

Networking Made Easy

ITSS Conference June 2005

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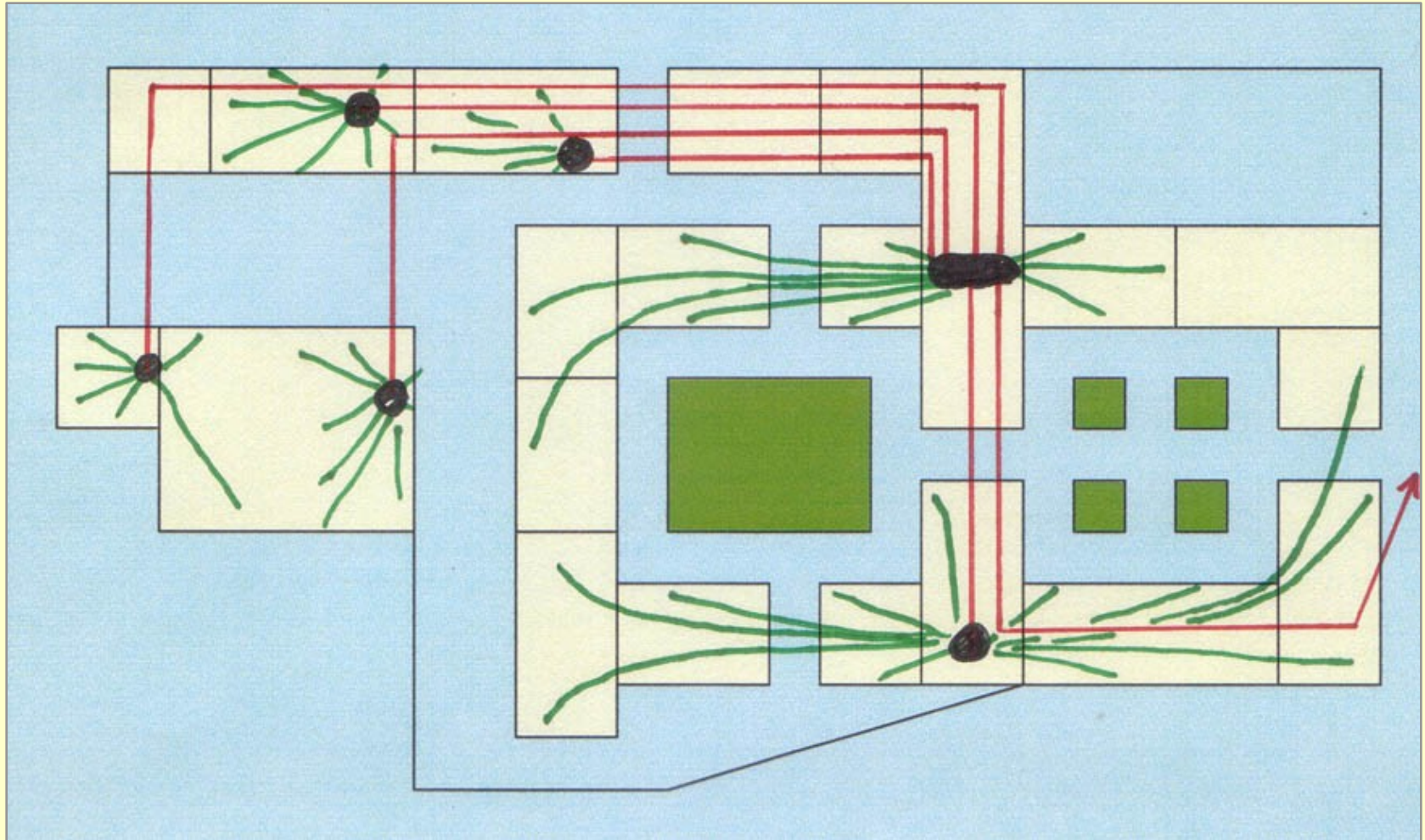
Presentation Running Order



For maximum viewing pleasure, please:-

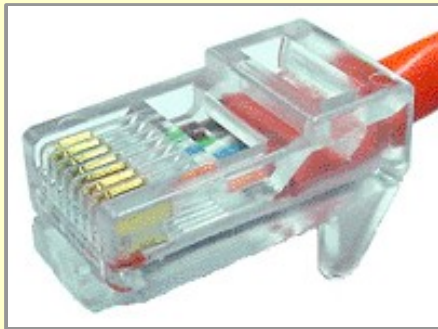
- set mobile phones to off / quiet;
- save any questions for Q&A session after the summary.

Jesus College Network

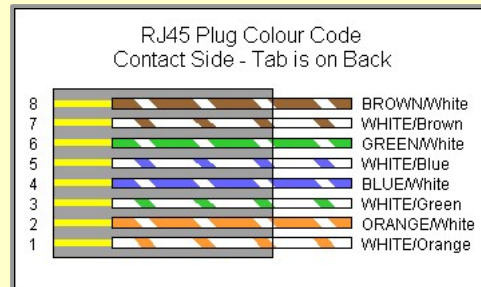


Copper: Cat5e UTP with RJ45 Connectors

- Cat5 is a basic cable standard – how many strands, how thick, what twisting, how to insulate. Cat3 is used for analogue telephone lines; Cat5 is for basic ethernet, Cat5e is better. Some people are using Cat6 or Cat7 now.
- UTP: Unshielded Twisted Pair. 8 individual wires are twisted into 4 pairs and encased in a sheath. A superior (but expensive) alternative is STP: shielded twisted pair, where the pairs are wrapped in metal foil which is connected to earth at one end.
- RJ45: a standard design of plug, a little like a large telephone plug.



RJ45 connector



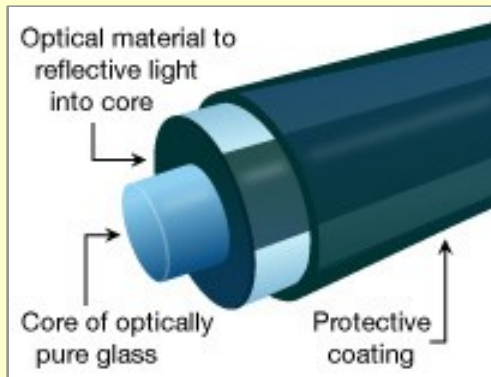
RJ45 – Cat5e wiring



Cat5e leads w/ RJ45 terminators

Optical Fibre with ST Connector

- Optical fibre is a glass fibre which can reflect light along a central tube.
- Specify fibre as multimode or single mode; multimode is much cheaper to use but typically limited to 500m runs (single mode ~200km).
- Also specify core diameter and external diameter, eg. 62.5/125.
- Many different connectors, eg ST, SC, LC, MRTJ.



Optic fibre basics



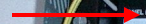
ST and SC connectors



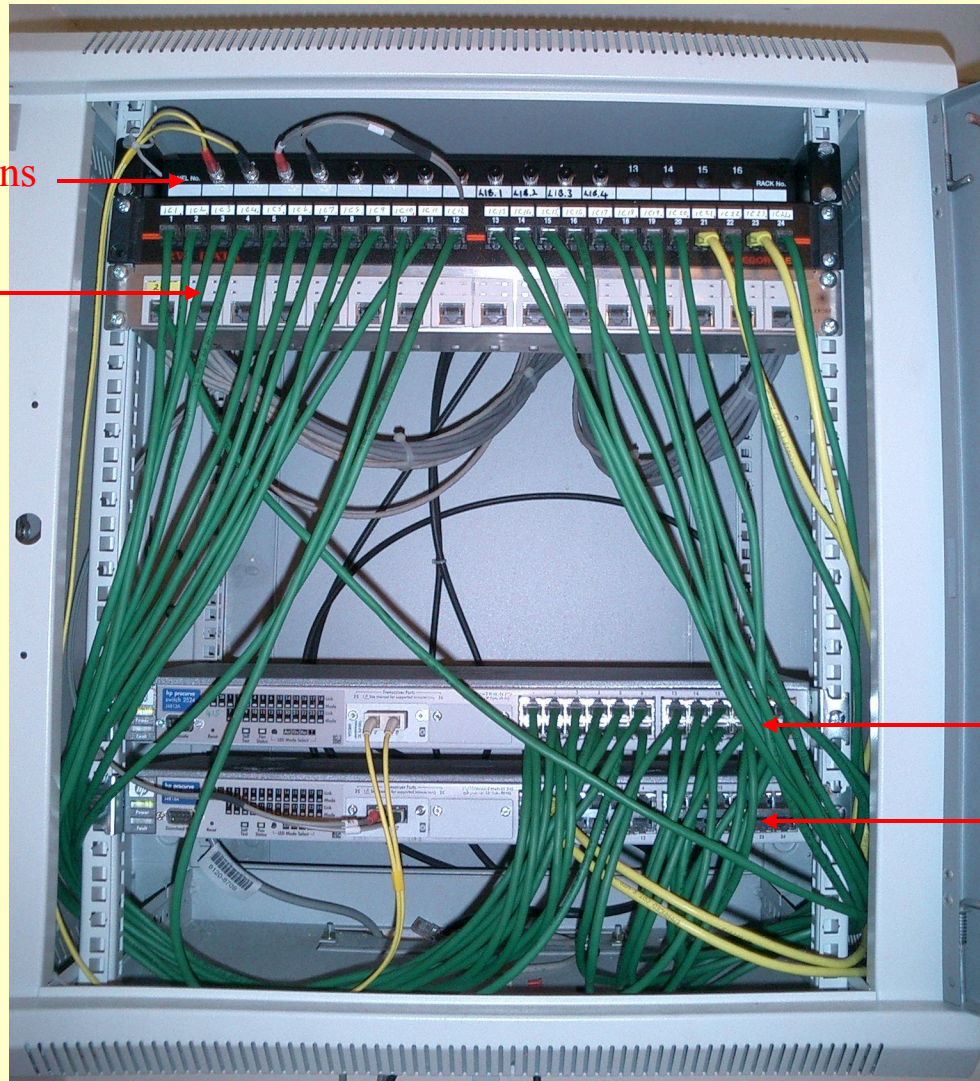
ST connector

A Wiring Closet

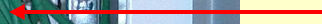
Optic fibre terminations



Copper terminations

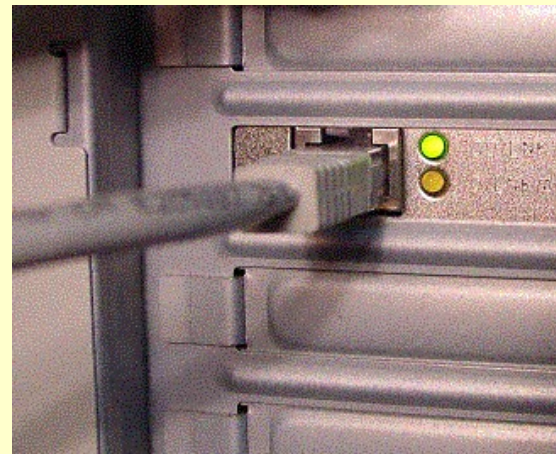
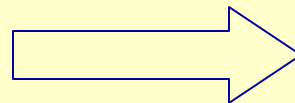
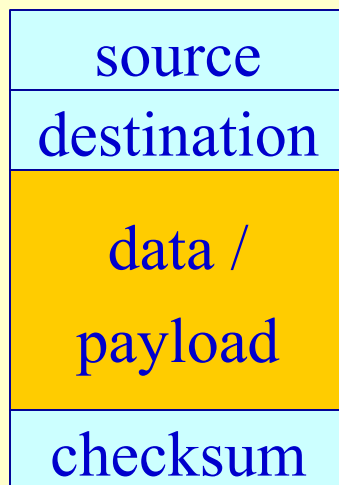


Managed ethernet switches



Data, Streams and Packets

- We typically have a series of characters or bytes ('data stream') that we want to transmit.
- This is broken down into chunks – for ethernet the max. is 1500B.
- Add the source and destination addresses, and a checksum.
- The resulting chunk of up to 1518B is a 'packet' and can be converted to electrical signals by the network interface card (NIC).



Network Speeds

Optic fibre speeds:

- 10Mbps: 10base-FL
- 100Mbps: 100base-FX
- 1Gbps (short): 1000base-LX
- 1Gbps (long): 1000base-SX

Trade-off between speed and distance. Faster connections are generally only reliable over short distances.

Copper speeds:

- 10Mbps: 10Base-T
- 100Mbps: 100Base-TX
- 1Gbps: 1000Base-TX

(Non-ethernet speeds:

- Dial-up: 0.056Mbps
- Broadband: 1Mbps)

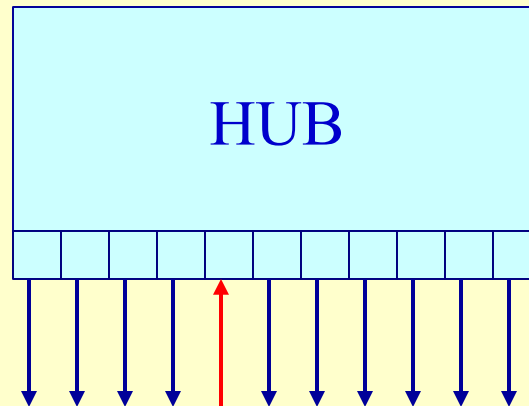
Repeaters: Hubs



Two port repeater



24 port repeater: a hub



A hub repeats packets on all ports

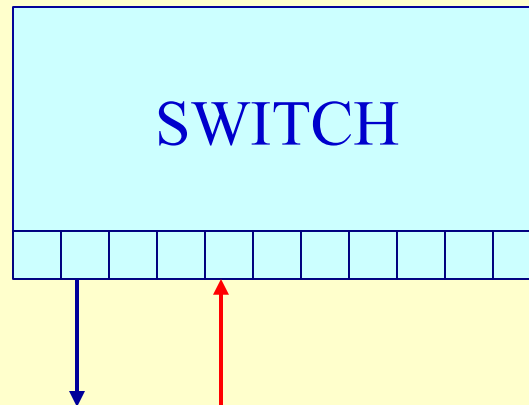
Repeaters: Switches and Media Converters



24 port bridging repeater: a switch



Media converter



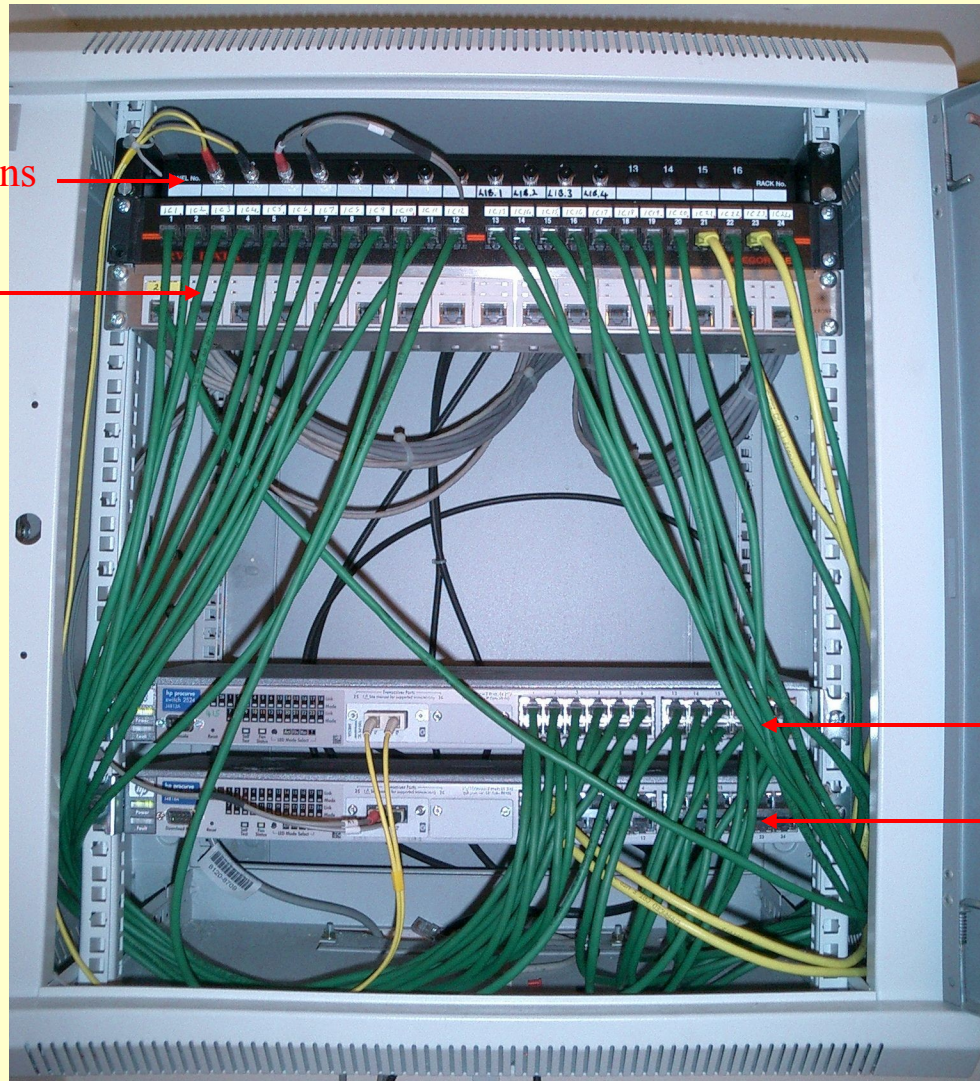
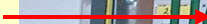
A switch only repeats the packet on the necessary port

Wiring Closet Revisited

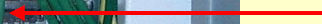
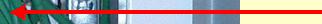
Optic fibre terminations



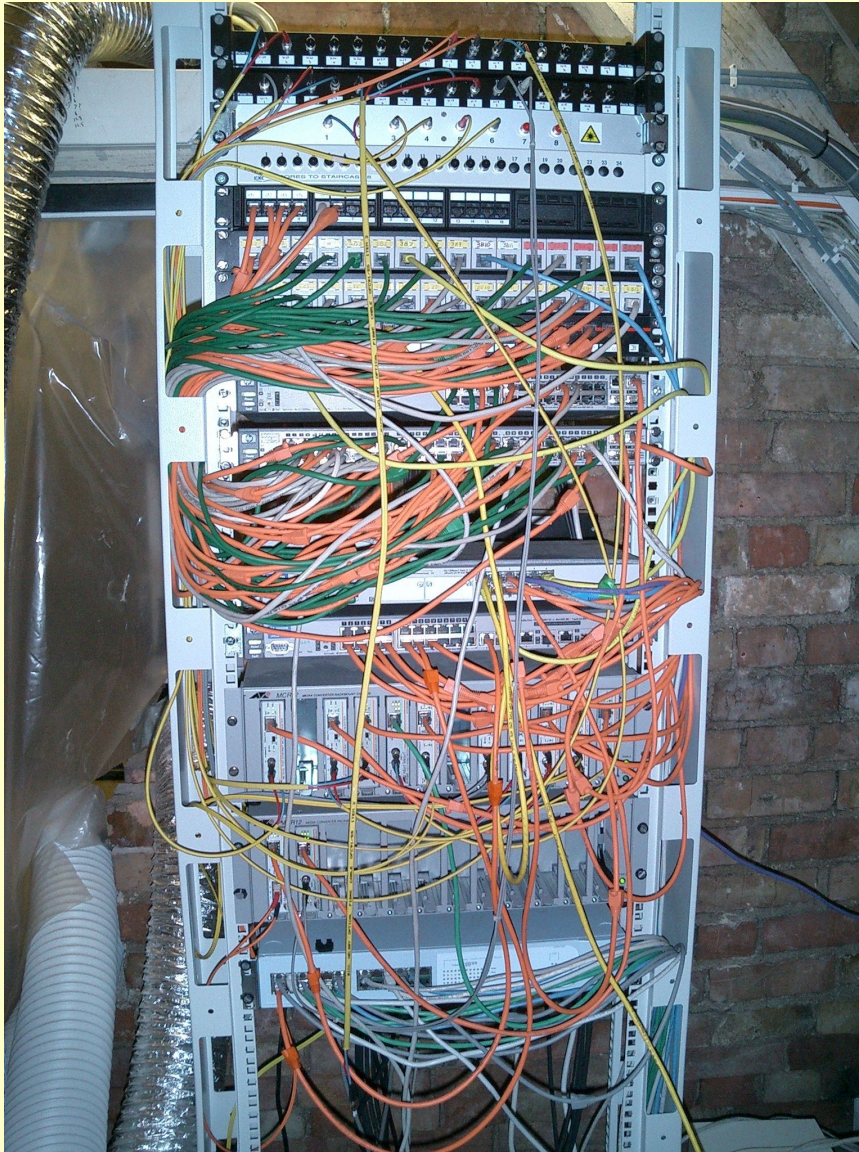
Copper terminations



Managed ethernet switches

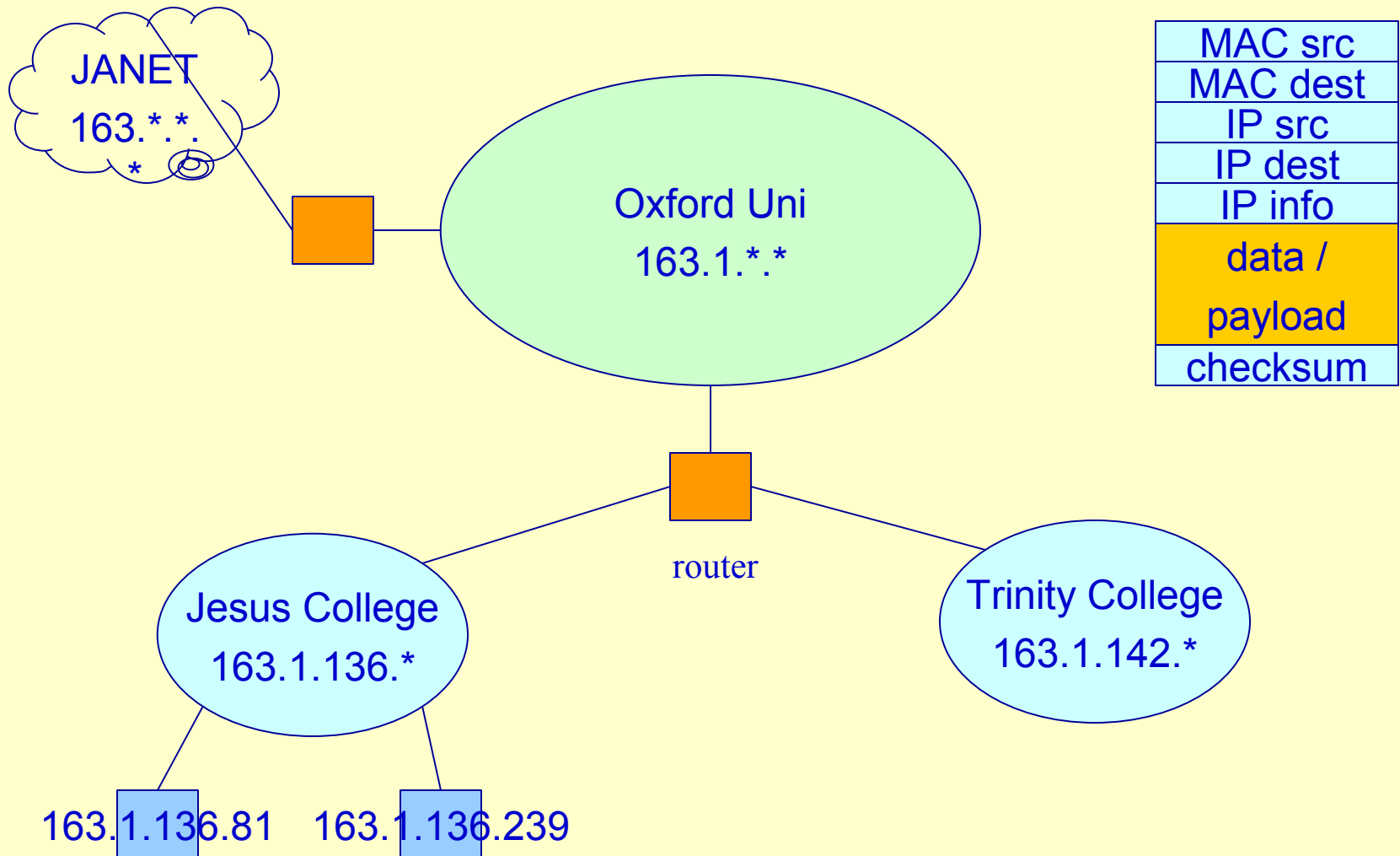


A Busier Wiring Closet!



- Colour coordinated cables;
- Order of panels:
 - Optic fibre at top,
 - then copper RJ45,
 - then switches,
 - then media converters.

Beyond the Playpen: Routers



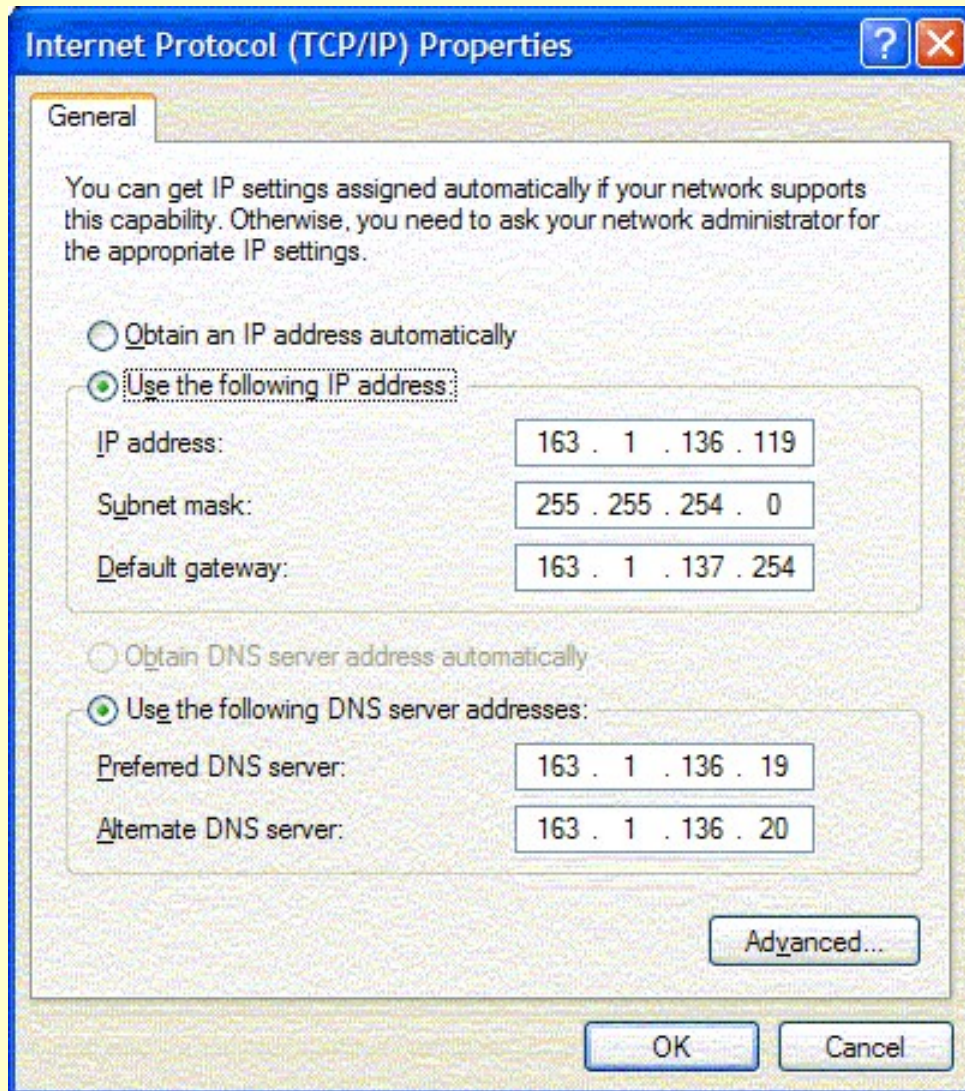
IP Addresses

- IP addresses identify computers / systems anywhere on the internet.
- Sequence of 4 bytes (0 – 255) separated by dots (163.1.136.11).
- IP address + 'network mask' tells us which computers are on the same LAN. If two computers have different network addresses then they need to communicate via one or more routers.

PC1	IP Address:	163.1.136.11	10100011.00000001.10001000.00001011
			BOOLEAN AND
	Network Mask:	255.255.254.0	11111111.11111111.11111110.00000000
<hr/>			
	Network Address:	163.1.136.0	10100011.00000001.10001000.00000000
PC2	IP Address:	163.1.137.97	10100011.00000001.10001001.01100001
			BOOLEAN AND
	Network Mask:	255.255.254.0	11111111.11111111.11111110.00000000
<hr/>			
	Network Address:	163.1.136.0	10100011.00000001.10001000.00000000

SAME NETWORK!

Windows XP IP Configuration

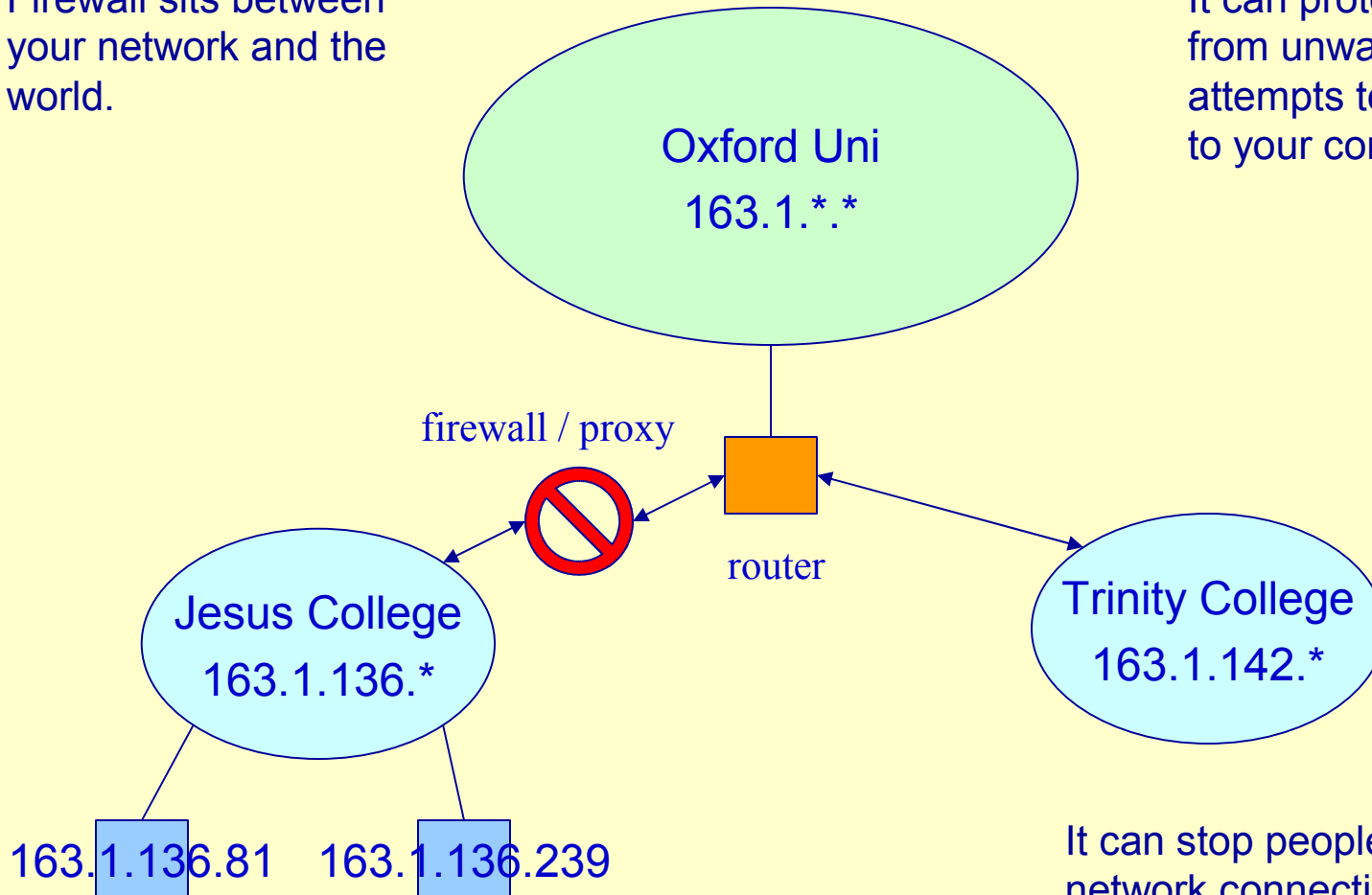


- IP address / subnet mask tell it which computers are on the local area network.
- Default gateway = Router.
- DNS: too much for one workshop, but essentially this allows you to take addresses like 'www.website.com' and find the corresponding IP address (eg. 197.32.9.131).

Beyond the Playpen: Firewalls and Proxies

Firewall sits between your network and the world.

It can protect you from unwanted attempts to connect to your computers.



It can stop people on your network connecting to things they shouldn't.

Diagnosics

- Detection: wait for a user to complain or actively seek out trouble?

```
C:\ E:\WINDOWS\system32\cmd.exe
U:\>tracert www.washington.edu

Tracing route to www.washington.edu [140.142.3.35]
over a maximum of 30 hops:

  1  <1 ms    <1 ms    <1 ms    163.1.137.254
  2  <1 ms    <1 ms    <1 ms    coucs3.backbone.ox.ac.uk [192.76.34.234]
  3  <1 ms    <1 ms    <1 ms    oxford-bar.ja.net [146.97.40.81]
  4   1 ms    1 ms     1 ms    po11-0.read-scr.ja.net [146.97.35.161]
  5   2 ms    2 ms     2 ms    po0-0.lond-scr3.ja.net [146.97.33.37]
  6   2 ms    2 ms     2 ms    po2-0.geant-gw1.ja.net [146.97.35.70]
  7   2 ms    2 ms     2 ms    janet.uk1.uk.geant.net [62.40.103.149]
  8  72 ms    72 ms    72 ms    uk.ny1.ny.geant.net [62.40.96.169]
  9  72 ms    72 ms    76 ms    198.32.11.61
 10 102 ms    102 ms   102 ms   chinng-nycmng.abilene.ucaid.edu [198.32.8.82]
 11 106 ms    106 ms   108 ms   iplsng-chinng.abilene.ucaid.edu [198.32.8.77]
 12 115 ms    115 ms   115 ms   kscyng-iplsng.abilene.ucaid.edu [198.32.8.81]
 13 125 ms    125 ms   128 ms   dnvrng-kscyng.abilene.ucaid.edu [198.32.8.13]
 14 151 ms    151 ms   151 ms   sttlng-dnvrng.abilene.ucaid.edu [198.32.8.49]
 15 151 ms    151 ms   151 ms   hnspp2-wes-ge-0-1-0-0.pnw-gigapop.net [209.124.17
9.1]
 16 151 ms    151 ms   151 ms   uwbr1-tge3-1.cac.washington.edu [209.124.176.23]
 17 151 ms    151 ms   151 ms   zinc-GE-2-2.cac.washington.edu [140.142.155.10]
 18 151 ms    151 ms   151 ms   www3.cac.washington.edu [140.142.3.35]

Trace complete.
```

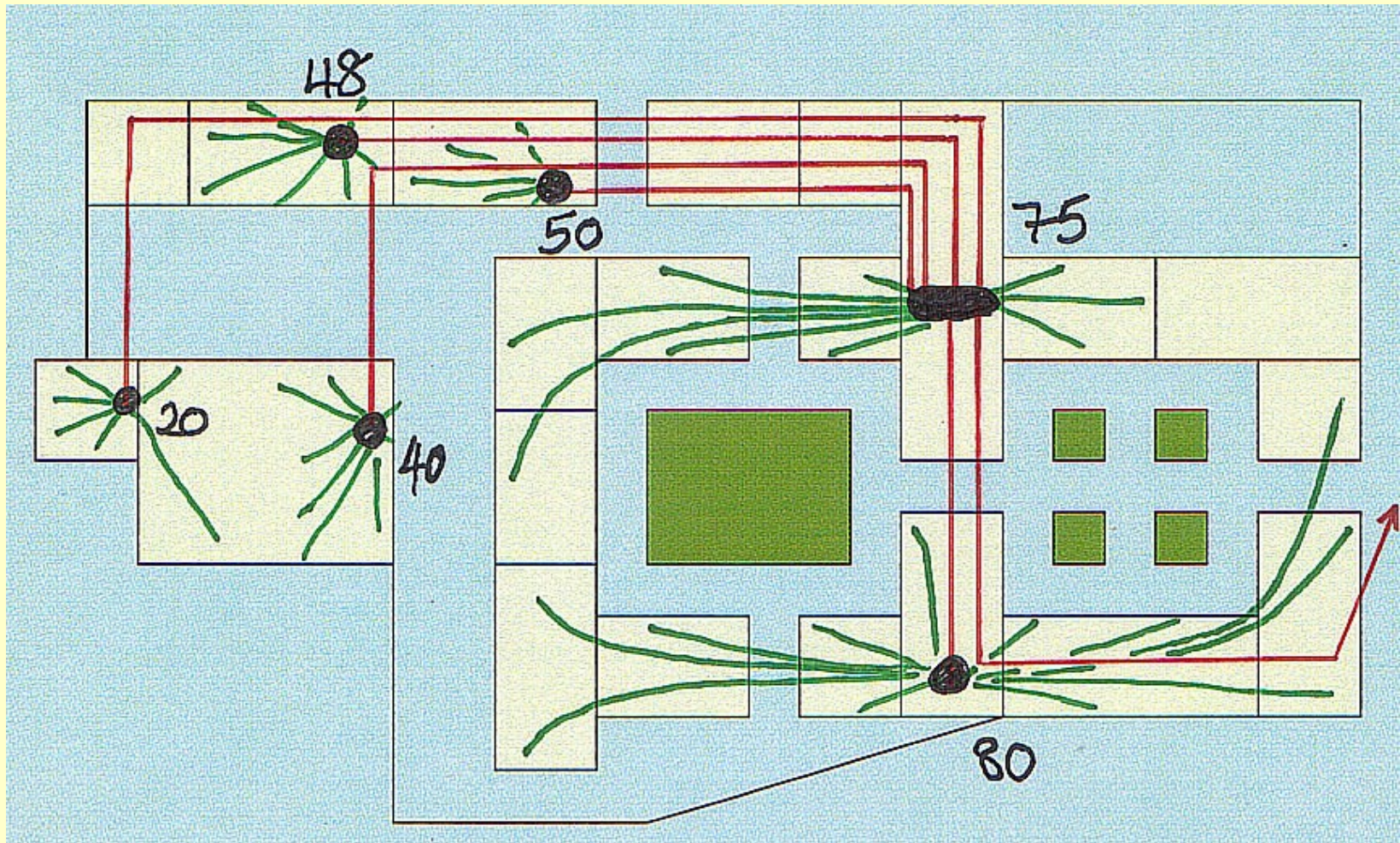
- Connect to service with name

Design

- Considerations when building a new network:
 - Number of users
 - Speed requirements
 - Ease of repair
 - Ease of extension
 - Where will your cables run
 - Where will your equipment live: security, heat, noise
 - How will it link up to the rest of your network
 - What type of cable (copper / fibre) will you use
 - What distances are your cables covering
 - Building regulations (listed buildings!)
 - What features do you want on your equipment
 - Different kit manufacturers (3COM, HP, Cisco, Allied Telesyn, ...)
 - Costs and options
 - Spare equipment / cables



Design: Drawing it Out



Summary

We have looked at:

- Network infrastructure
 - Cabling
 - Hubs, switches, media converters
 - Routers, firewalls, proxys, gateways
- Basic diagnosis of network problems
- Design considerations

Go and see how it works on your own network!

Thank you for listening.

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