

LANs (but not firewalls)

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Make friends and influence people

- ◆ Make friends with your local computer centre network team.
- ◆ But...
 - don't have a computer centre and/or network team?
 - May not be responsible for your network.
 - May have other priorities
- ◆ Networking is a collaborative activity
- ◆ Beware of reactions to “enthusiastic amateur syndrome”

◆ Technology

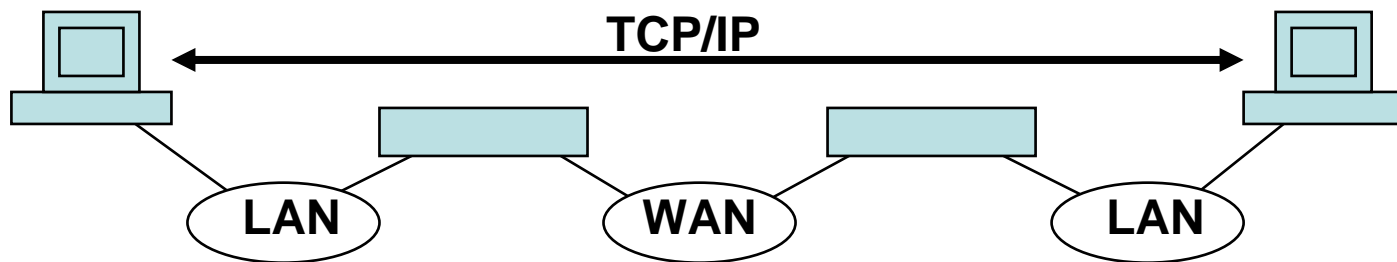
- Assumptions
- History & basic operation
- Speed & duplex
- Media, speed & distance
- Hardly anything about VLANs, WLANs or Spanning Tree Protocol (STP)

◆ Using the technology

- Spending money wisely
- Good management
- Monitoring

Assumptions

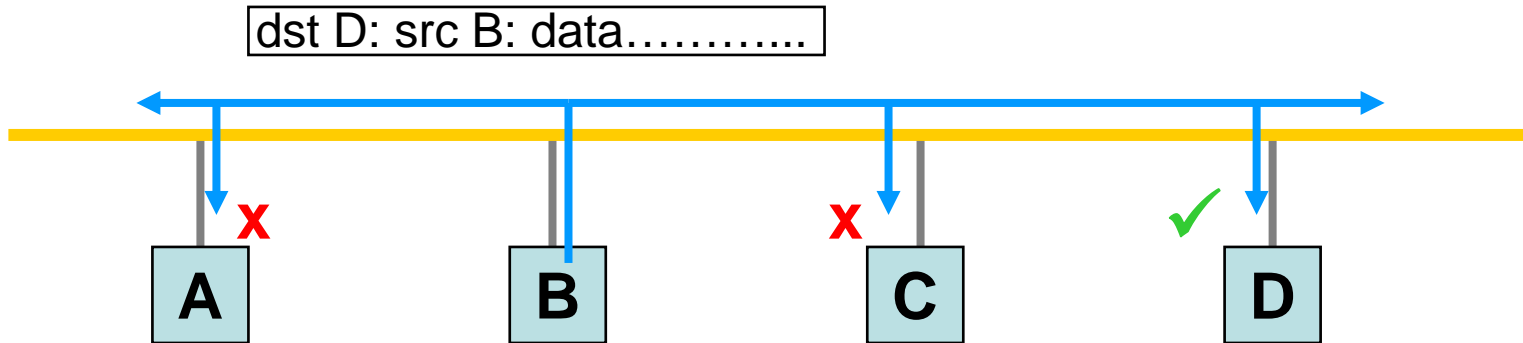
- ◆ Many kinds of LAN but Ethernet/IEEE802.3 dominates
- ◆ Range of media: ~~coax~~, UTP, fibre optic
- ◆ Range of speeds: ~~10Mbps~~ -> 100M -> 1G -> 10G
- ◆ Data sent in packets from one machine to another
- ◆ TCP/IP provides end-to-end connectivity over LANs and (different technology) WANs



Assumption

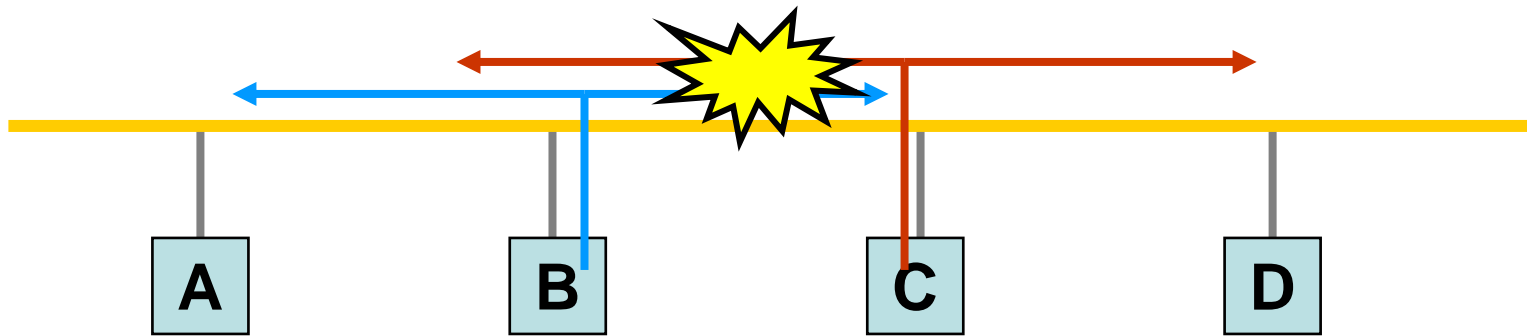
- ◆ You can do simple arithmetic

History & basic operation



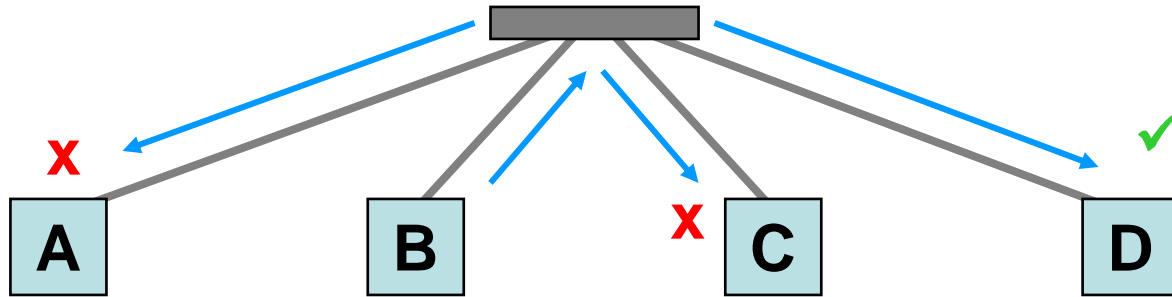
- ◆ Single Cable
- ◆ Packets sent with source and destination addresses
- ◆ Each station listens for packets with own address

Collisions



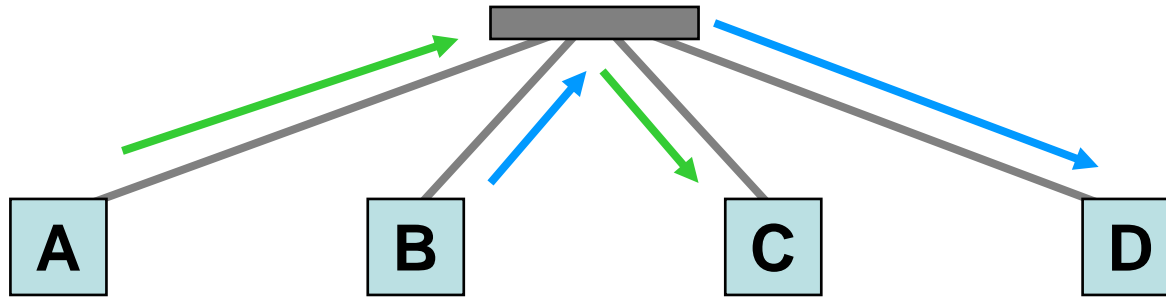
- ◆ Stations monitor network whilst transmitting
- ◆ Garbled signal => collision
- ◆ Random backoff + retransmit
- ◆ Collision is not packet loss, but is delay
- ◆ 16 successive collisions => error & TCP retrans
- ◆ Collisions are (were!) normal on ethernet

Cheap Cables & Hubs



- ◆ Replace shared cable with cheap UTP cabling and repeater “hub” (beware of that word!)
- ◆ Maintain illusion of shared medium
- ◆ Separate Tx & Rx pairs in cable
- ◆ Collision detected by simultaneous Tx & Rx

Ethernet Switching



- ◆ Intelligent switch buffers packets & knows where to send them
- ◆ Multiple simultaneous paths
- ◆ Advantages
 - Mixed speed (fast servers & uplinks, modest for hosts)
 - Full duplex - simultaneous send and receive
 - VLANs

Media - copper UTP

- ◆ Cat[egory] 5, cat 5e, cat 6
- ◆ 4 pairs - 10/100 uses 2 pairs, GigE uses 4 pairs
- ◆ RJ45 connectors
- ◆ Max 100m - 90m fixed plant + patch cords
- ◆ Hub-host pairs are wired straight through
- ◆ 10/100 hub-hub or host-host may need crossover
 - Some modern gear will detect and adapt
 - GigE is different - straight cables for everything
- ◆ **MARK YOUR CABLES** - number, crossover

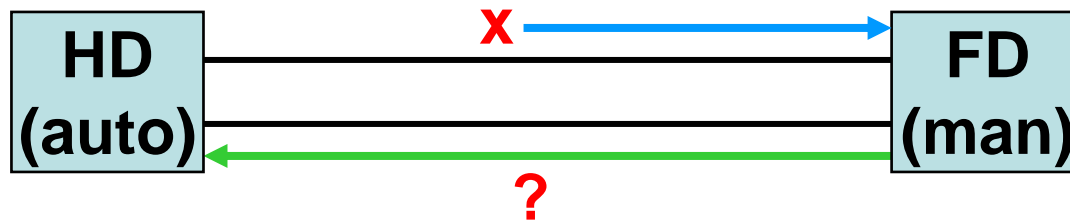
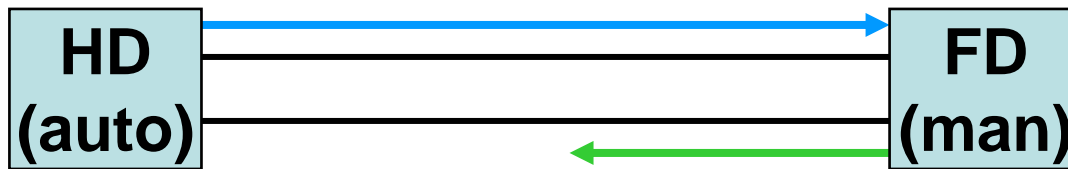
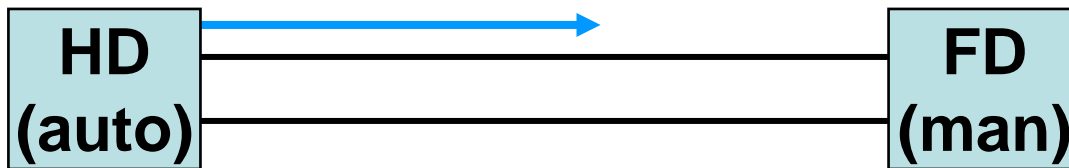
Media - Fibre optics

- ◆ Two major classes of cable
 - Multimode - cheaper, shorter distance
 - Single mode - more expensive, longer distance
- ◆ Interfaces to match, e.g.
 - 1000base-SX: LEDs, up to 220m on MM cable
 - 1000base-LX: lasers, up to 5km on SM
- ◆ Oodles of connectors: ST, FC/PC, SC, LC, MT-RJ
- ◆ No host-hub differentiation
 - for MT-RJ and duplex SC or LC use cross connect cables

Speed and Duplex

- ◆ Systems connect at choice of speed and duplex
- ◆ Autosensing of speed; autonegotiation of duplex
 - Autonegotiation mandatory for GigE
- ◆ ... or manual setting
- ◆ Beware of mismatches
 - Autonegotiating port has to assume HD if no response
 - A manually set port won't negotiate, even if set FD

Duplex Mismatch



- ◆ For good performance VERY important to get duplex right

Speed & Duplex Advice

- ◆ Set speed & duplex on interswitch or server links
- ◆ Auto for end stations
 - BUT MONITOR
 - Check interface status (can be difficult!)
 - Check error rates and, if possible, collision rates (should be zero for FD)

Caveats - Advanced Topics

◆ Spanning Tree Protocol (STP)

- Take advice - don't mess with it!

◆ VLANs

- Ditto
- In spades if you mix it with STP

◆ Wireless LANs (WLANs)

- Current max of about 30Mbps
- Major security issues
- See above...

Spending your money wisely (1)

◆ Capacity planning

- 100Mbps => max 10 MB/sec allowing for overheads
 - 600 MB/min, 36 GB/hour
- 1Gbps => max 100 MB/sec
 - 6 GB/min, 360 GB/hr, 1TB in ~3 hour
- Aim for 10-50% of theoretical max

◆ Latency may be more important than bulk

- Human factors
- Transfers between processing phases

◆ Know what you need - it's just simple arithmetic

Spending your money wisely (2)

- ◆ You get what you pay for
- ◆ Performance
 - High performance usually implies hardware assist
 - Look for “non-blocking”, “aggregate throughput”, “packets per second (pps)” and do arithmetic
- ◆ Management and monitoring
 - Console/Telnet/SSH
 - Web
 - SNMP
- ◆ Support

- ◆ Secure your network equipment
 - Passwords
 - SNMP community strings
 - Access controls
- ◆ Keep software up to date
- ◆ Save your configurations
 - Document setup
 - Vendor's management app
 - Keep config file somewhere (TFTP/FTP)
 - Cut & paste

Monitoring

- ◆ Console/terminal/web/etc..
- ◆ For significant installations consider network management tools
 - Vendor's own tools
 - Free/cheap: MRTG, RRDTool, etc.
- ◆ Look out for:
 - Throughput
 - Duplex state
 - Errors, discards, collisions (shouldn't be any?)
- ◆ Your FLCC or other networkers in your vicinity may be able to help

Summary

- ◆ Cooperate and collaborate
- ◆ Don't skimp on equipment, cables etc..
- ◆ Do the sums
 - Planning
 - Operation
- ◆ Google is your friend

◆ Manufacturers

- <http://www.cisco.com/>
- <http://www.3com.com/>
- etc..

◆ Technical

- Charles Spurgeon's Ethernet Web Site
<http://www.ethermanage.com/ethernet/>
- O'Reilly Associates <http://www.oreilly.com/>

◆ Your Friendly Local Computer Centre

◆ Google!

And now...

◆ Thank you, and Questions