Building an Internet Router (P33)

Handout 1: What's a router?
Class project and logistics

Dr Andrew W. Moore
andrew.moore@cl.cam.ac.uk

Thank you supporters:

Some logistics

Web page: http://www.cl.cam.ac.uk/teaching/current/P33/

TAs:
Malcolm Scott (Hardware) *malcolm.scott@cl.cam.ac.uk*
Chris Smowton (Software) *chris.smowton@cl.cam.ac.uk*

Hot-spare TAs:
Lech Swirski *ls426@cl.cam.ac.uk*
Jonathan Woodruff *jdw57@cl.cam.ac.uk*

Meta TA:
Muhummad Shahbaz *muhummad.shahbaz@cl.cam.ac.uk*

Grades:
Mphil (ACS) – Pass / Fail - based on a mark out of 100
All others (DTC) – Mark out of 100

Some more logistics

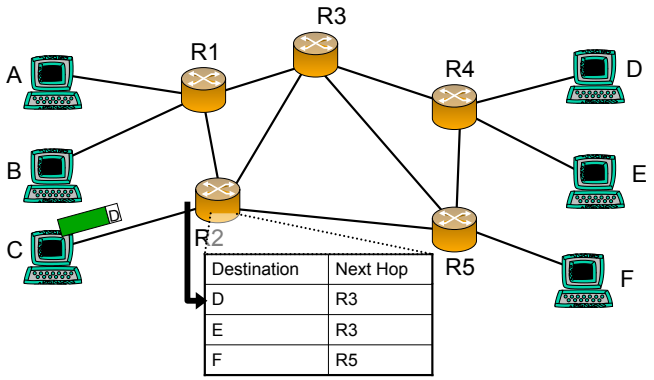
Class Mailing list: *bir-list@cl.cam.ac.uk*
think of this as a self-help mailing list for all of you

Staff Mailing list: *bir-staff@cl.cam.ac.uk*

Submission mail: *bir-tick@cl.cam.ac.uk*

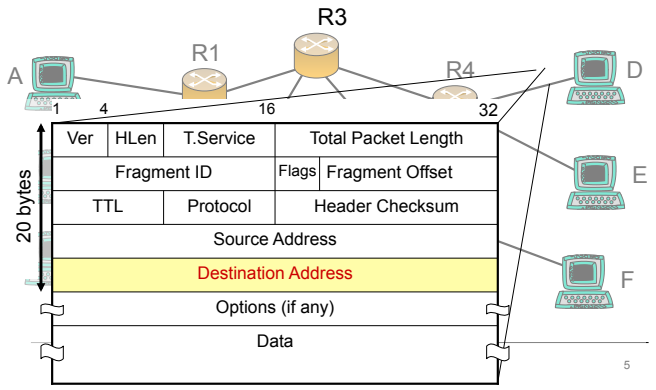
Group aliases can appear if you require them.

What is Routing?



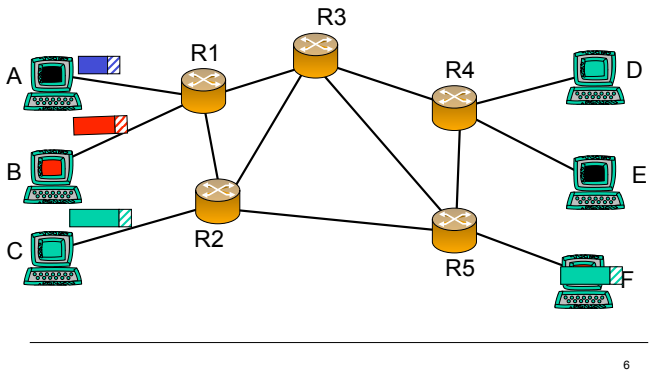
Destination	Next Hop
D	R3
E	R3
F	R5

What is Routing?



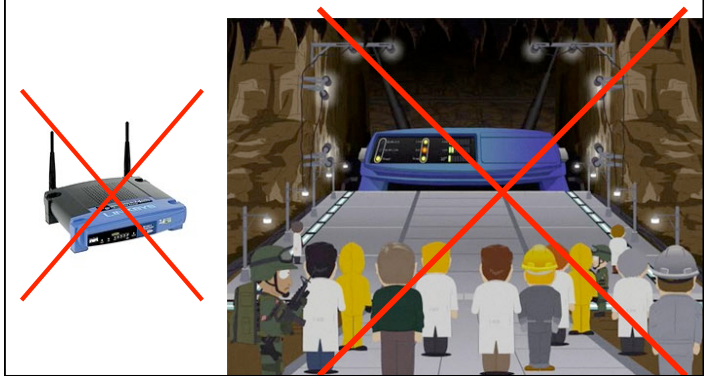
5

What is Routing?



6

What a Router Looks Like



What a Router Looks Like

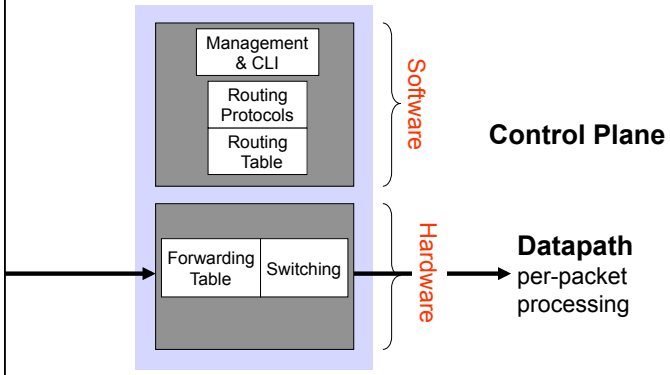
Cisco CSR-1

Capacity: 92Tb/s
Power: 4.7kW

Juniper T320

Capacity: 320Gb/s
Power: 2.9kW

Basic Architectural Components of an IP Router



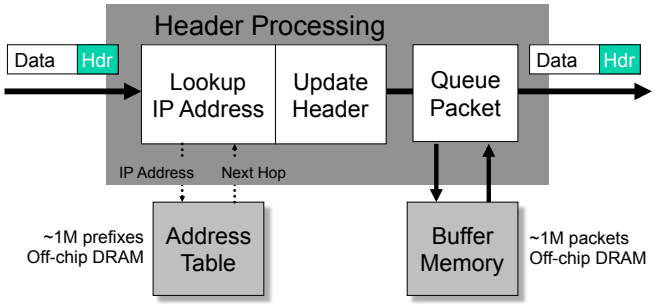
9

Per-packet processing in an IP Router

1. Accept packet arriving on an incoming link.
2. Lookup packet destination address in the forwarding table, to identify outgoing port(s).
3. Manipulate packet header: e.g., decrement TTL, update header checksum.
4. Send packet to the outgoing port(s).
5. Buffer packet in the queue.
6. Transmit packet onto outgoing link.

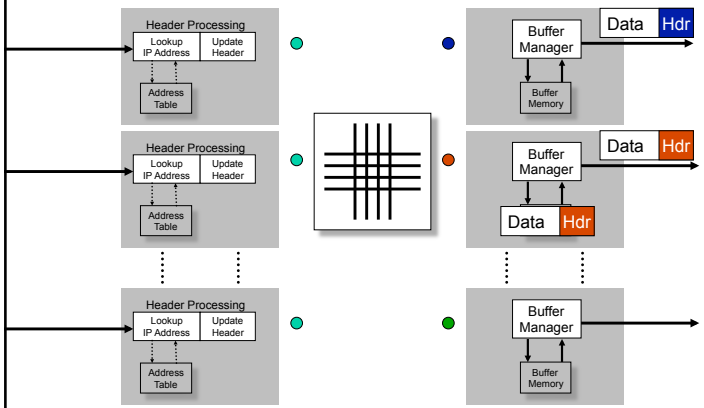
10

Generic Router Architecture



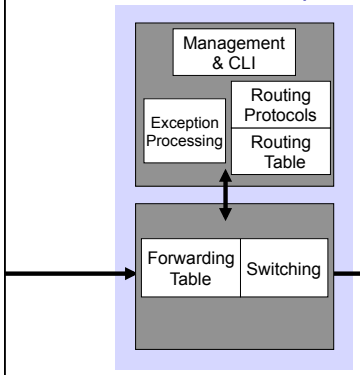
11

Generic Router Architecture



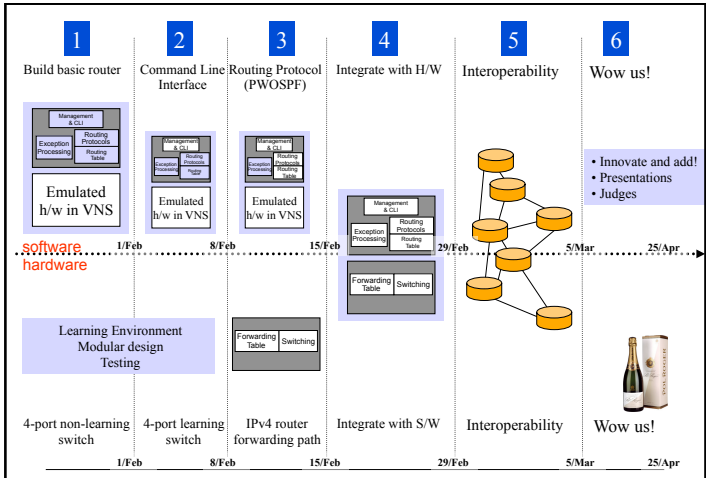
The P33 Project:

Build a 4-port x 1GE Router



Software Team
Develop s/w in Linux on PC in lab

Hardware Team
Develop h/w in Verilog on NetFPGA board in lab



P33 Final presentations and demonstrations

Judges come from industry (Cisco, Redgate, Ensoft, Zeus)

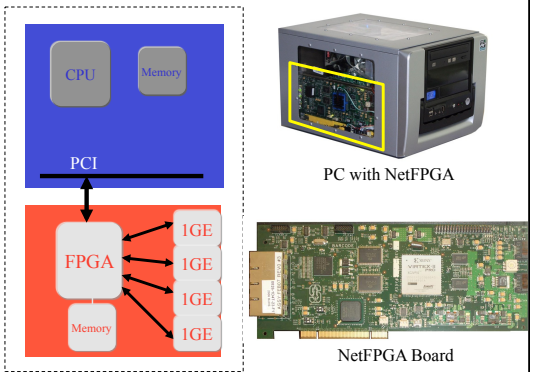
Open invitation

10 Marks for each group and a *best in show* prize

What is the NetFPGA?

Networking Software running on a standard PC

A hardware accelerator built with Field Programmable Gate Array driving Gigabit network links

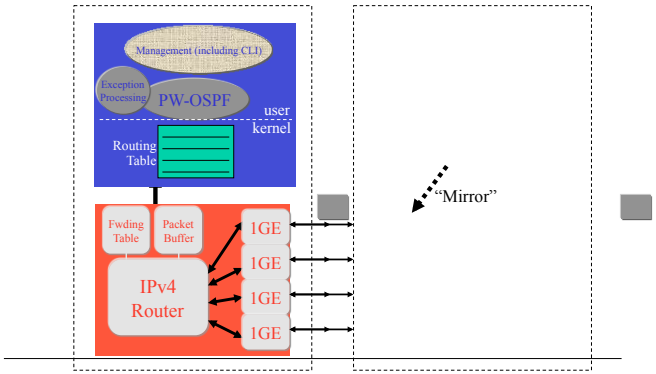


PC with NetFPGA

NetFPGA Board

Running the Router Kit

User-space development, 4x1GE line-rate forwarding



Using the nf-test machines

- Each group is allocated an nf-test machine
  `{nf-test1,nf-test2,nf-test3,...}.nf.cl.cam.ac.uk`
- These machines are headless (no KVM) and located in SW02 (alcove)
- Login via ssh; set your own password and go
  We suggest running "`vncserver`" and then using "`vncviewer`"; as a useful way to leave jobs/desktop running and reconnect if you need to move location. ("`screen`" is another alternative)
- SW02 is a busy classroom – please respect others
  If you need to gain physical access to an nf-test machine
  Do it quietly! You may be refused entry – don't take it personally.

nf-test machine *rules*

- Abuse the machines – that's the end of this module for you – zero tolerance policy.
- only connect eth0 to the cisco (access) switch
- these machines run a firewall for a reason
  - if it doesn't work for you, lets fix the rules
- Play nicely with each other; your interoperability marks depend on it.

nf-test machine *information*

- **Warning:** Files stored on nf-test machines are *not* backed up - and may be lost at any time.
- You must make sure that you regularly copy your files into your REAL (computer laboratory) home directory as a back-up
- **Machines fail** – they usually fail 24 hours **before** the big deadline!

Next steps

- Explore the web page
  - http://www.cl.cam.ac.uk/teaching/current/P33/
  - Hardware: do the online tutorial http://www-netfpga.cl.cam.ac.uk
  - Software: explore the vns system http://vns.cl.cam.ac.uk
    - https://www.srg.cl.cam.ac.uk/vns/vns-assignments/simple-router/
- Decide if you still want to take the class - promptly
- Build a team of 2 people: 1 s/w and 1 h/w
  - *We will stay now and help you decide what you are*
- Come to SW02 on Monday 2pm…