

Networking Autumn 2017

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Check Panopto!

- Is it running?
- Is it running?
- Seriously, is it running?

What this course is

- Some networking **theory**
- Some networking **practice**
- Some networking **business and reality**

What you will learn

- The main components of networking 2017-style, hopefully with an eye to 2027 (or at least 2018).
- Some background to explain why networking today looks like it does, much of which is rather contingent, and how people make money.
- Some theory and science to justify the technology.

The key question

- Both GCHQ and Google lament that when they ask applicants the question “you click on a link, what happens?”, people can’t really give much of an answer beyond the GUI.
- This course should get you from the click to the wire.

Who are you?

- I'm expecting people from
 - 3rd/4th years of our BSc/MSci/MEng programmes and parallel joint honours programmes
 - Advanced Computer Science and Cyber Security MSc programmes
 - Is there anyone else? ICY? Conversion MSc?

Programming Skill

- I'd really like you to be able to program, well, in C (ie, Hayo's course, and perhaps be taking Operating Systems in parallel with this)
- However, for Cyber Security Students, I want you to be able to take this course as a pre-requisite for Network Security, which is compulsory, and you might not have C skills.
- In which case, we can do the 10% programming exercise in other languages, but you might not get the full experience.

Extended Course

- There will be an additional section in the second exercise towards the end of the course for “extended” students, which will look at deeper issues.

Some Basic Assumptions

- Spoiler: Apollo 13 did get back to earth
- Spoiler: The Titanic sinks before the end of the film
- Spoiler: Ethernet lower layers and TCP/IP upper layers **have won**. There are no serious contenders on the 10–20 year horizon. Everything else is history or weird curiosity.
- So this course is unashamedly Ethernet and TCP/IP focused, as there are no other games in town.

Week 1:

- This Introduction
- Packet v Circuit Switching, layer models (DoD 4/5, ISO 7), what's in the subnet, transport, application layer.
- Network Hardware: Switches, Routers, data/control/management plane. Software defined networks.

Week 2

- Socket Concepts, Threading requirements, old code forks. Socket API.
- I really want to do this in C, with Java as a distant second choice. Please talk to me if this is going to be a problem for you. There will be an exercise.
- Application: DNS
 - Worth a whole lecture, as it's a critical Internet service. I will talk about practical deployment and some security issues as well as how the protocol works.

Week 3

- Background: LAN/WAN split, Arpanet, X.25, PSS, DEC/XNS/SNA, DoD, OSI. Why OSI Failed.
- Lower Layers: FDDI, Slotted/Token Rings, **Ethernet** (in its various forms). Touch on Transmission (SDH, WDM). ATM in passing.

Week 4

- IP: addressing, routing, concepts. **Why IPv6 is needed.**
- IP: address allocation, bootp, DHCP, SLAAC.

Inversion

- In the past few years, I taught the knotty details of TCP at this point.
- Strong knowledge of TCP is important and valuable: there's a real shortage, 35 years after the RFCs, 40 years after Cerf's paper, of people with good understanding of its dynamics
- But I think it needs applications to motivate it, so I'm going to switch to applications at this point and come back down the stack.

Week 5

- Application: HTTP, SMTP, IMAP, POP3, SNMP, NTP
 - For all the application lectures, I will deal with deployment and server issues as well as the protocol, so you can go out and do stuff with them.
- For the good of everyone's futures, I'm going to spend some time on security issues within these protocols.

Week 6

- TCP 1: history, basic concepts. Windows, acks.
 - Previously I had a deadline here to meet Network Security, which I was teaching in the same semester. We're more relaxed this time.
- TCP 2: Detailed operation
 - This might take more than one lecture

Week 7

- TCP 3: Options (scaling, PAWS, etc, timestamps)
- TCP 4: Nagle, silly-window.
- Implementation: how it looks in the kernel.
- I'm going to assume some familiarity with Unix/Linux kernels, but I'll try to make it accessible if you don't have that

Week 8

- UDP, RTSP, other transports
- NAT and its evils. IPv6 as cure. IoT. NAT security / logging / problems.

Week 9

- Application: Voice (I will try to get Chris Gallon in), 21CN, issues and politics.
- If I can't get Chris, Jim Reid on DNS security, issues and politics
 - Marshall Rose referred to politics as “Layer 8” of the 7 layer model.
- Tutorial, Catchup, Exercise feedback and discussion

Week 10

- Routing inside the enterprise: Interior (RIP, OSPF, IPv6 analogues). VLANs.
- Routing outside the enterprise: Exterior (BGP, tech and politics). PPPoA/E, VLAN stacking

Week 11

- Summary and spare

Assessment

- Exercise set w/c 2/10/2017, due 23/10/2017
 - Will be a programming task, including testing against other people's code for interoperability and bugs
- Exercise set w/c 6/11/2017, due 27/11/2017
 - Will **not** be a programming task, but a bit of shell-scripting might help it along.
- Each worth 10% of total marks, so don't sweat them too much.

Office Hours

- Wednesdays, 10–12 in Room 132
- I.G.Batten@bham.ac.uk
- Or Canvas discussions
- <https://igb.batten.eu.org/>
- Canvas/Panopto will (I hope) contain full recordings

Books

- “Distributed Systems: Concepts and Designs” by Coulouris, Dollimore, Kindberg and Blair is also used for Distributed Systems and covers a lot (was used in the past when the two courses were combined)
- TCP/IP Illustrated, Volume 1 by W. Richard Stevens is the essential book on TCP/IP
- TCP/IP Illustrated, Volume 2 is **not** necessary (it documents kernel implementations) but is a fascinating read (really)
- I will also expect you to read RFCs as we go along.

Things I've left out

- There is hopefully some spare time in which we can fit in some of the following.
 - Wireless networking (802.11[abgn])
 - Network management (SNMP in more detail)
 - Network design issues