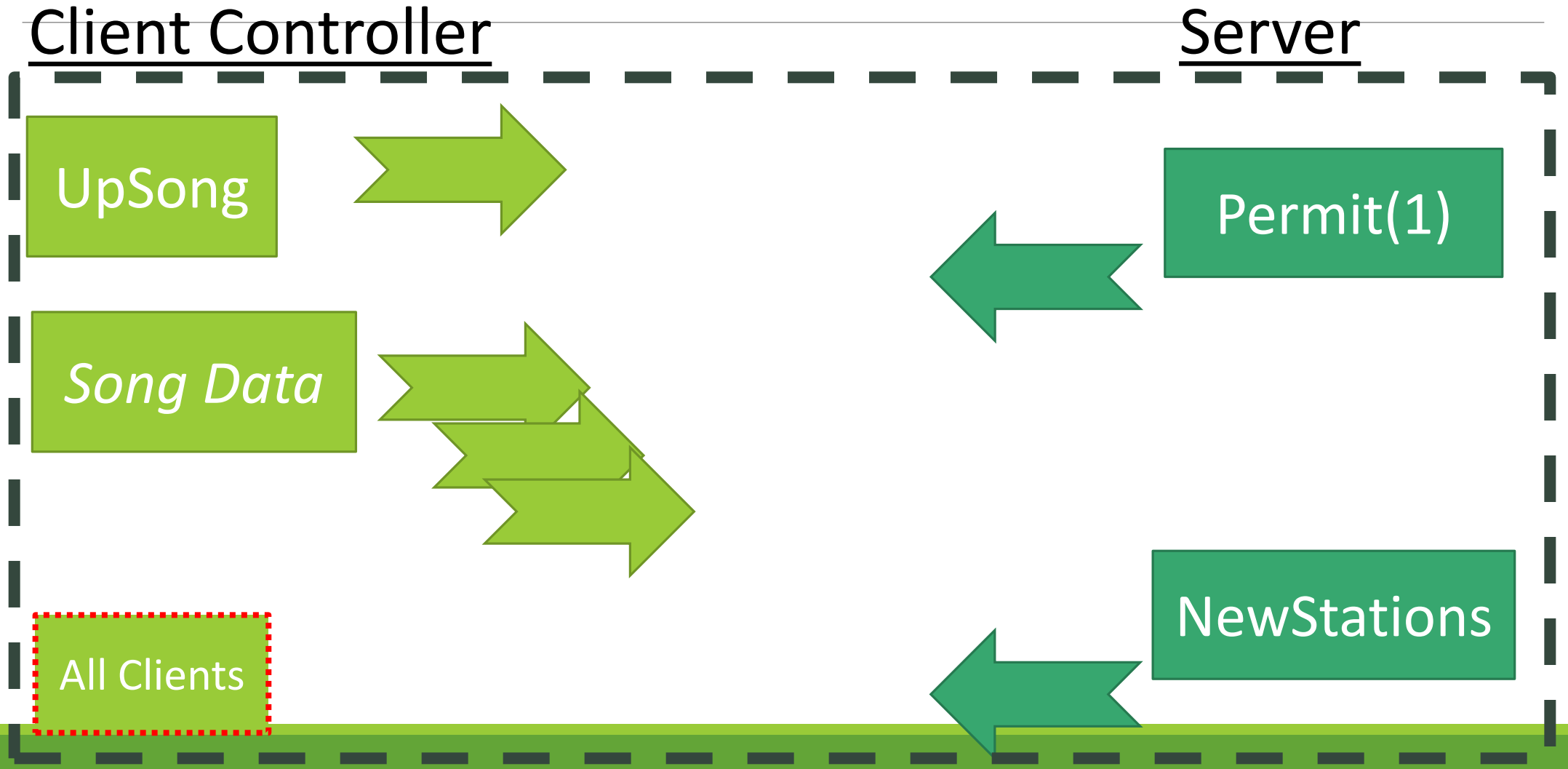
- Remember to use switch from host to network order when needed.

See “Internet Radio Application.pdf” for full details.

Server – Client Protocol: Errors



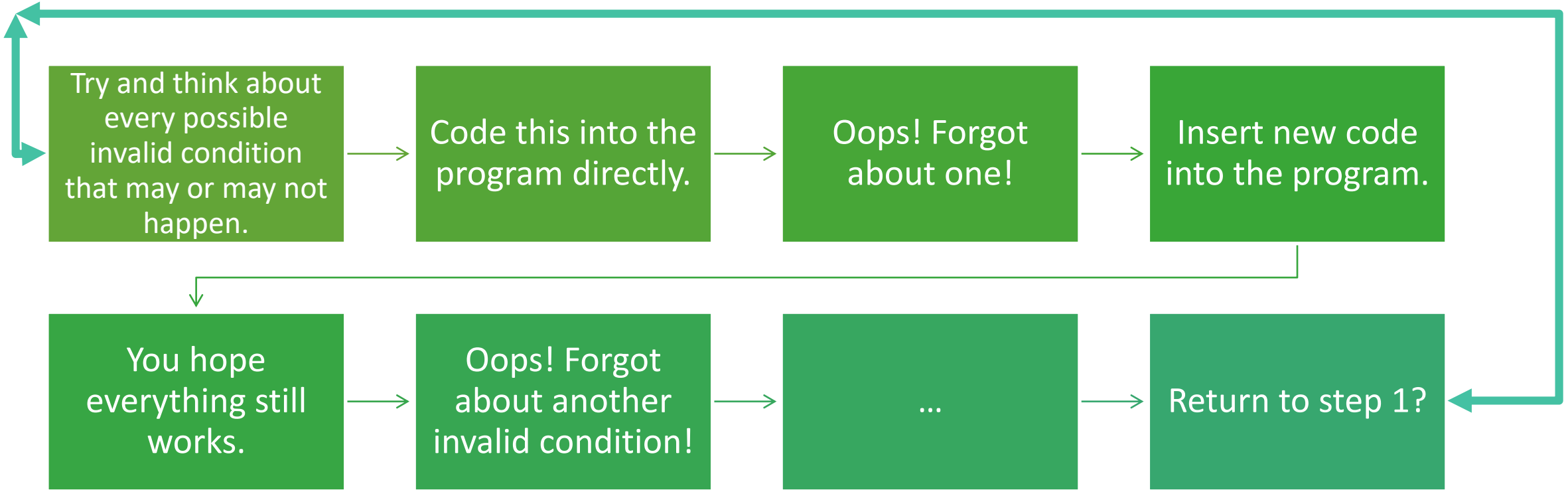
Server – Client Protocol: upload procedure



Protocol Implementation

HOW TO MAKE IT WORK

Protocol Implementation: First steps…



Protocol Implementation: Finite State machine

1. Find all possible “states” and “transitions” that are expected to happen.
2. Code this into the program directly.
3. Oops! Something unexpected happened!
4. Just go to the default state.

Protocol Implementation: Finite State machine

This is a very wide topic, we will try to use a very basic and intuitive approach.

We can think of the Finite State machine as a graph where each vertex is a state and each edge is a transition

What is a state?

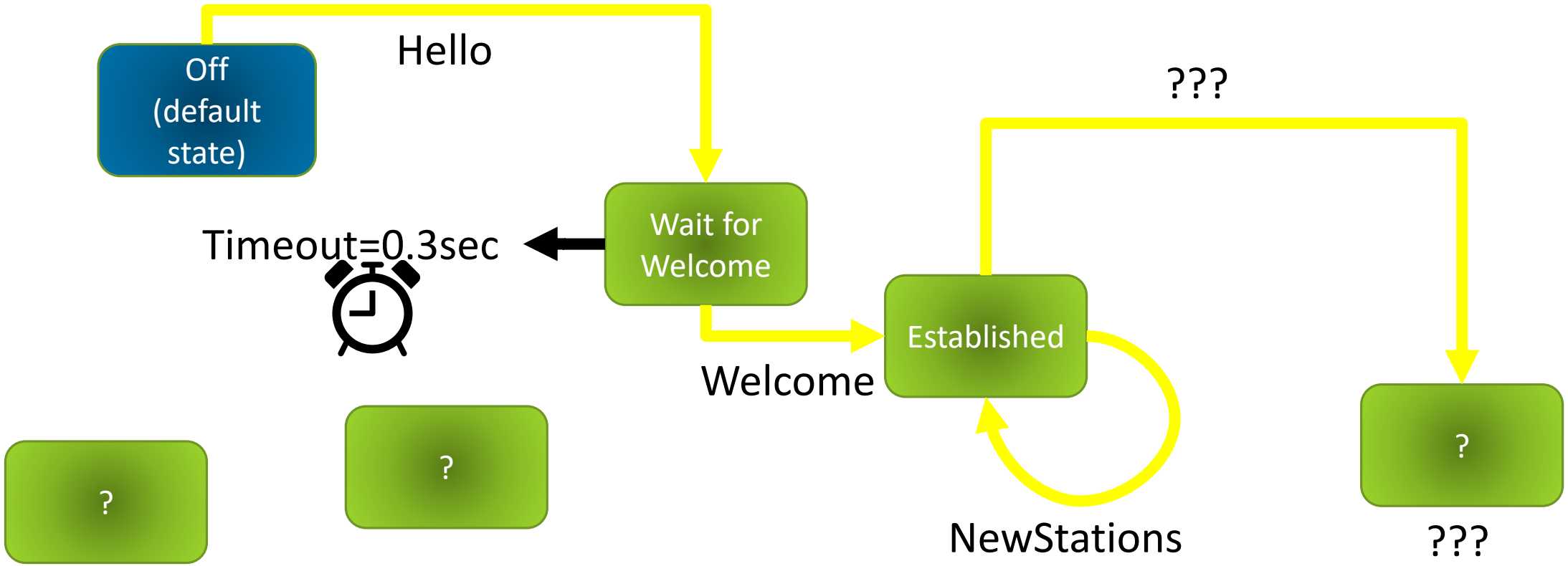
- A state is any condition where our state machine **waits** for a **specific** input.

What is a transition

- A transition is any event which causes our state machine to change states.
- Lets assume the transitions are our input.

Client's Finite State machine

To simplify things lets ignore the "invalid command" message type.
Just remember any time we get an "invalid command" we go to the "off" state



Finite State machine

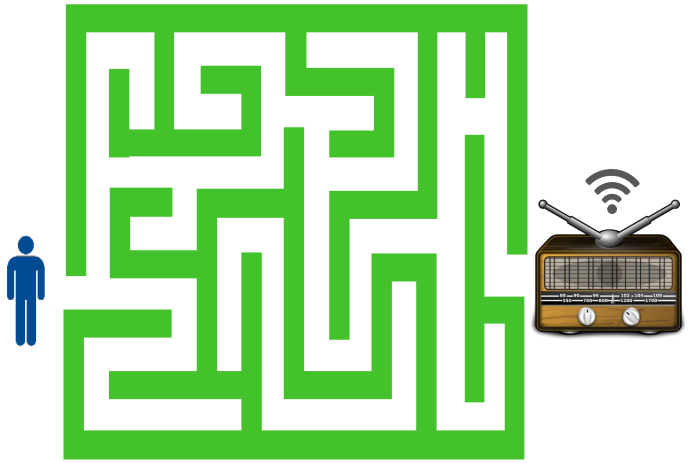
Let see how we can use our state machine in the program.

This is merely an example! you may choose to implement this very differently.

```
//Each time we get a message from the server we use this function//
int handleMsgFromServer( int CurrState , char* msg)
int newState;
switch (CurrState){
        case OFF:{newState =offStateMsgHandler(msg)}
        case WelcomeWait:{newState = WelcomeWaitMsgHandler(msg)}
        case Established:{newState = EstablishedMsgHandler(msg)}
...
        default: {terminate() /**/basically go to the "off state" /**/ }
...
```

Finite State machine cont.

```
//each time we get a welcome from the server we go to this function//
int WelcomeWaitMsgHandler( char* msg)
int newState, msgType=msg[0];
switch (msgType){
        case WELLCOME:{
                handleWelcom(msg);
                newState =ESHTABLISHED;
                                }
        case OTHER???:{newState = ?}
…
                default: {newState =OFF/**/basically go to the "off state" /**/ }
Return newstate;
```



Where to start

OR: THE DEMAND PAPER IS TOO LONG!!!

Design paper

You need to submit a **short** design paper for both the server and client.

For the client you will also need to submit the complete FSM we started to construct in this presentation.

We will go over each design paper with each pair of students.

Full requirements are listed in “Programing project Labs Planning.pdf”.

The design paper is free but mandatory five points out of your grade in this project

Demand paper

The demand paper, i.e. *“Internet Radio Application 2018.pdf”* contains **everything** you’ll need to know about the project.

Use the handbook for a shorter read.

- It contains the same text, ordered with the same numbers for easier reference .
- Doesn’t contain some specifics, examples, longer explanations.
- However if you’ll still have to read the full demand paper to make sure you comply with all demands…

Start small, the Client.

You could start with the basic protocol, without the upload procedure, just remember it’s going to be there in the end.

The server is more complex.

DON’T.

A word about plagiarism

Project schedule

30/12/18 and 31/12/18

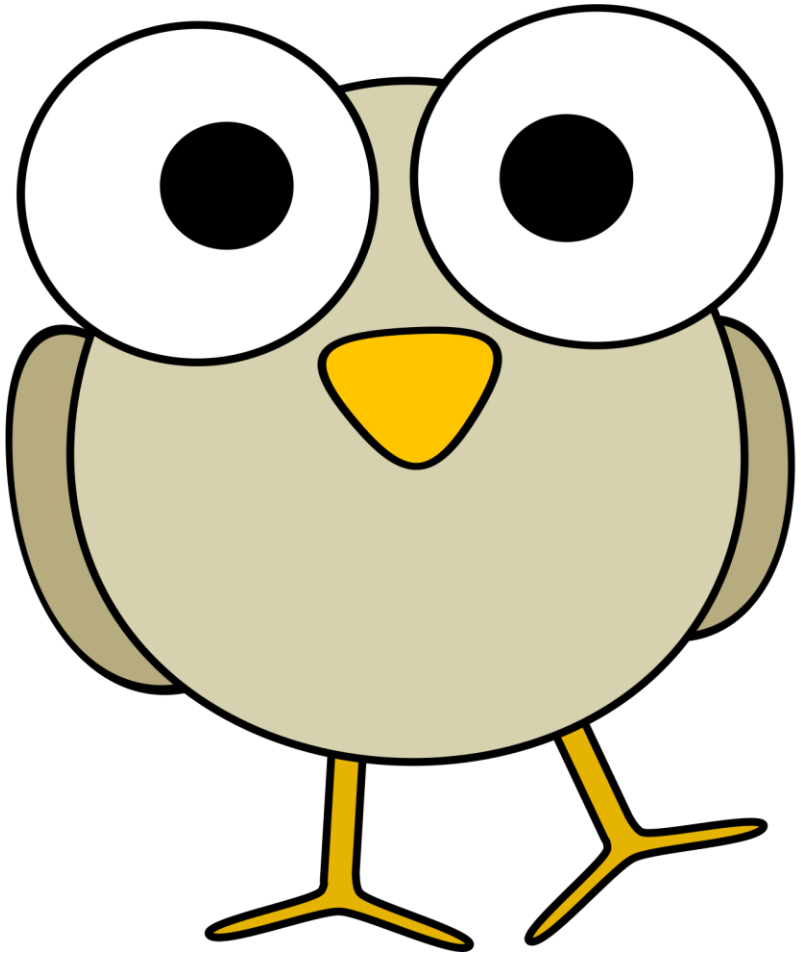
- Design paper submission.

??/1/19

- Finale project submission.

??/1/19 and ??/2/19

- Project defense.



? ?

Queries?