## How the web works - 1

Transmission Control Protocol / Internet protocol Domain Name System

 An understanding of these two is required to understand the limitations of Web based systems

## TCP/IP

 Provides an addressing mechanism for each machine – an IP address



Provides a way to transmit a message to an address



## History

 Originally funded by American department of Defence - connecting UNIX style mainframes



- Designed to be robust (to recover from military attack)
- Grew from connecting Universities and research groups into the standard networking protocol for the Internet

## **IP** numbers

- To uniquely identify each machine, assign each one a unique IP number or IP address
- No other computer should have this number (in practice this is not quite true)
- A 32 bit code

10010101 01001100 00001100 00000100



IP numbers usually written using a special notation

• Dotted quad notation – each 8 bit pattern written as a denary number

10010101 01001100 00001100 00000100

149.76.12.4

So how does a transmission occur? (An abstract!)

 Take the message and divide into smaller packets



- Label each one with the destination address
- Packets are then sent out onto the network



- No guarantee that packets travel the same route
- Redundancy and error checking built into the protocol
- Broken nodes don't stop the transmission

# No guaranteed 'time' for transmission

- Issue for real time applications
- Video streams -YouTube
- Uses buffering
- Uses high compression to reduce file size / bandwidth



# One central organisation required to administer the IP addresses



- IANA Internet assigned numbers authority
- An American controlled and funded organisation

Users work through intermediate regional or organisational bodies

- UK Universities work through JANET
- Companies can work through ISPs who block book IP numbers

## IP numbers classified into groups

Class A 1.0.0.0 to 127.0.0.0

- Allows 1 million hosts
- Rare
- Large organisations

## Class B 128.0.0.0 to 191.255.0.0

- More common than Class A
- 16320 nets with 65024 hosts each

•••

Class C 192.0.0.0 to 255.255.255.0

- Allows 2 million networks with 254 hosts
- More common than B

## Class D, E, F

- Experimental
- Reserved for future use

In reality much more complex:

Subnets, port numbers, IP routing

- Allows the number of sub networks to be much larger
- Allows the number of connected machines to be much larger









So how does the RIAA/ BPI know who you are?

• By looking for your IP number



Scenario: A business wishing to allocate IP numbers to machines

#### Solution One

- Use an ISP to block book a range of IP numbers
- Assign one to each machine using the TCP/ IP settings - *a fixed IP address scheme*

## Advantage

- A particular machine can host a particular service
- Web server, Mail server etc.

## Disadvantage

- Expensive (in terms of cost and resources)
- Doesn't match modern working practices

Laptops only occasionally connected to the network still need an IP address

# Scenario: A business wishing to allocate IP numbers to machines

## Solution Two

- The company uses IP numbers that are specifically for LAN use only
- Some ranges of IP numbers are not forwarded over the Internet
- These can be safely used for machines on the LAN

A small number of 'real' addresses are required for

- Hosted services required on the Internet
- Packets originating on the LAN to be sent out to the Internet



## Advantage

- Smaller number of real addresses required
- Don't have to apply for large blocks of real numbers

## Disadvantage

• Still using a fixed IP address scheme



# Scenario: A business wishing to allocate IP numbers to machines

#### **Solution Three**

- The company uses a dynamic IP address scheme
- Machines acquire one IP address when connected
- IP address is released when the PC is disconnected

Most home ISPs use this system to allocate IP addresses

#### Most organisations use DHCP

A DHCP server machine hosts a repository of IP numbers

- When a machine is connected it requests (leases) an IP address from the set available
- Statistics can be used to determine the optimal number of IP addresses required
- Granting an IP number can be done after 'authenticating'

## **Kingston University**

Uses the MAC address from your machine

• Every Network card (NIC or Network Interface controller) has a unique number



- Media Access Control address (MAC address)
- Only machines with a recognised MAC address can get an IP number

#### Finally:

Despite all of these techniques, still running out of IP numbers, so ...

- IPv6 new addressing scheme to be phased in
- 128 bit addresses (as opposed to 32 bits)