TEU00311
What is the Internet doing to me? (witidtm)

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

URLs accessed 20190907

What're we here for?

- We all use the Internet all the time

- You may or may not know what's happening under the hood, and shouldn't need to know all the nitty-gritty detail

- But, to make better decisions as to what you do, it's good to know something about some of those details

- This module aims to help you learn enough to make better decisions about what you want, and how to get it, as you interact with the Internet

- I hope: you'll apply those lessons, tell others about it all and maybe agitate for a better Internet for a better society (but you won't fail the module if you don't agitate:-)

Administrivia

TCD Personnel/Contacts

- Lectures:
  - Dr. Stephen Farrell, stephen.farrell@cs.tcd.ie, WR3.4, x2354
  - Dr. Dave Lewis, dave.lewis@cs.tcd.ie, ORI G.38, x8428
    - You'll see Dave on Oct 1
- Teaching Assistant:
  - Christian Cabrera, cabrerac@scss.tcd.ie
- Demonstrators: TBD

Who are we? (SITS as of Aug 23rd)

- 7 x Human Health and Disease Single Pathway
- 5 x Computer Science Single Pathway
- 3 x Global Business
- 3 x TSM Economics and Mathematics (Freshman)
- 3 x Mathematics Single Pathway
- 3 x Molecular Medicine Single Pathway
- 3 x Philosophy Single Pathway
- 2 x Social Studies Single Pathway
- 2 x BESS
- 2 x Mental Health Nursing

- 1 x Physics Single Pathway
- 1 x Science (Freshman)
- 1 x Middle Eastern and European Languages and Cultures
- 1 x Deaf Studies Single Pathway
- 1 x Chemistry Single Pathway
- 1 x Microbiology Single Pathway
- 1 x Bioengineering
- 1 x Engineering with Management Single Pathway
- 1 x Engineering Single Pathway
- 3 x no info
- 1 x me:-)

Initial survey (14 answers)

How familiar are you with how Internet related technolgies work?

- Not at all familiar 14.285%
- A little familiar 42.857%
- Fairly well informed 35.714%
- Expert for some bits 7.142%

Which of the following would you regularly bring to college?

- Laptop running windows 42.857%
- MAC latop 50.00%
- Iphone 64.285%
- Android phone 28.571%

Which of the following sevices do you use regularly?

- Facebook 78.571%
- Gmail 100.00%
- Instagram 78.571%
- Linkedin 14.285%
- Netflix 71.428%
- Openstreetmap 7.142%
- Reddit 14.285%
- Snapchat 35.714%
- Soundcloud 7.142%
- Spotify 92.857%
- Whatsapp 71.428%
- Wikipedia 64.285%
- Youtube 92.857%

Schedule

- Tuesday 1000-1050, Synge 2, Hamilton building
- Thursday 1600-1750, M17, Museum building
- Weeks 3-7: Just lectures
- Weeks 8,10-14:
    - Themed lecture (Tue, 1000-1050)
    - Hackathon/lab (Thu, 1600-1750) – **venue moves to Regent's House**
- Reading week: Week 9, October 21
- September 10th is in week 3 - Why do week numbers start at 3? I've no idea;-)
- Details of labs are being worked out, stay tuned

External Experts

- Most labs/hackathons will be lead by an external expert, most will be remote

- Getting busy people to help (for nothing:-) means being flexible so changes are likely as we go

- Will let you know as dates/topics are firmed up

Assessment

- Blackboard tests – 45% (see next slide)

  - https://tcd.blackboard.com/webapps/blackboard/execute/courseMain?course_id=_56807_1

  - I'm not a huge fan of blackboard but we'll try...

- GDPR request and anonymised report – 25 %

- Group project (report) – 15%

- Individual project (report) – 15%

- No exam unless you flunk, then a supplemental for 100%, but don't flunk!

Blackboard tests

- Initial survey (not marked)

- Week 4 - Assignment#1, Small essay (5%)

- Week 5 – Quiz#1, Multiple Choice Questions (MCQ) on content to date (5%)

- Week 6 – Assignment#2, Dave's ethics canvas thing: PDF → blackboard :-) (5%)

- Hackathons: MCQ before each so you have enough background to (3 x 10%)

- For all BB tests – deadlines apply, late submission means high penalties, details will be posted for each

- I may change some of that depending how well the quiz thing works (or not!)

Module Materials

- There is no book – feel free to recommend some if you like
- Materials will be linked to from, or on, the module web page:
    - https://down.dsg.cs.tcd.ie/witidtm
- Content of module web page is also in Github at:
    - https://github.com/sftcd/witidtm
- Clone that repo and/or visit that page often, as it will change during the runtime of the module!
    - Who knows what "clone that repo" means?
    - I'll be happy to take PRs, if offered – if **very** good I might even give some marks or let someone off an assignment

Style

- The module is designed to be interactive, so don't sit there and say nothing!
- It is entirely ok to ask what might appear to be dumb questions, e.g. "Who makes money from YouTube?" - supposedly naive questions can be good and the answers might be quite subtle
- It is entirely ok to comment on what we tell you, e.g. "That's nonsense – I use <foo> all the time and it's fine" - this is about you after all, so (dis)agreeing with us and one another is desirable (but don't be an ass, and do listen)
- If you don't comment or ask questions, we'll all be more bored and I'll get cranky!
- So, let's start...

Here're some questions we'll come back to at the end of the slide-deck (today or next day, whenever) but please start to ponder them...

How do you interact with the Internet?

Do you care about your, my, or all of our, security on the Internet?

If so, what do you care about most?

Do you care about your, my, or all of our privacy?

That's all for now, we'll be returning to those questions as we go.

But… what other questions should we be considering?

What else?

- Your topic here... what'd you like to cover?

-

-

-

(we can revisit this multiple times)

Meanwhile… let's start with…

Is the Internet a network?

Is the Internet a network?
(hint: the answer is "no":-)
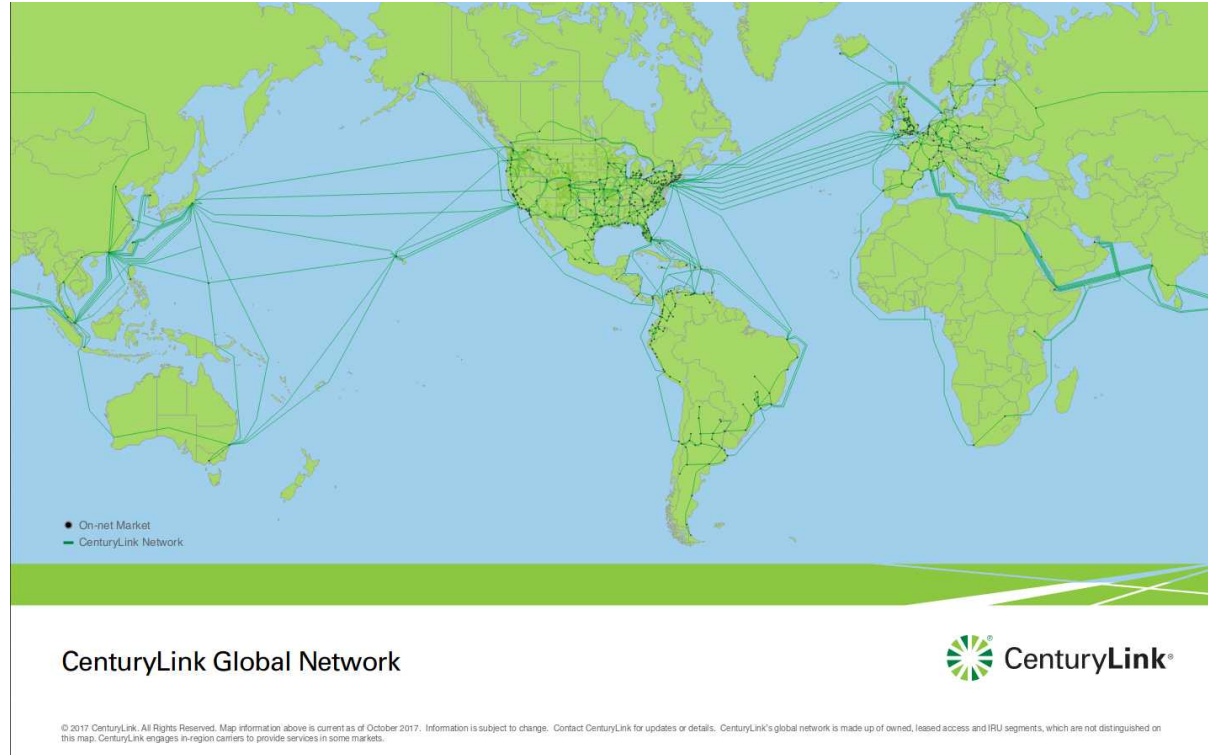
A network of networks

- The Internet is made up of about 65,428 Autonomous Systems (ASes)
  - https://en.wikipedia.org/wiki/Autonomous_system_%28Internet%29
  - 65,428 number as of Aug 19 (https://www.cidr-report.org/as2.0/)
- Think of these as the set of Internet Service Providers (ISPs, like Eircom, Vodafone, Virgin), other networks (e.g. HEANET which is TCD's "ISP"), big companies (e.g. Google, FB) and oddities like Internet eXchange Points (IXPs, like INEX)
- Each is (in principle and often in practice) an independent network (or set of networks) and their operators can do whatever they want
  - They're essentially defined by sets of numbers: Static: AS number (ASN); Dynamic: sets of IP address prefixes
- They interact using Internet protocols (like IP, TCP, BGP)
  - IP: Internet Protocol; TCP: Transmission Control Protocol; BGP: Border Gateway Protocol
- We'll delve more into all that later, but first… some pretty pictures

CAIDA Map of ASes
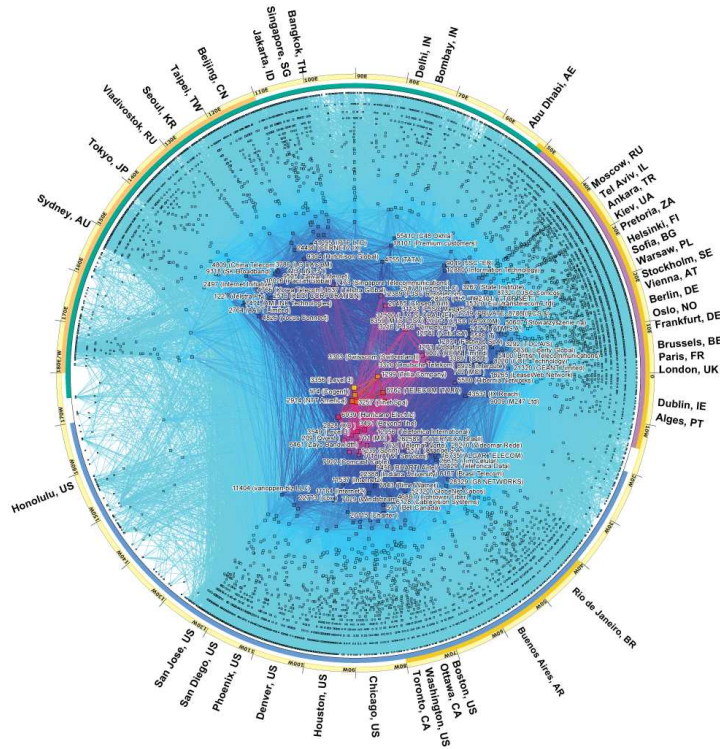
- CAIDA (Center for Applied Internet Data Analysis) is a UC San Diego Internet measurement organisation
  - You can measure **a lot** of what happens on the Internet as it happens!
- This is a 2017 map of the ASes as they were then
  https://www.caida.org/research/topology/as_core_network/2017/
- More central => more connected, serving more people
  - You can see Dublin at about 3 o'clock
  - In the middle (if you zoom) you could see level3 and cogent which are large ASes

Level3 is one of those (a BIG one)

CenturyLink Global Network

© 2017 CenturyLink. All Rights Reserved. Map information above is current as of October 2017. Information is subject to change. Contact CenturyLink for updates or details. CenturyLink's global network is made up of owned, leased access and IRU segments, which are not distinguished on this map. CenturyLink engages in-region carriers to provide services in some markets.

https://www.level3.com/~/media/files/maps/en-network-services-level-3-network-map.ashx

Cogent similarly

Cogent's network stretches over 204 markets throughout **43 countries** in North America, Europe and Asia, with over **57,400 route miles of long-haul fiber** and more than **34,100 miles of metropolitan fiber** serving over **840 metropolitan rings**. Our end-to-end optical transport network consists of IP-over-WDM fiber links running up to **2,120 Gbps** intercity capacity and **2,000 Gbps** on metropolitan rings, located in Cogent's major markets throughout North America, Europe and Asia. On the IP layer, Cogent's Tier 1, IPv6 and MPLS enabled network has direct IP **connectivity to more than 6,760 AS** (Autonomous System) networks around the world with over **185 Tbps** internetworking capacity.
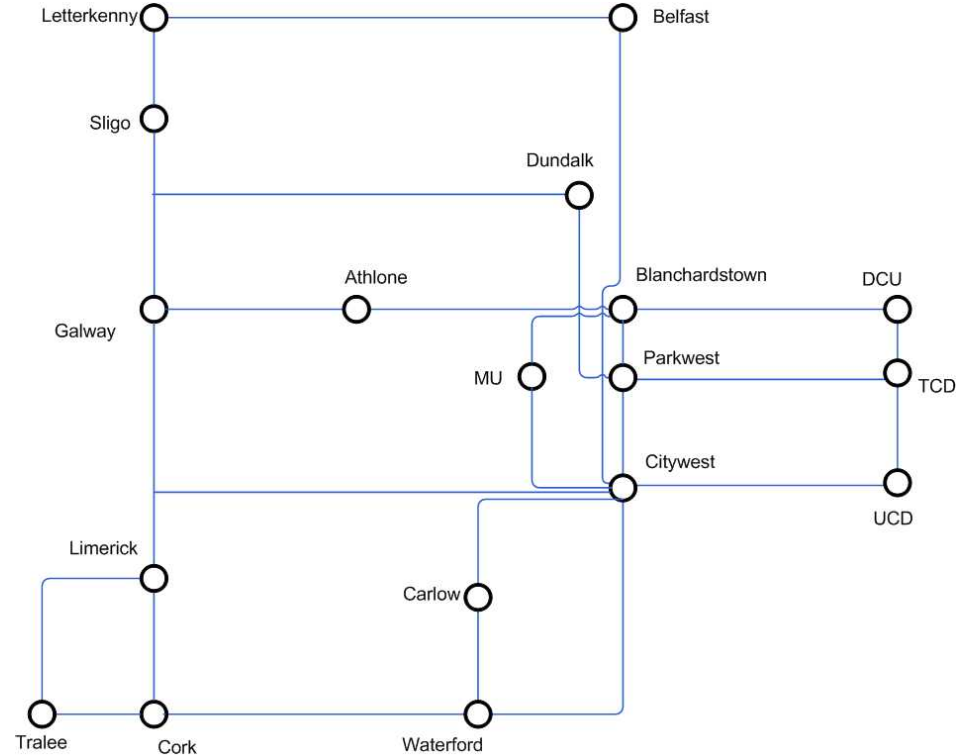
https://www.cogentco.com/en/network/network-map
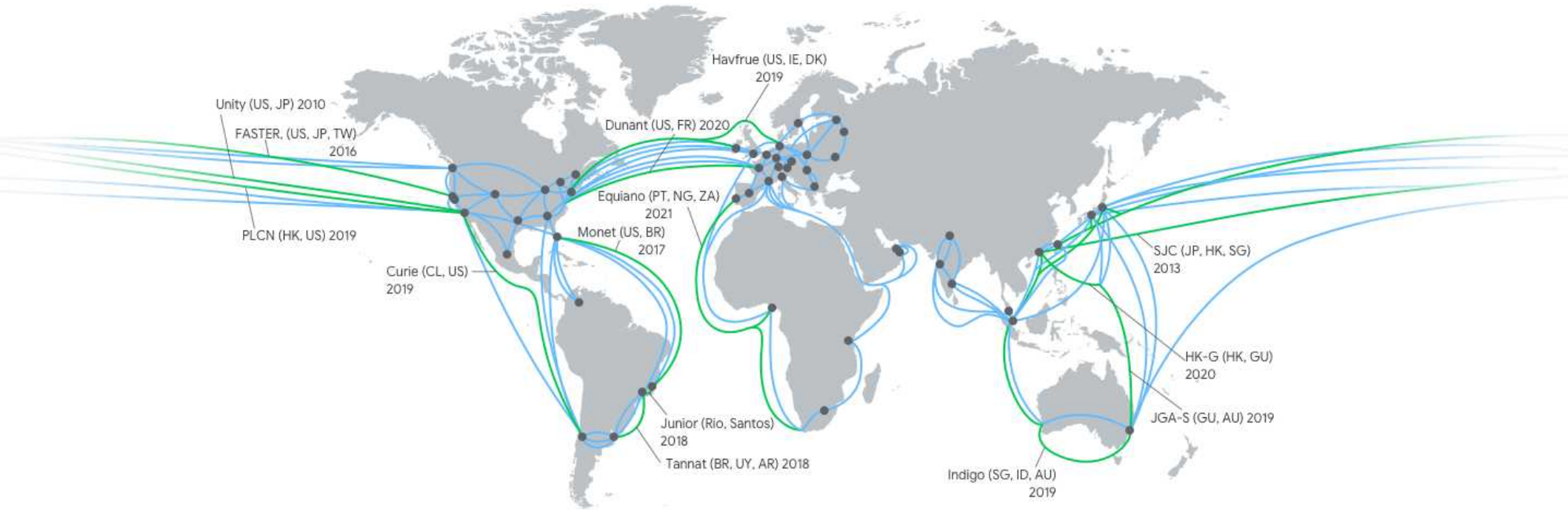
Google cloud

note this is just google cloud, not all their stuff

Heanet national n/w

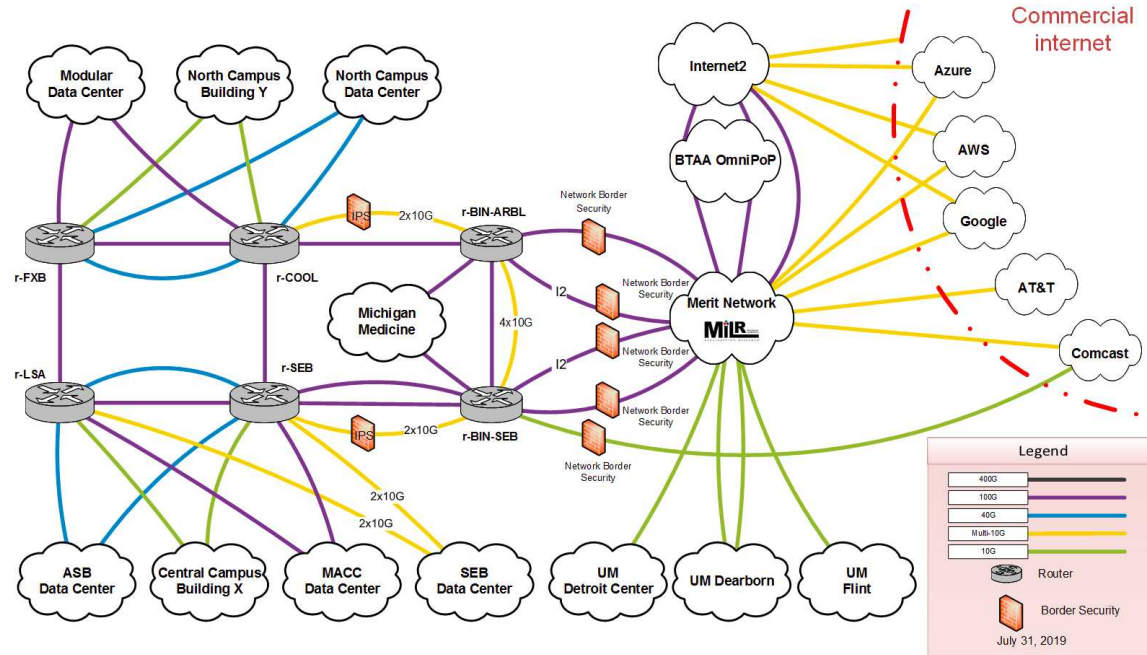https://www.heanet.ie/the-network/network-maps

The TCD network

- Me: Could you send me a n/w diagram to give students an indication of the complexity of a campus n/w?

- Them: No.... <mumble> ... security ;-(
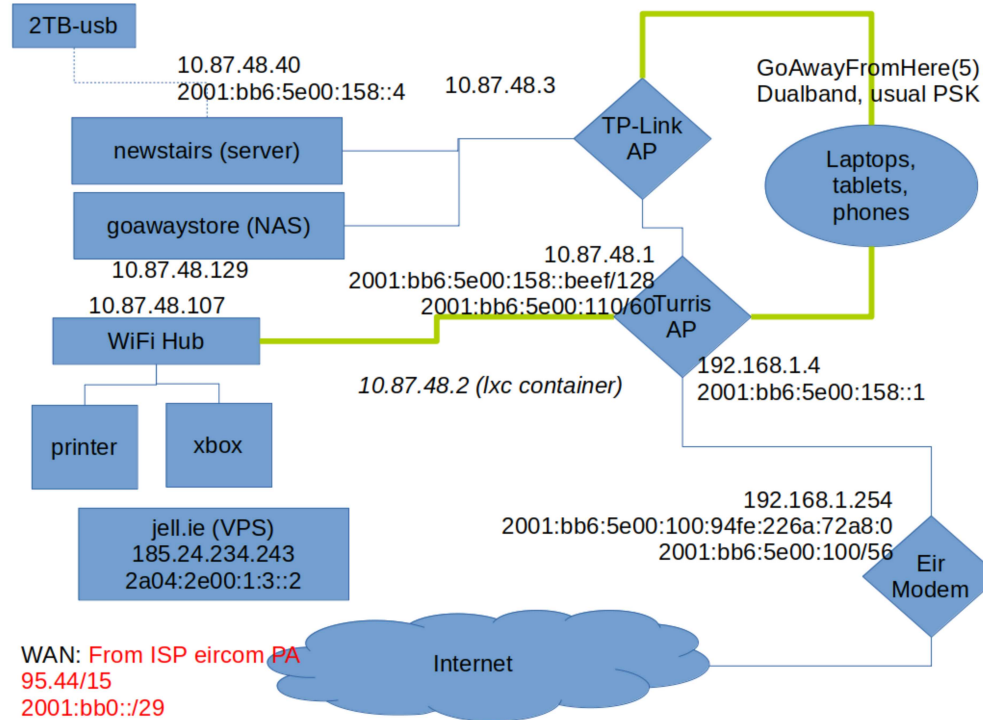
- Ah well, they're mostly similar so...

Umich n/w diagram

University of Michigan Network
And connections to the World

https://its.umich.edu/enterprise/wifi-networks/campus-network-diagram-description

My home network

2TB-usb

10.87.48.40
2001:bb6:5e00:158::4

10.87.48.3

GoAwayFromHere(5)
Dualband, usual PSK

newstairs (server)

TP-Link
AP

Laptops,
tablets,
phones

goawaystore (NAS)

10.87.48.129

10.87.48.1
2001:bb6:5e00:158::beef/128
2001:bb6:5e00:110/60

Turris
AP

10.87.48.107

WiFi Hub

10.87.48.2 (lxc container)

192.168.1.4
2001:bb6:5e00:158::1

printer   xbox

jell.ie (VPS)
185.24.234.243
2a04:2e00:1:3::2

192.168.1.254
2001:bb6:5e00:100:94fe:226a:72a8:0
2001:bb6:5e00:100/56

Eir
Modem

WAN: From ISP eircom PA
95.44/15
2001:bb0::/29

Internet

That's from a few years ago – numbers are out of date:-)

Interoperability

- To make the Internet work we need to agree on how to **interoperate** for some basic/ minimal set of things
  - That means defining/agreeing on Internet Protocols
  - Where we need to agree on how to interoperate, a lot of that is done by the Internet Engineering Task Force (IETF) and other Internet standards bodies (IEEE SA, W3C)
    - I'm quite involved with IETF stuff, so consider me biased there:-)
- But we do not aim to agree about everything in everyone's network
  - So an awful lot happens at the "application layer" in code written by people and organisations
  - And yet more happens when people configure services that use that code

What's a network protocol?
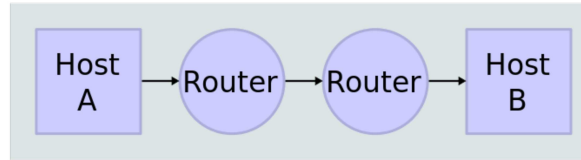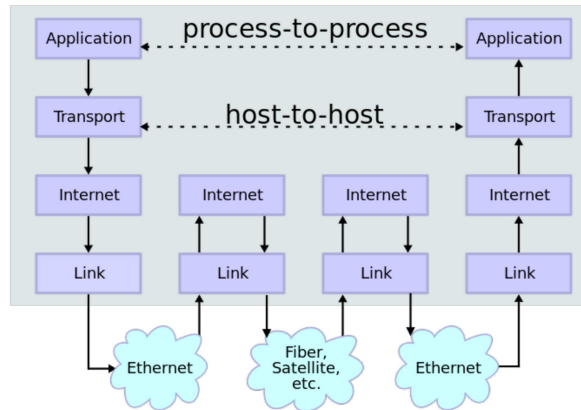
https://en.wikipedia.org/wiki/File:IP_stack_connections.svg

"Permissionless innovation"

- One important point is: in principle each network operator can do whatever it wants so long as it interoperates "nicely" with others (and even when it doesn't act particularly nicely;-)
  - That also applies to your home network (if you want and are able)
  - There are no protocol police
- This is one of the main reasons why the Internet has been so successful
- Related: the classic "End-to-end argument" paper
  - Salzer, Reed. Clark,"End-to-end arguments in system design" ACM ToCS (1984).
    - https://web.mit.edu/Saltzer/www/publications/endtoend/endtoend.pdf
  - I recommend a read of that!
  - Don't consider it as gospel though – it's the end-to-end **argument** and not really the end-to-end **principle** even though it gets called the latter a lot

"Tussles"

- Repeating: we do not aim to agree about everything in everyone's network...
  - So an awful lot happens at the "application layer" in code written by people and organisations
  - And yet more happens when people configure services that use that code
- When the "policies" reflected in those collide then "fun" follows;-)
  - If protocols or application code constrains what operators can do then people complain
  - If what n/w operators are doing breaks (esp changes to) applications then people complain
  - In both cases people often complain at the wrong place;-)
- Another paper:
  - Clark, David D., et al. "Tussle in cyberspace: defining tomorrow's Internet." ACM SIGCOMM Computer Communication Review. Vol. 32. No. 4. ACM, 2002.
    - https://www2.cs.duke.edu/courses/compsci514/cps214/spring09/papers/p347-clark.pdf
  - Same "Clark", but older:-) Interestingly, the 2002 paper is IMO far more dated (and wrong!) than the 1984 paper!
- We'll consider a "topical" example later (Search for "DNS over HTTPS" if you want to check it out); don't worry if this issue seems a bit too hard to grok at this point

Aside: Cyber<blah>

- Be wary of anyone who uses a term like "Cyber<blah>"

- ~90% of the time, that's a strong indicator that they don't really know what they're talking about (if they did, they'd use a more precise and well-defined term)

- Sadly, about 10% of the time (and increasing) such terms are used because "industry" keeps on doing it and people just repeat stuff thoughtlessly

- Don't be afraid to ask someone to define "Cyber<blah>" if they use such a term, and don't be surprised if they find that hard!
  - E.g. "Does cyberspace include a person driving a car that's had it's license plate automatically scanned?" or "What's not included in cybersecurity?"

The Internet is not the web

- Another important point!
- The web is (roughly) the set of computers that speak the HTTP protocol
  - HTTP == HyperText Transfer Protocol
- Email doesn't use HTTP, but rather (mostly) the Simple Mail Transfer Protocol (SMTP) which is a couple of decades older than HTTP
- Mobile network internals (3G, 4G, 5G...) mostly run over IP using a bunch of protocols you'd prefer to never have to know about
- But lots of our interactions with the Internet are via the web

Some of the things we'll do later...

- Understand what happens under the hood when your browser loads a web site

- Get an overview of advertising networks

- Learn how to watch network traffic

- Build a home network

- Be sneaky on a home network

- We'll look more at the web soon, meanwhile back to you...

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