

## ECE435: Embedded Systems – Homework 3

### Ethernet

**Due: Wednesday, 28 September 2016, 3pm**

This Homework investigates Ethernet technology. It should run on any Linux machine but it's probably a good idea to try it on your Raspberry Pi.

#### 1. Download and Build the Code

(a) Download the code from:

```
http://web.eece.maine.edu/~vweaver/classes/ece435/ece435_hw3_code.tar.gz
```

(b) Unpack the files:

```
tar -xzf ece435_hw3_code.tar.gz
```

(c) Build the C files:

```
cd ece435_hw3_code
make
```

#### 2. Ethernet Network

If at all possible, please hook your Raspberry Pi up to a wired Ethernet network. It is possible to do the homework without this, but it would be better if you could.

#### 3. `ifconfig`

- Run the `ifconfig` tool and see if your Ethernet card is configured. Look for the `eth0` interface.
- If you have it configured and on a network you should have a line that says what your IP address is, `inet addr` and then four numbers separated by dots.
- If your Pi currently is *\*not\** on a wired network, you can temporarily set up the Ethernet port with a fake address for the rest of this homework.

```
sudo /sbin/ifconfig eth0 192.168.10.5 up
```

#### 4. Investigating the Ethernet Interface (2pts)

- (a) Use the command `dmesg | grep eth` to see the boot messages about your Ethernet adapter. What speed is it running at?
- (b) Look at the `ifconfig eth0` results again. How many collisions has it seen? How many errors? How many packets dropped?
- (c) If the collision count is low, can you explain why that is?

#### 5. Modify the client code (3pts total)

- (a) Modify the provided `client.c` so that it takes two command line arguments. The first is a hostname (which will replace `DEFAULT_HOSTNAME`). The second is a portname (which should be put into the `port` variable).
- (b) Some hints:

- The number of command line arguments is in `argc`, the actual arguments are in `argv[1] ... argv[argc]`
  - You can convert from a string to an integer with the `atoi()` function
- (c) Once this is done you should be able to try to connect to an arbitrary server/port with a command like:
- ```
./client www.google.com 80
```
- (d) Be sure to comment your code!

## 6. TCPdump (2pts)

Use `tcpdump` to gather a raw Ethernet packet heading from your client to a webserver. In one window run this command:

```
sudo tcpdump port 80 -xe -i eth0 -XX
```

In the other run something like:

```
./client www.umaine.edu 80 and then type a message to send (such as GET).
```

If you are unable to get the above to work, you may use this Ethernet frame to answer the rest of the questions instead:

```
16:05:34.982471 b8:27:eb:af:37:11 (oui Unknown) > 00:13:3b:10:66:7f
(oui Unknown), ethertype IPv4 (0x0800), length 70:
pi3.48549 > um-web-proxy1.um.maine.edu.http:
Flags [P.], seq 1:5, ack 1, win 229,
options [nop,nop,TS val 17055320 ecr 883456963], length 4
0x0000: 0013 3b10 667f b827 ebaf 3711 0800 4500  ..;.f..'..7...E.
0x0010: 0038 572a 4000 4006 69cc c0a8 0833 826f  .8W*@.@.i....3.o
0x0020: 2e7f bda5 0050 cdc4 6a49 3c7b 6ca5 8018  ....P..jI<{l...
0x0030: 00e5 79f4 0000 0101 080a 0104 3e58 34a8  ..y.....>X4.
0x0040: 7bc3 4745 540a                                {.GET.
```

- Cut-and-paste the result of one round trip client/server communication into the README file.
- What is the MAC address in the source field? Who owns the OUI of that MAC address (you can use a tool such as <https://www.wireshark.org/tools/oui-lookup.html>)
- What is the value of the Ethernet type field?
- You'll notice that in the data part of the frame there are more bytes than the raw message you sent. What are these extra bytes?

## 7. Answer the following questions (3pts total)

Short answers are fine. Put your answers in the README file using a text editor, it will be automatically included in the submission process.

- Why did Ethernet win out over TokenRing?
- What is one advantage of using an Ethernet switch over a hub?
- What is one benefit wired Ethernet has over wireless?

## 8. Submit your work

- Run `make submit` which will create a `hw3_submit.tar.gz` file containing `README`, `Makefile`, `server.c` and `client.c`.  
You can verify the contents with `tar -tzvf hw3_submit.tar.gz`
- e-mail the `hw3_submit.tar.gz` file to me by the homework deadline. Be sure to send the proper file!