

What is the Internet doing to me?  
(witidtm 2023/2024 - TEU00311)

# Lab Sessions

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<https://github.com/sftcd/witidtm>  
<https://down.dsg.cs.tcd.ie/witidtm>

# Lab#1

# Initial Goals

- Sort yourselves into groups of ~2-3
- Login to SCSS account on lab machine and/or get your laptop online
- Fire up a “new”/“clean” browser
- Explore settings, esp security/privacy related
- Watch HTTP traffic (shift-ctrl-I)
- Find the “worst” site you can
  - NSFW disallowed!!!
  - You define/justify “worst”
  - Report back from group

# Stretch goal

- If we get the above done great, if not, that's ok
- Could be some people get to the stretch goal today or we look at it in future...
- Stretch goal: HTTP archive (.har) file generation and a bit of analysis

# Login/get-online

- Desktop logins: no “domain”, use SCSS password, not your TCD password (if those differ), so e.g. if your TCD email is **bloggsj14@tcd.ie** then you enter “bloggsj14” as the username
- Get online: we’ll deal with things as they arise
- After you’re done: see if anyone else needs help

# I did check that username... :-)

“Your message to bloggsj14@tcd.ie couldn't be delivered.

A custom mail flow rule created by an admin at tcdud.onmicrosoft.com has blocked your message.

5.1.1 The e-mail service at tcd.ie does not know this email address.”

Go do stuff!

# Play with “new” browser

- Don't use one that has e.g. stored credentials for some account you care about – basically don't muck up your daily-driver setup
- Lab machine browsers can probably be reset easily enough (TBC)
- On own laptop: maybe install one you've not used before
  - Possibles: Firefox, chromium, vivaldi, brave, opera...
  - More exist, but start being careful if you go for something less widely used: browser downloads have been known to contain malware from time to time (but mostly on phones)



# Browser settings

- Defaults are important and not always what *you* would want!
- Play about in settings and see what you find – ask if not sure or comment if you think you should tweak
- As they differ a bit, and change over time, you might want do this now and then for all browsers you use: e.g. lab machine, laptop, phone
- Things to check/set:
  - Telemetry/sending usage info
  - Search engine/Search suggestions
  - Locations/Camera/Microphone/Notification permissions
  - DNS over HTTPS (DoH)
  - Cookies
  - Blockers/Tracking protection
  - Logins/passwords
  - Javascript/NoScript
  - “HTTPS-only” mode
  - Clear things on exit

# Watch web traffic

- Open browser
- Type shift-ctrl-I (or equivalent) to open developer interface
- Re-size screens to taste
- Choose “network” tab in developer pane
- Try loading a few sites and watch what happens
  - DO NOT load NSFW sites!
- Look about on the web and decide which site is the “worst” from your POV and why
  - Just yell/put up hand when you have a “worst” to nominate
  - We’ll pick a winner if we’ve time – Prize == applause:-)

# Shift-ctrl-I for macs...

- Macs differ:
  - Firefox: Option + Command + I
  - Safari: Option + Command + C
  - Chrome: Option + Command + C
- Access to developer tools in Safari has to be activated in the settings first. If anyone has problems with that they can find detailed information on how to do this here:  
<https://support.apple.com/en-ie/guide/safari/sfri20948/mac>
- Thanks to Luca Schäfer (2021 student) for the above

# Stretch goal

- Figure out how to save an HTTP archive file (.har)
- Figure out how to view .har files
- Figure out how to diff .har files
- See what changes between seemingly identical browser sessions
  - ...any tracking?

Go do stuff!

# More goals

- Find the location of an image
- Consider what facial recognition means for us
- Stretch goal: minimal image manipulation to defeat recognition
- DO NOT use any image that has a reasonable probability of upsetting anyone

# Images and the Internet

- Why are details of images relevant to this module?

# Why are details of images relevant to this module?

- We upload lots of images
- Automated image capture is near ubiquitous
  - CCTV, ANPR, ...
- Other people upload images of us
- Organisations with image databases analyse those



# Data vs. Metadata

- Typically we talk about the “data” as being the main thing being processed or communicated or stored...
  - E.g: the bits rendered for an image or video, the content of an email, the messages in a text chat or the audio packets in a voice call
- So-called “metadata” is also data but is “about” the above rather than part of the above
  - E.g. timing of a communication, sender/receiver IP addresses, the size of data fields, etc
- Even if data is well-protected (e.g. encrypted), metadata can leak separately (or be deliberately stored/exposed) so meta-data creates risk
- For someone surveilling, metadata can be more attractive than data, e.g. law enforcement may benefit more from building a social graph of criminals compared to seeing the content of a few messages, or, facebook might learn enough from whatsapp metadata that they no longer need to see the content to sell advertising
- Metadata is also often more structured and hence easier to process for those who want to see what people are doing
- Metadata can also be a little unexpected to end-users, e.g. author information in documents, or, in images...

# Image Metadata: EXIF

<https://photographylife.com/what-is-exif-data>

<https://helpdeskgeek.com/how-to/how-to-remove-exif-data-from-your-photos/>



```
exif DSCN0010.jpg
EXIF tags in 'DSCN0010.jpg' ('Intel' byte order):
-----
Tag                |Value
-----
+-----
Image Description   |
Manufacturer        |NIKON
Model               |COOLPIX P6000
Orientation         |Top-left
X-Resolution        |300
Y-Resolution        |300
Resolution Unit     |Inch
Software            |Nikon Transfer 1.1 W
Date and Time       |2008:11:01 21:15:07
YCbCr Positioning   |Centered
Compression         |JPEG compression
X-Resolution        |72
Y-Resolution        |72
Resolution Unit     |Inch
Exposure Time       |1/75 sec.
F-Number            |f/5.9
Exposure Program    |Normal program
ISO Speed Ratings    |64
Exif Version        |Exif Version 2.2
```

**Date and Time (Original)** |2008:10:22  
16:28:39

```
Date and Time (Digitized) |2008:10:22 16:28:39
Components Configuration |Y Cb Cr -
Exposure Bias            |0.00 EV
Maximum Aperture Value |2.90 EV (f/2.7)
Metering Mode            |Pattern
Light Source             |Unknown
```

```
Flash |Flash did not fire, compulsory flash mode
```

```
Focal Length |24.0 mm
Maker Note   |3298 bytes undefined data
User Comment |
FlashPixVersion |FlashPix Version 1.0
Color Space     |sRGB
Pixel X Dimension |640
Pixel Y Dimension |480
File Source     |DSC
Scene Type      |Directly photographed
Custom Rendered |Normal process
Exposure Mode   |Auto exposure
White Balance   |Auto white balance
Digital Zoom Ratio |0.00
Focal Length in 35mm |112
Scene Capture Type |Standard
Gain Control     |Normal
Contrast         |Normal
Saturation       |Normal
Sharpness        |Normal
Subject Distance Range |Unknown
```

**North or South Latitude** |N

**Latitude** |43, 28,  
2.81400000

**East or West Longitude** |E

**Longitude** |11, 53,  
6.45599999

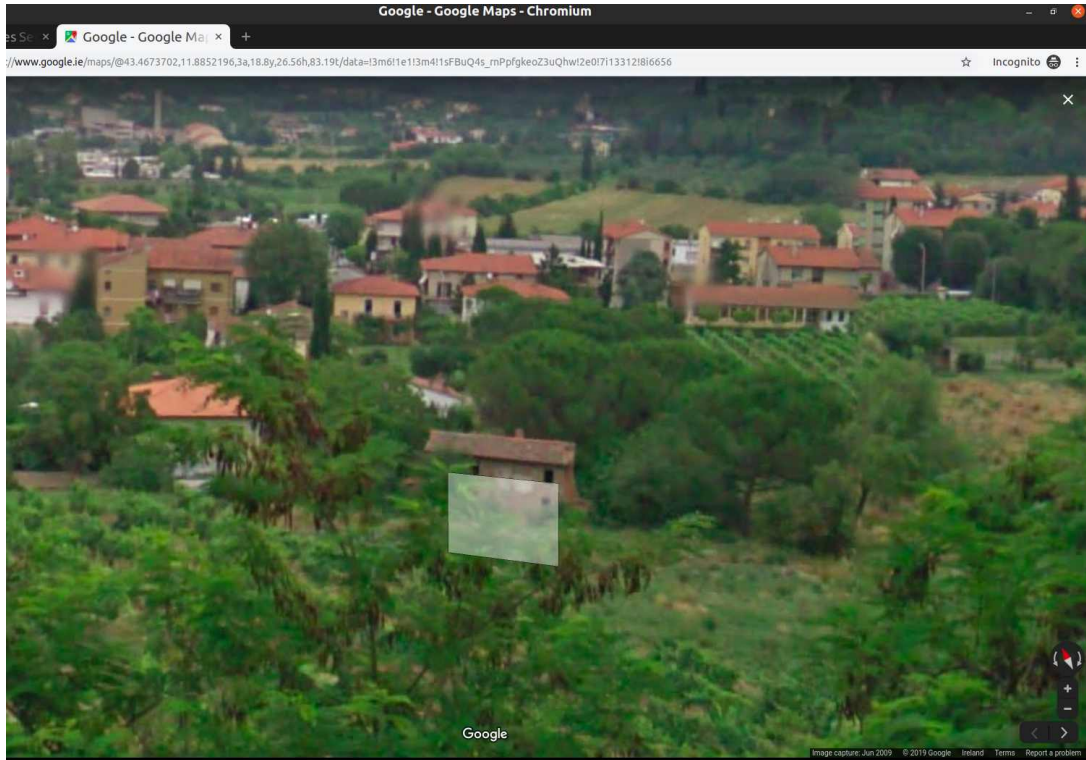
**Altitude Reference** |Sea level

```
GPS Time (Atomic Clock) |14:27:07.24
GPS Satellites           |06
GPS Image Direction      |
Geotectic Survey Data |WGS-84
GPS Date                 |2008:10:23
Interoperability Index |898
Interoperability Version |0100
```

-----  
EXIF data contains a thumbnail (6702 bytes).

<https://raw.githubusercontent.com/ianare/exif-samples/master/jpg/gps/DSCN0010.jpg>

# 52100 Arezzo, Province of Arezzo, Italy



- Took about 5 minutes to find this in Google street view
- Most of that was finding a way to map degree, minutes, seconds to fractional Lat,Long
- All **automatable**, could easily produce location history from a set of images
- How could such a “leak” be damaging to you or to someone else in your images?

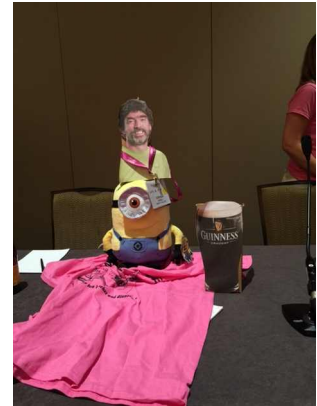
# Viewing EXIF Data

- Local: Right-click and “properties”
- Better local: install something allowing you to scan multiple images
  - E.g. “`sudo apt install exiftool`” in Linux
- On web: save image to local then GOTO above

# My Pictures

- I scanned the 28,216 files in my Pictures directory and found 499 of those contained EXIF GPS lat/long values
  - Earliest was from 2009, most recent from 2019
  - Latitude ranged from 67° N, to 3° S
  - Longitude ranged from 157° W, to 67° E
    - The 157° W pic: a conference in Hawaii I attended remotely;-(
- On the linux command line that looked like:

```
$ exiftool -gpslatitude -gpslongitude -createdate -csv -r ~/Pictures
```



# Photo Sharing (1)

- What happens when you share photos?
  - Worth noting that some people, esp. Photo enthusiasts, do want all the EXIF data preserved/shared
- “Approximately 69% of services under study were found to actively sanitize EXIF metadata, which mitigates privacy risks for the users.”
- The quote above and the table on the next slide are from:
  - Gouert, Charles, and Nektarios Georgios Tsoutsos. "Dirty Metadata: Understanding A Threat to Online Privacy." IEEE Security & Privacy 20.6 (2022): 27-34.  
<https://udspace.udel.edu/server/api/core/bitstreams/f2a04ac2-e998-49a4-b943-c26659c74fe4/content>  
accessed 20230919
- If “scrubbing” happens on the server, the server still gets metadata even if service users don’t, not clear when that might apply



# Photo Sharing (2)

Service	Class	Platforms	Policy	Service	Class	Platforms	Policy
Signal	Messaging	iOS, Windows	Scrub	420chan	Imageboard	Browser	Scrub
FB Messenger	Messaging	iOS, Browser	Scrub	2chan	Imageboard	Browser	No Scrub
iMessage	Messaging	iOS	No Scrub	Hispachan	Imageboard	Browser	Scrub
Slack	Messaging	Ubuntu, iOS	Scrub	Diochan	Imageboard	Browser	Scrub
Skype	Messaging	Ubuntu, Windows	Partial Scrub	Ylilauta	Imageboard	Browser	Scrub
WhatsApp	Messaging	iOS	Scrub	MS Outlook	Email	Windows	No Scrub
Viber (PC)	Messaging	Ubuntu	No Scrub	Yahoo Mail	Email	Browser	No Scrub
Viber (Phone)	Messaging	iOS	Scrub	Gmail	Email	Browser	No Scrub
WeChat	Messaging	iOS	Scrub	Protonmail	Email	Browser	No Scrub
Instagram	Social Media	Browser, iOS	Scrub	AOL Mail	Email	Browser	No Scrub
Twitter	Social Media	Browser	Scrub	Craigslist	Marketplace	Browser	Scrub
Facebook	Social Media	Browser	Scrub	Amazon	Marketplace	Browser	Scrub
LinkedIn	Social Media	Browser	Scrub	eBay	Marketplace	Browser	Scrub
Reddit	Imageboard	Browser	Scrub	FB Marketplace	Marketplace	Browser	Scrub
4chan	Imageboard	Browser	Scrub	Alibaba	Marketplace	Browser	No Scrub
PTchan	Imageboard	Browser	Scrub	Etsy	Marketplace	Browser	Scrub
Flickr	Imageboard	Browser	No Scrub	Tanga	Marketplace	Browser	Scrub

# Your EXIF task...

- 1) Find some image(s) online or locally
  - 2) Determine if they contain EXIF location data
  - 3) Find the location of that image in e.g. Google street view
  - 4) As time permits: GOTO 1
- What can you infer from the above?
  - What could you infer if you did the above for a number of images of related subjects?



Go do stuff!

# Facial recognition

- A kind of “biometric” (more later on the imperfections of biometrics:-)
- Nice overview, including tricky issues at:  
[https://en.wikipedia.org/wiki/Facial\\_recognition\\_system](https://en.wikipedia.org/wiki/Facial_recognition_system) (accessed 20230919)
- Basic idea: program analyses image bits, search for pattern that looks like a face (eyes, nose, mouth, ...), classifies that (based on machine learning using image collections), compare results from two images – if close enough, declare match
  - False positives and negatives will happen
- Note: this is not my area of expertise!

# Facial recognition (ab)uses

- Find a photo of “this person”
  - Find local pics of your mum, organise your image gallery
- Find people with outstanding arrest warrants in a crowd
  - Recognition of faces in moving crowd is harder than individually, but likely, not that much harder
- Determine ethnicity of people using public transport
  - Critics may say things like the above - proponents might talk about improving efficiency but build systems that have this effect

# Image Search

- Google “reverse” image search
  - GOTO <https://images.google.com/>
  - Click the “camera” icon
  - Paste/upload an image
  - Google will search for info and other images

# Image Search Task

- Your task: play with that image search to try find images that produce bad search results
  - The goal is to get a feel for what does/doesn't work well with that
- Don't use any NSFW images
- Don't use images of people who might not want you to use their image (including yourself if that's the case!)

# Stretch goal – Try break that

- Find an image that produces good search results (easy:-)
- Pick an image editor
  - My suggestion: gimp, <https://www.gimp.org/>
  - But there may be simpler options
- Try find the “smallest” change that causes the search results to be noticeably worse
- General topic: adversarial images
  - <https://davideliu.com/2020/05/27/introduction-to-adversarial-attacks-on-images/>  
accessed 20230918
  - Same concepts apply to other machine learning settings, e.g. text, audio, ...

Go do stuff!

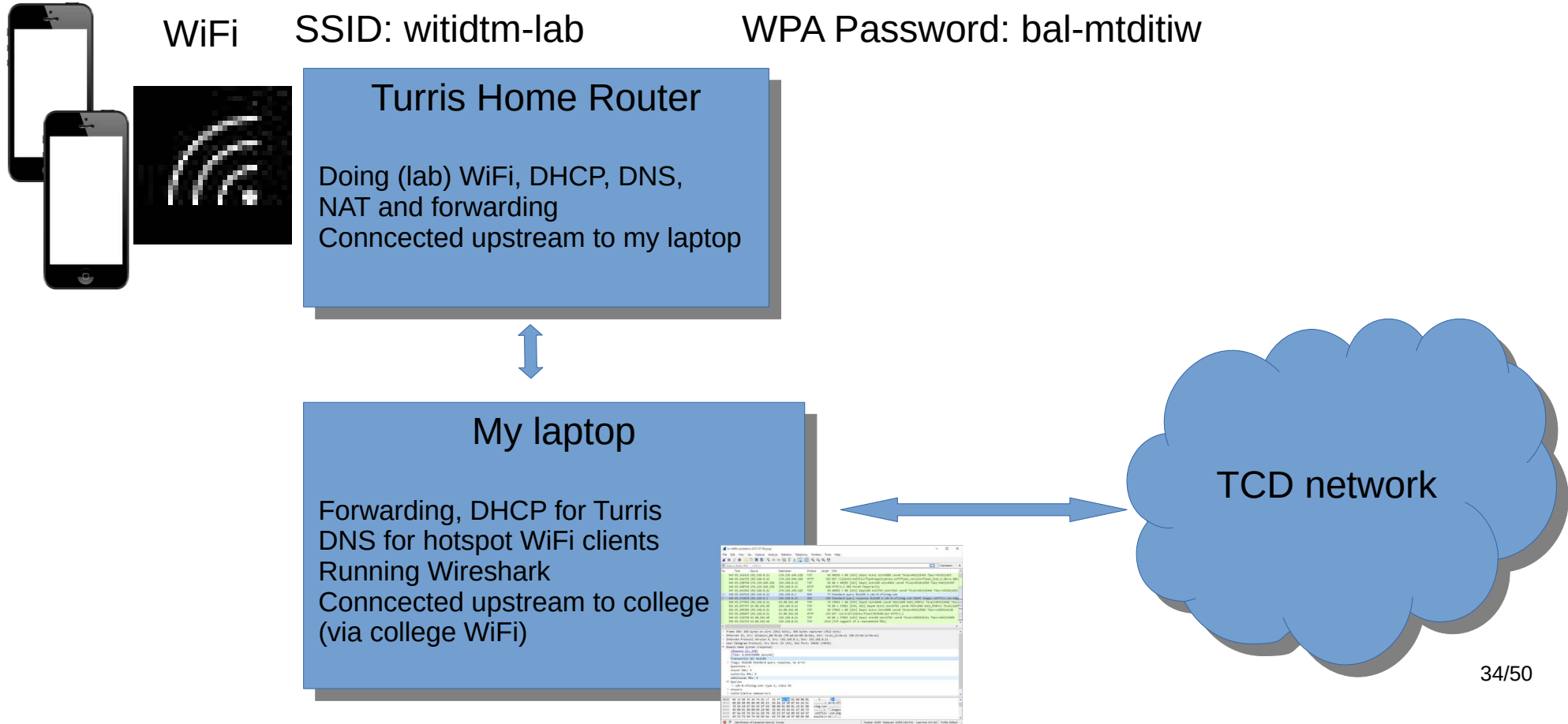
# Lab#2



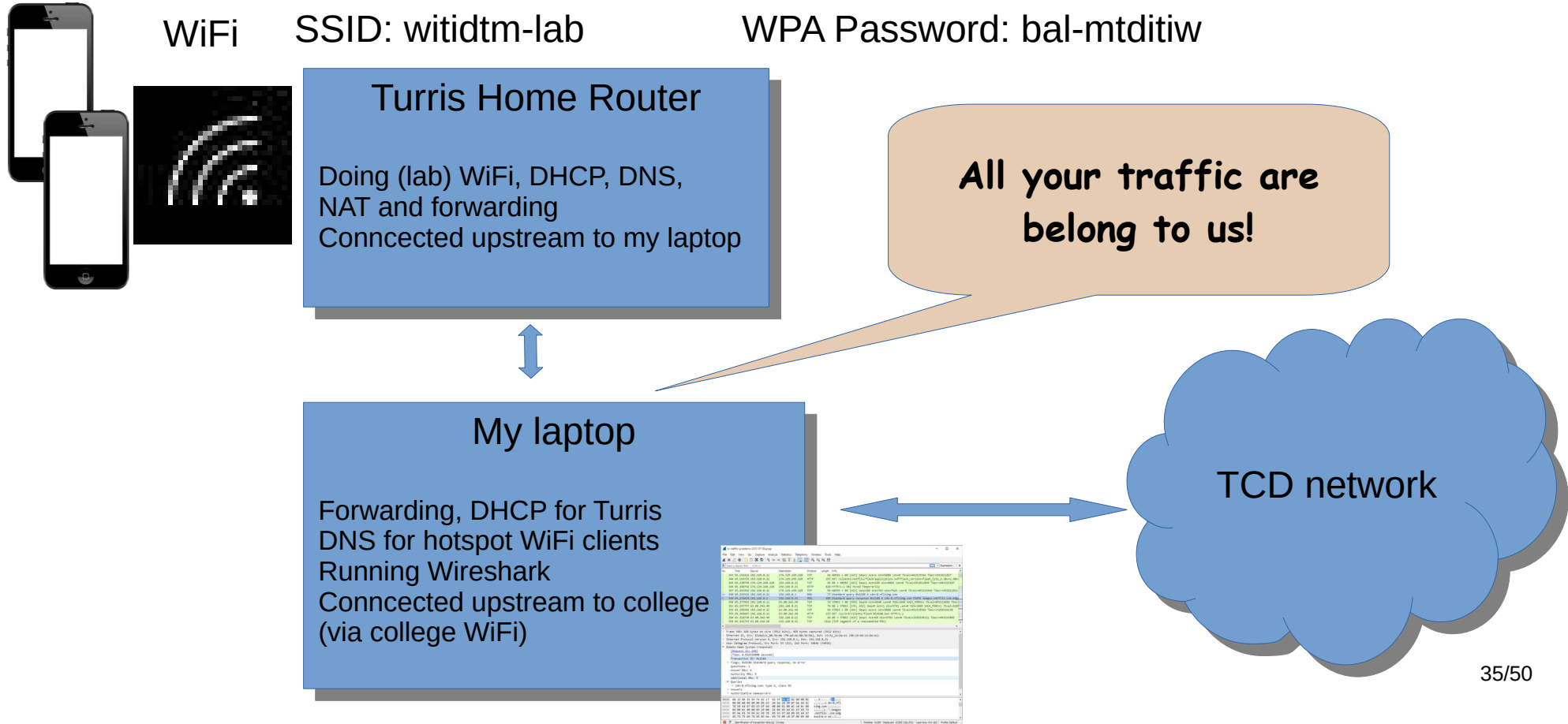
# Yet Moar goals

- Join my hotspot
  - SSID: witidtm-lab
  - WPA Password: bal-mtditiw
- We'll watch some traffic using wireshark, and chat about that
- Stretch goal: do it yourself at home if interested

# Hotspot setup



# Hotspot setup



# Wireshark

- Fine tool to observe network traffic
  - <https://www.wireshark.org/>
- The network-side equivalent of what you saw in a browser with shift-ctrl-l
- But not limited to web traffic, you see it all as it is “on the wire”

# Some traffic

- Display wireshark and see what's visible

# MAC Addresses

- Device-tracking often (ab)uses **long-term hard-coded identifiers** such as MAC addresses (or IMEI/IMSI in mobile n/w)
- MAC address: link layer address (mostly) hardcoded to radio or other network chip
  - Same form of address used in WiFi and most other network protocols at link layer, e.g. Bluetooth
  - Roughly: how two devices on the same local area network (LAN) identify one another
- Looks like “6C:9C:ED:87:27:60” (48 bits) - 1<sup>st</sup> half is manufacturer ID (Cisco), 2<sup>nd</sup> half device-ID (a WiFi router in TCD SCSS)
  - You can look up manuf IDs from the registry, e.g.  
<https://www.adminsub.net/mac-address-finder/84:C7>
- MAC address is often fixed for the lifetime of the device; There is now a 64-bit version, not sure how widely used yet
  - You can probably see these in the “about device” tab or similar

# Randomised MACs

- MAC address randomisation is a good idea and starting to be deployed
  - Often, the MAC address only really needs to be stable for a session, so can be randomised
  - But – if you paid for the hotel WiFi that might be based on your MAC address, or an enterprise network might use MAC addresses to decide which machines are allowed on the local network, or the machine may be a switch/router/server where changing MAC address would break stuff or be inefficient
- So you can't always randomise, and doing so well needs higher-layer controls
- HOWTO turn on varies by OS and version
- On an android 10 phone I used have:
  - Developer options/Enhanced Wi-Fi MAC randomisation
  - You may need to turn on developer options first (search for HOWTO)

# Some traffic

- Display wireshark and see what's visible



# DHCP (1)

- Dynamic Host Configuration Protocol (DHCP) is (almost always) how your device gets an IPv4 address after joining a network
  - Spec is RFC2131 from 1997
- DHCP has a “hostname” option that client’s send and that has often been the same as a long-term device name, e.g. “Stephen’s iPhone”
  - That can be used for a loooong time
  - Recent phone OSes tend to send something more random looking but often don’t vary the value
  - If you migrate from an old to a new device, that setting might carry over even if your current OS would otherwise use a random value
  - Changing hostname could break stuff though so be a bit careful
- Other DHCP options clients send can also be identifying e.g. OS version

# DHCP (2)

- As well as returning an IP address, the DHCP server can send many other options
  - Most aren't widely deployed
- The DNS server IP address option is though
  - Tells clients what server to use for DNS in this network
- OSes can override that but mostly (so far) don't
  - Unless you have DoT configured or some Apple stuff

# Router Admin

- Demo OpenWRT/Foris/Luci

# DNS names

- Today, we can mostly see the DNS names being queried as that's cleartext
- Starting to see more use of encrypted DNS traffic
- Two flavours: DoT and DoH
- We'll look quickly at that but chat more about it later
- On that old crappy android device enabling DoT used be:
  - Settings/Connections/More Connection Settings/Private DNS
  - BUT that won't work with college as upstream as DoT uses port 853 and college block that port – it should work fine at home and with your mobile data provider

# Do53 vs DoT vs DoH

- Do53 == old style cleartext DNS
- Who do you want to/care about seeing your DNS traffic?
  - Your ISP, TCD, coffee-shop and their ISP, Cloudflare, Google ?
- Pros and cons to each of these

# Brave Browser

- Not a bad browser on mobiles
- Has various “shields up/down” settings
  - Settings/Brave Shields and Privacy/Use Secure DNS
  - DoH – that does work in college
    - There may be a set of known services from which to choose
    - Or you can add a custom one:
      - For cloudflare try: <https://1.1.1.1/dns-query>
  - DoH can also be set in most other browsers these days too

# Some traffic

- Display wireshark and see what's visible

# Stretch Goal

- Repeat this at home if interested
  - Can help with, but not mandatory for, my assignment
- Setup hotspot using laptop
- Install wireshark
- Inspect traffic and learn



# Fake a real web site

- <https://highscalability.com/> re-directs to an insecure http:// URL -- **BAD PRACTICE!!!**
- Inside my laptop I'm running a web server
- I can “easily” re-direct the traffic for the insecure URL to that but let the secure stuff go through

```
# start lighttpd
```

```
$ ./testlighttpd.sh
```

```
$ sudo sysctl -w net.ipv4.conf.all.route_localnet=1
```

```
$ sudo iptables -t nat -A PREROUTING -i enxa0cec80097d6 \  
-p tcp -d 172.67.173.147 --dport 80 \  
-j DNAT --to-destination 127.0.0.1:8099
```

```
$ sudo iptables -t nat -A PREROUTING -i enxa0cec80097d6 \  
-p tcp -d 104.21.30.199 --dport 80 \  
-j DNAT --to-destination 127.0.0.1:8099
```

# Lab Conclusions...

- What do you conclude?
  - <add stuff here>