Teaching London Computing

Programming for GCSE Topic 7.2: Internet Components

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Aims

- Explain the main ideas of the Internet

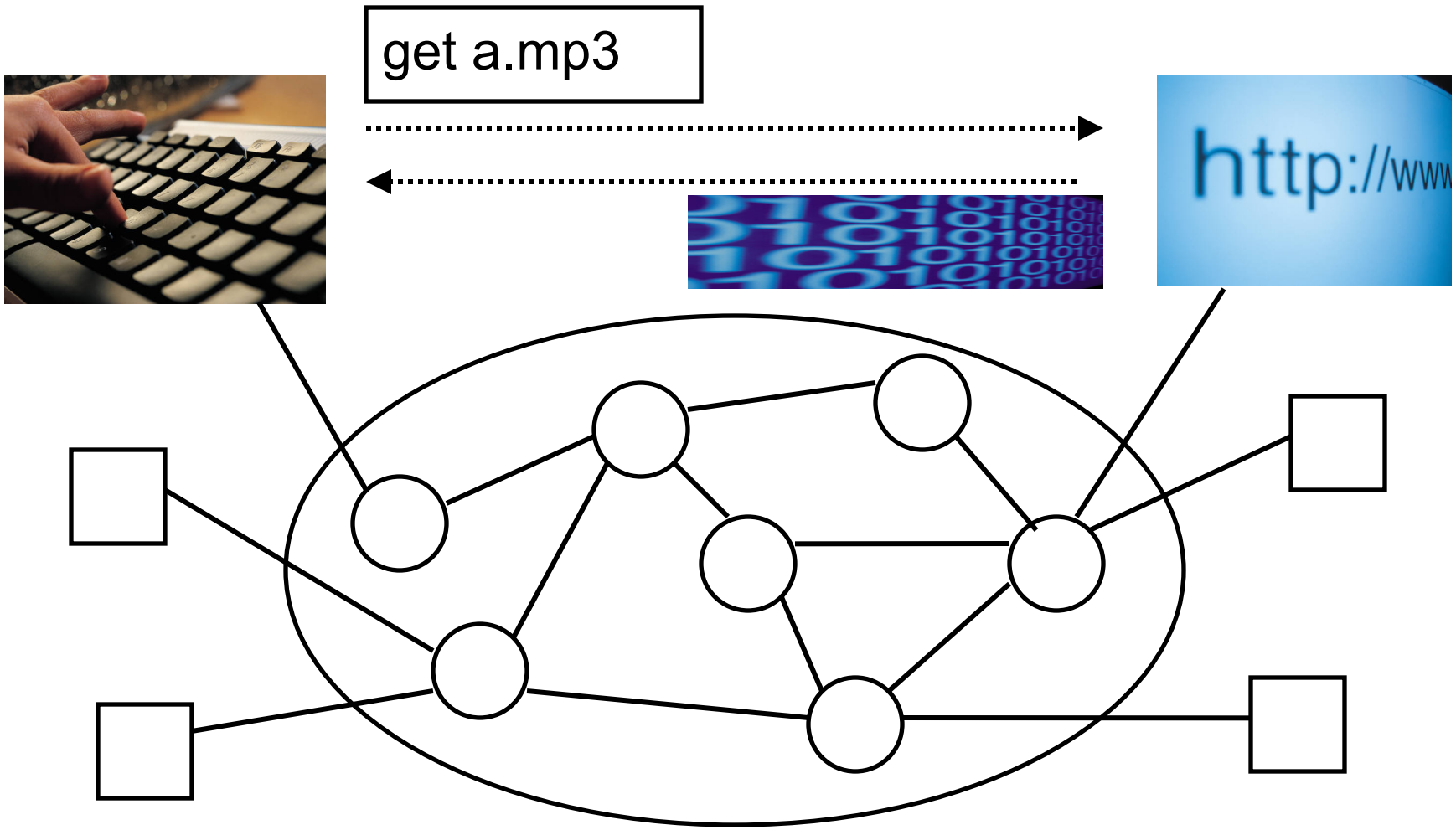
- *Why is it call the Internet?*
- *How is it run? Is anyone in control?*
- *What's the Internet architecture?*
- *What's a router?*

Teaching Issue

- As with other network topics
  - Principles not just description
  - … not overwhelming complexity

The Internet

Hardware of the Internet

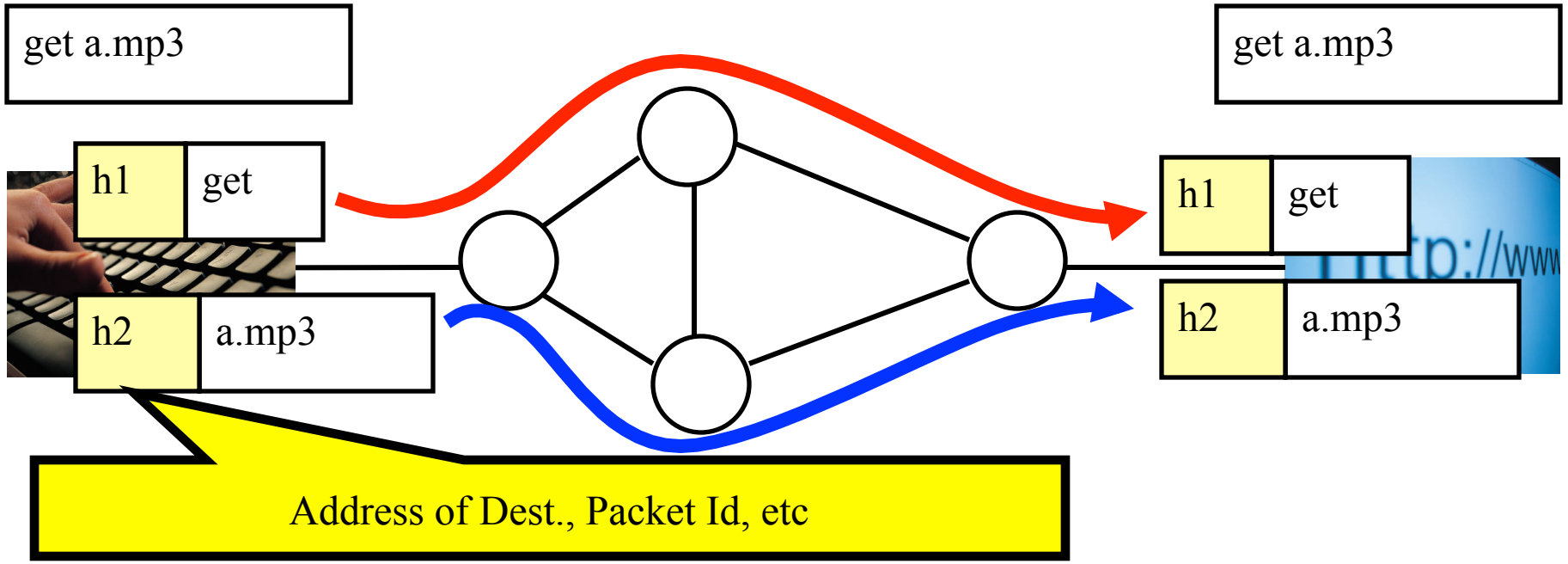


Three Main Components

- Hosts: computers running programs
  - Client: makes requests to …
  - Server: provides a service; waits for requests
    - Email, Web, iTunes
- Transmission lines
  - Copper wire, optical fibre, or radio
- Routers: specialized computers that connect multiple transmission lines

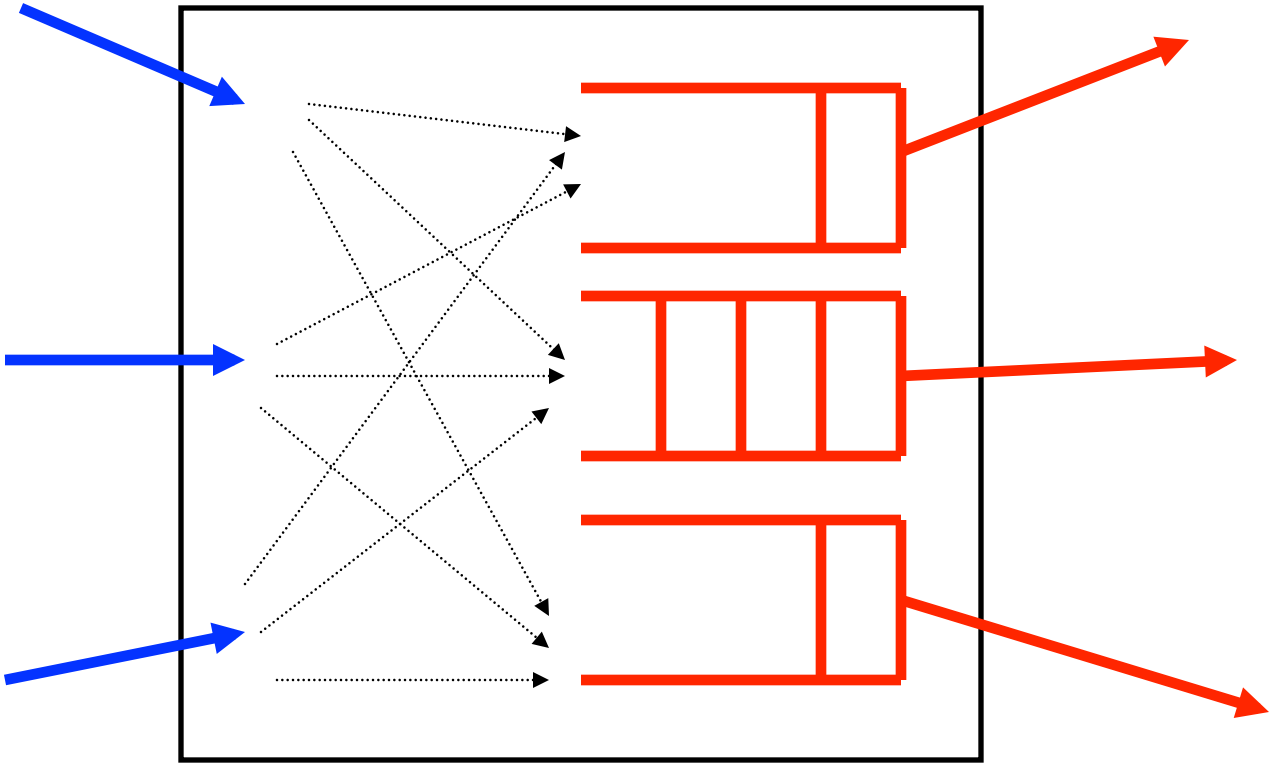
Packet Switching

- Split a message into chunks
- Add a header to each chunk
- Send packets independently
- Combine received packets



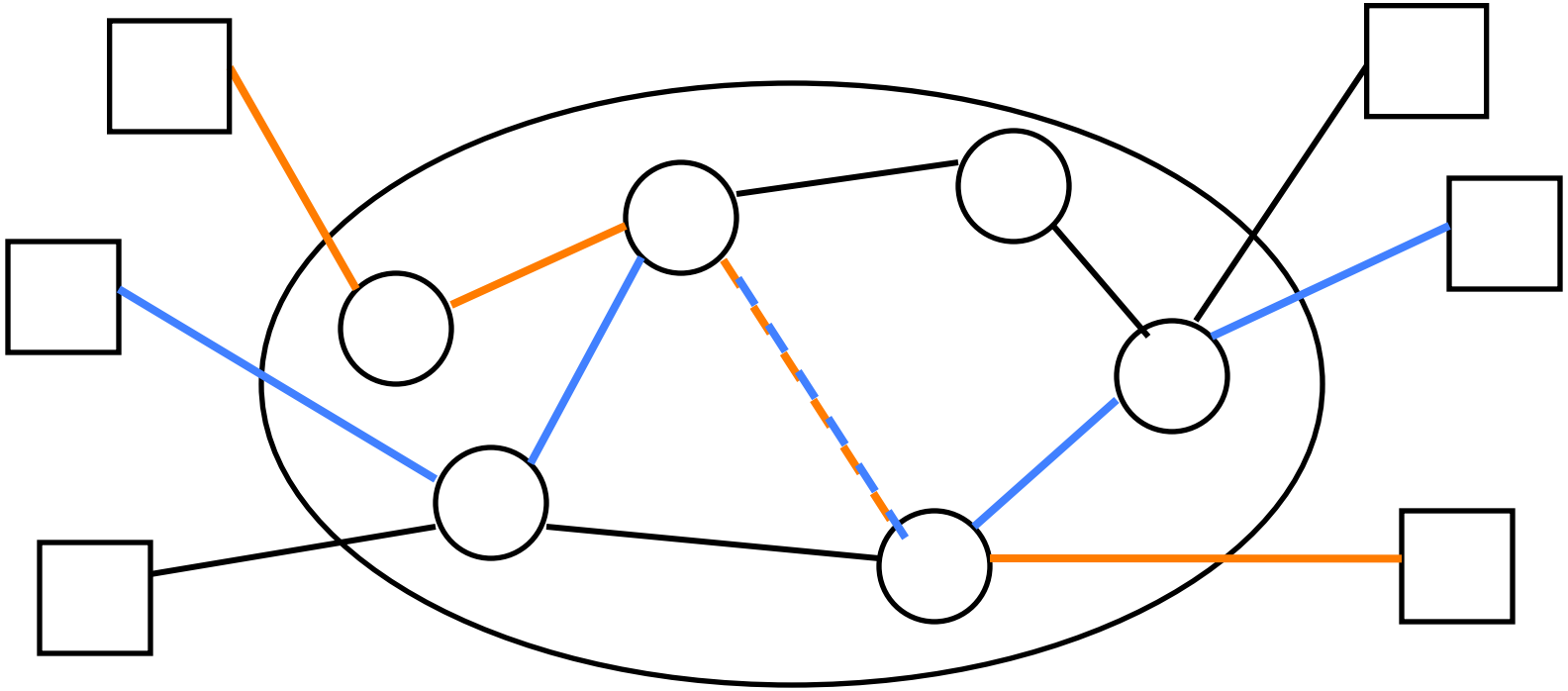
Routers in Packet Switched Network

- Each router is a specialized computer that receives, stores and forwards packets.



Multiplexing

- Link can be shared between different data streams
  - Division in time – as needed, not fixed



Remarkable!

- Internet could have traffic jams
  - Shared communication lines
  - No central co-ordination
- Polite behaviour (particular in TCP) prevents traffic jams (network congestion)
  - … but no delivery guarantees

Networks Architecture

Lots of protocols

Protocol

- Agreement on how to communicate
- Defines:
  - format of a message
  - actions when data sent & received,

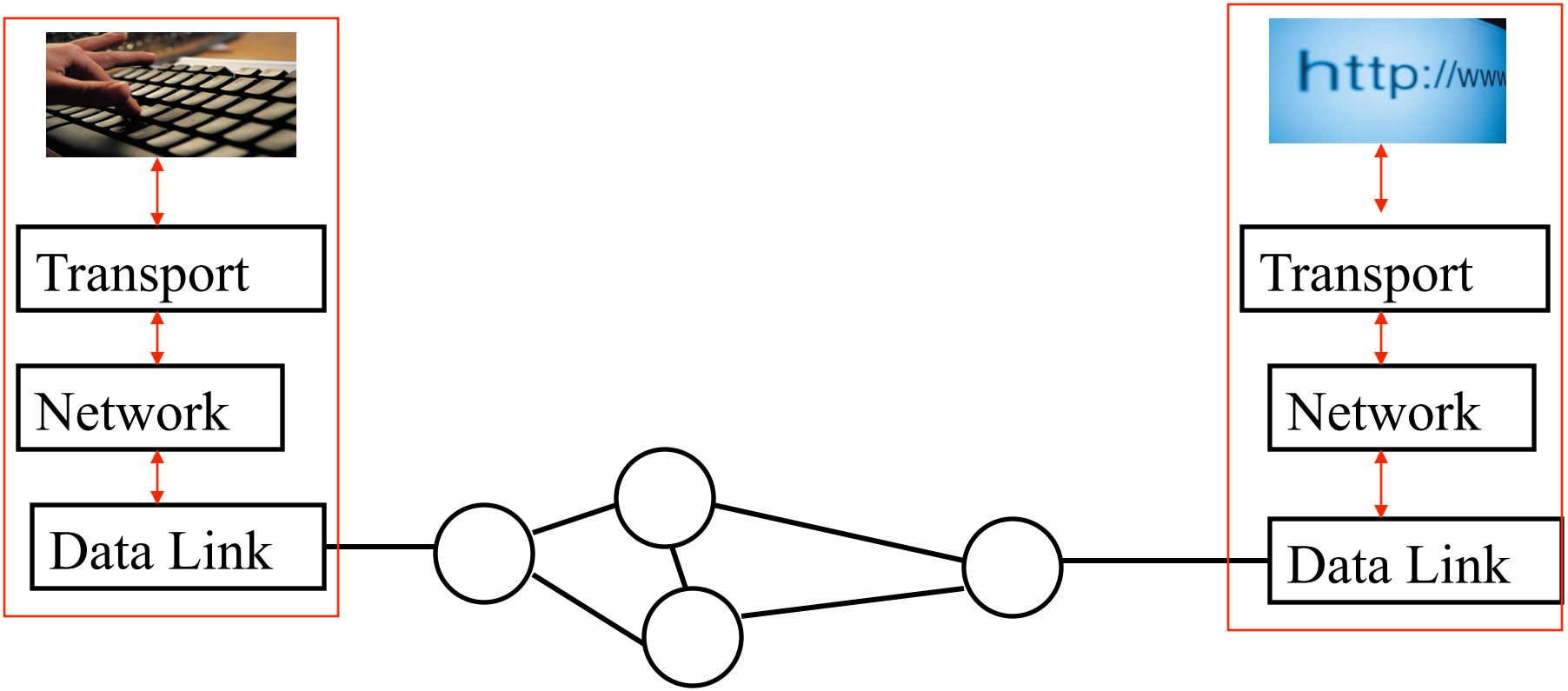
- E.g. TCP, IP, UDP, HTTP, SMTP, Ethernet, …

One Protocol for the Internet?

- Too many machines in the Internet
- Too many problems to solve/implement.
  - How to request/receive web pages?
  - How to split and combine packets?
  - How to find a route to the destination?
  - How to send data over physical cables?
  - …
- Hard to introduce new applications

Layered Architecture

- Build a stack of layered protocols, each:
  - solves only a few (not all) problems
  - defines abstraction of the Internet



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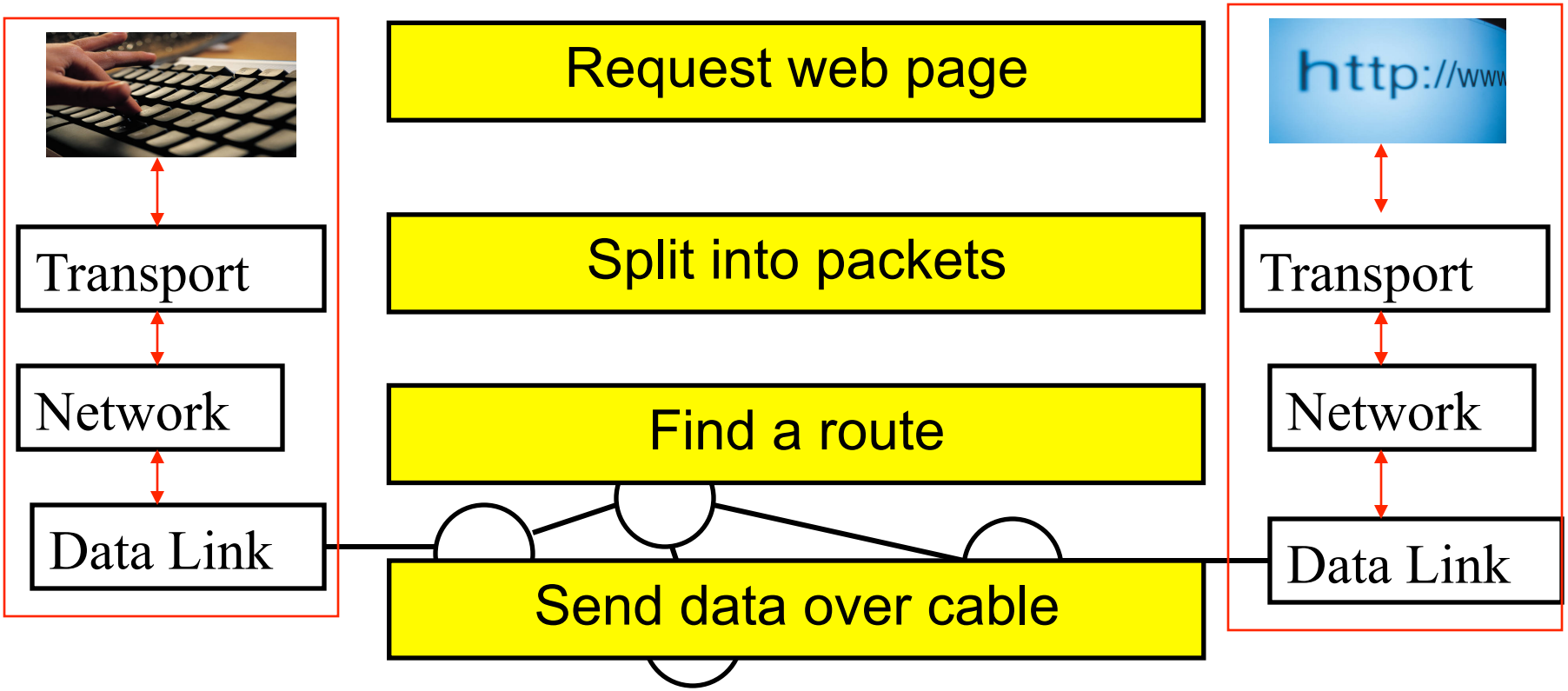
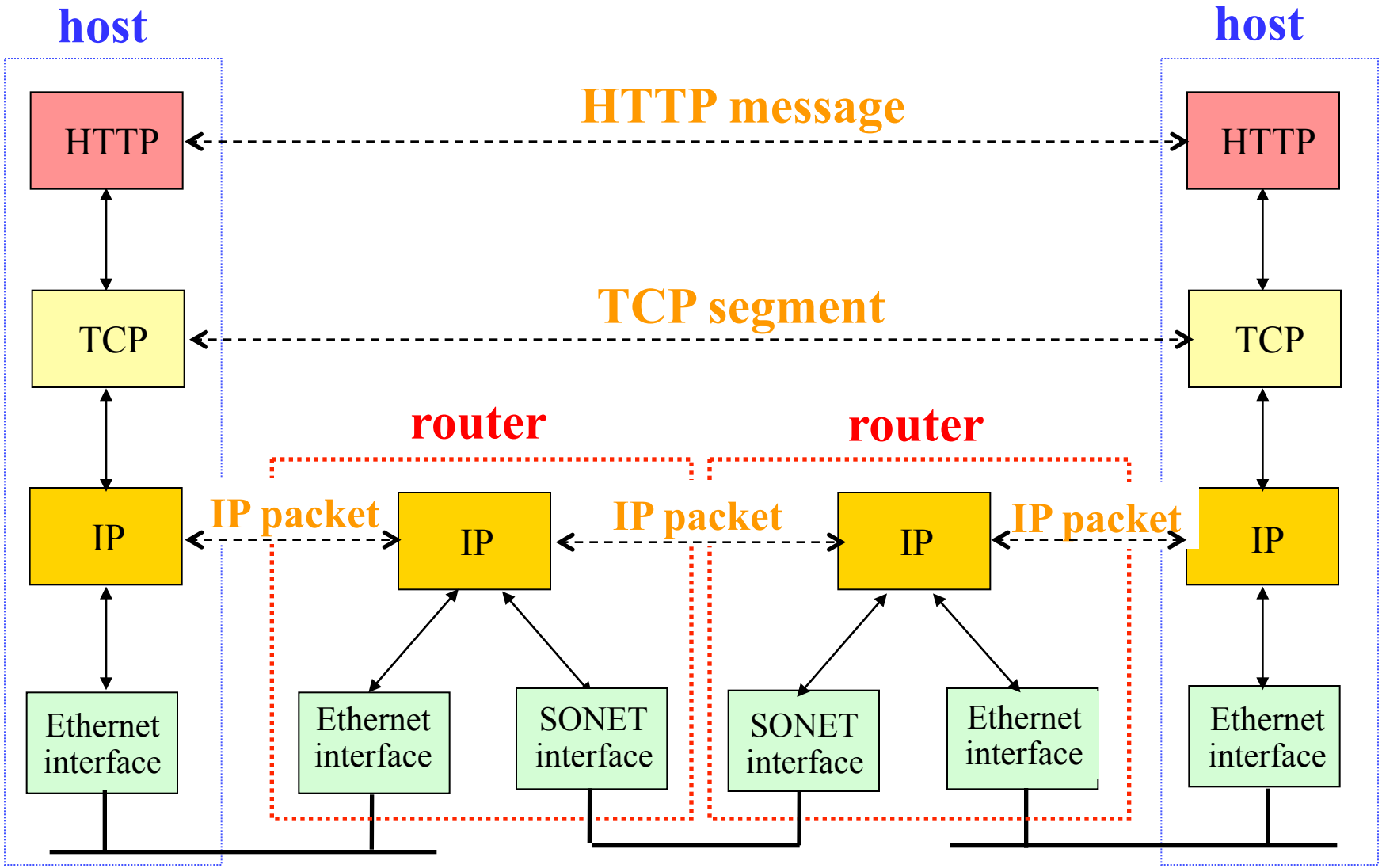


End Hosts vs. Routers



Remarkable!

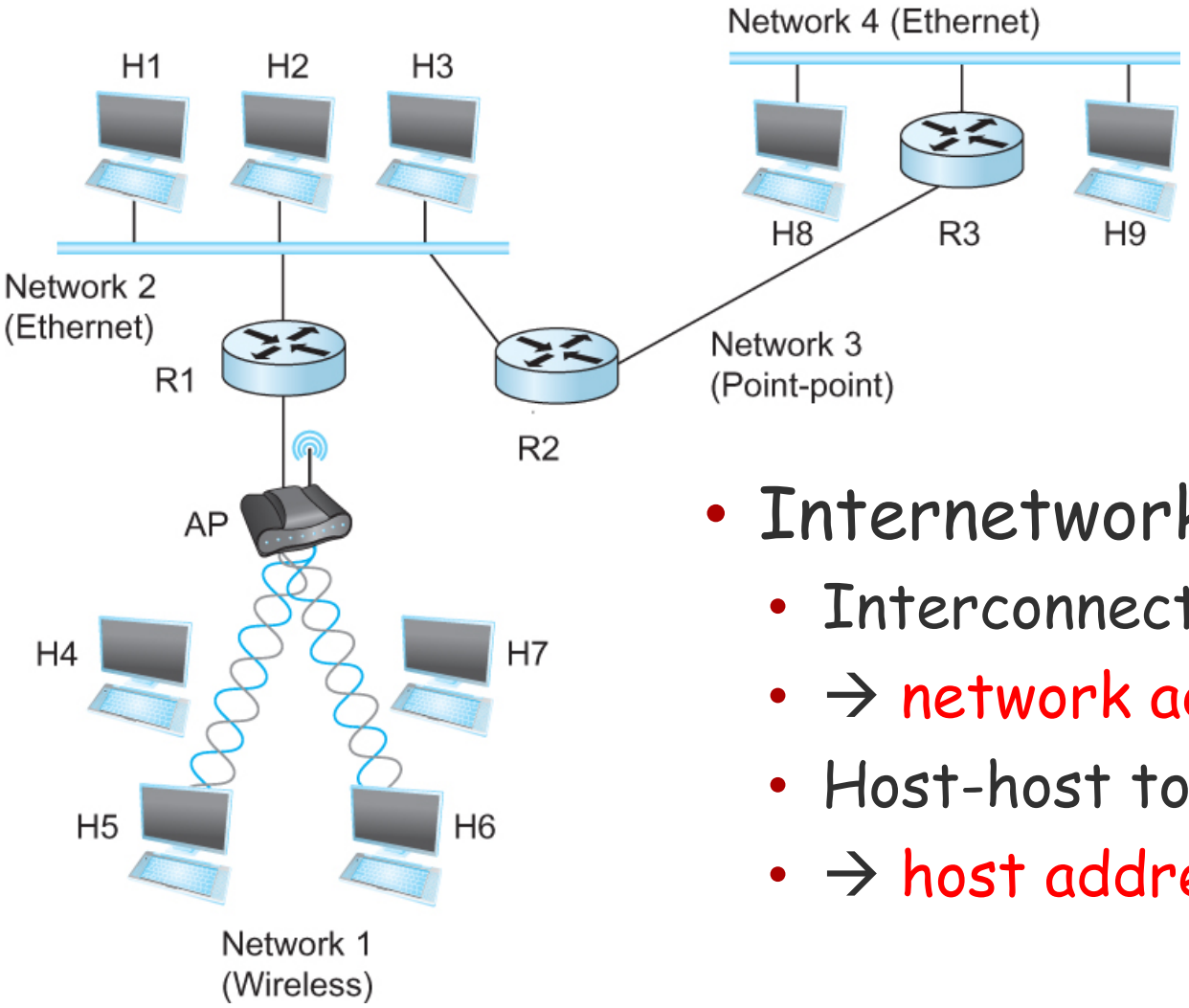
- No one knows how many Internet computers
- Decentralised organisation
- Many link standards
  - Ethernet
  - Wifi
  - … fibre optic
- Internet evolves: new applications

Internet Analogy: Post

- Address: town + house – IP address
  - Network + host
- Mail sorting – router
  - Letters find their way: you do not know where the sorting offices are
- Various data links
  - Post by train, van, bike
- Shared infrastructure
  - You post a letter when you want – capacity?

IP Addresses

Internetworking



- Internetwork
  - Interconnected networks
  - → network address
  - Host-host to packet delivery
  - → host address

IP Address

- For computers (hosts) on the Internet
  - Globally unique
- Consists of 4 bytes. Written as “aa.bb.cc.dd”
  - Hierarchical: network + host
  - Router: multiple addresses
- E.g. (Real)
  - www.amazon.co.uk : 87.238.85.129
  - www.facebook.com : 204.15.20.80
  - www.eecs.qmul.ac.uk : 138.37.95.150
  - frank.eecs.qmul.ac.uk : 138.37.88.242

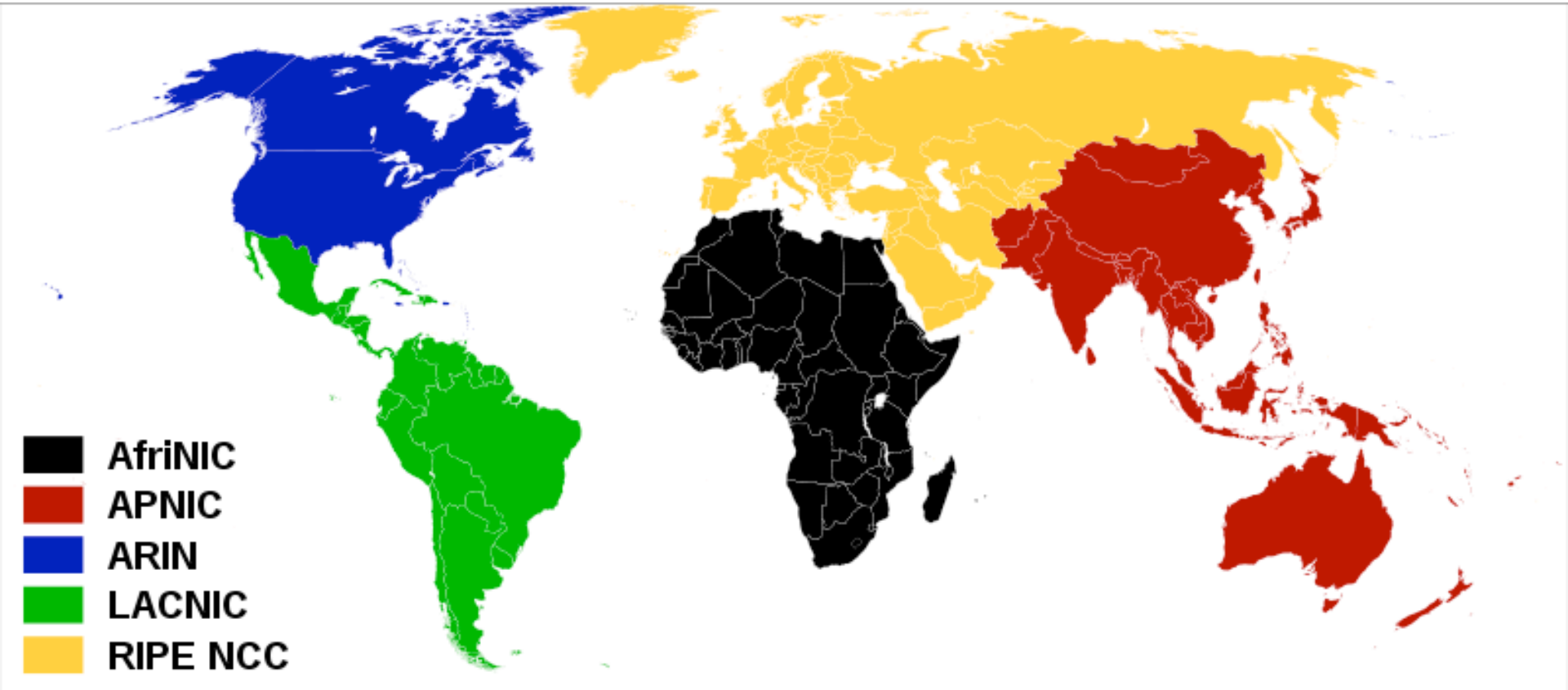
How Are Addresses Allocated?

IANA The Internet Assigned Numbers Authority
ICANN Internet Corporation for Assigned Names and Numbers

- IANA
  - manages the IP address space allocations globally
  - delegates five regional Internet registries (RIRs)
- IANA is managed by ICANN
  - under contract to the US Department of Commerce
- Regional Internet Registries
  - allocate IP address blocks to local ISPs

Regional Internet Registries

- Réseaux IP Européens Network Coordination Centre (RIPE) for Europe, the Middle East, and Central Asia



Who Got the Addresses?

- Class A (16 million hosts) see: http://en.wikipedia.org/wiki/List_of_assigned_/8_IPv4_address_blocks
- 25.0.0.0/8 UK Ministry of Defence (RSRE)
- 51.0.0.0/8 UK Government Department for Work and Pensions

AS3161 Queen Mary and Westfield College (SuperJANET SMDS)	
161.23.0.0/16	Queen Mary and Westfield College
138.37.0.0/16	Queen Mary and Westfield College
192.135.234.0/24	Queen Mary and Westfield College
192.135.231.0/24	Queen Mary and Westfield College

CONFIGURATION

DNS – an example

Remarkable!

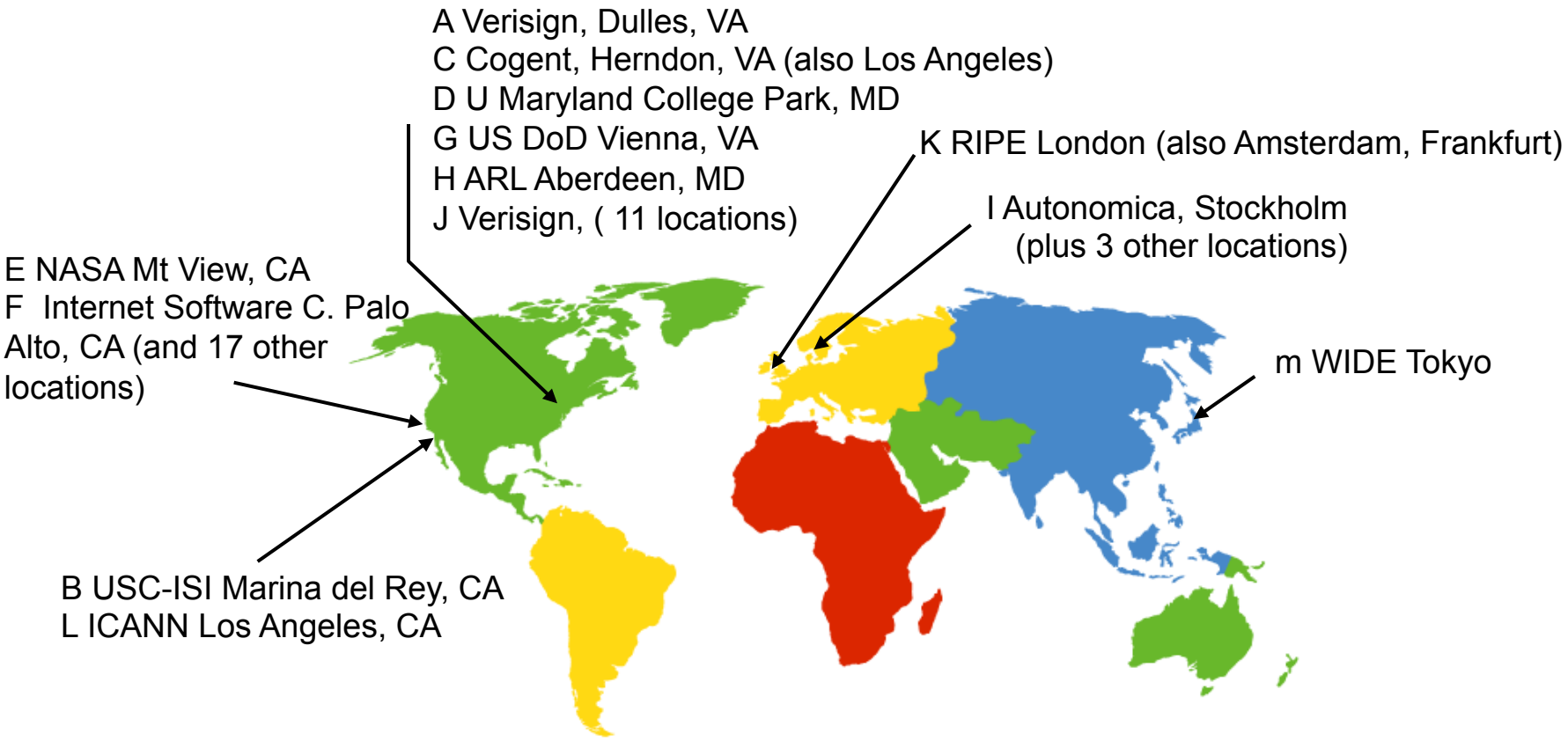
- No centralised configuration
- Automatic configuration
  - Granny takes laptop to coffee shop
  - … IP address allocated
  - … connected to Internet
  - … can send mail

Domain Name System (DNS)

- Translate URL → IP
  - Yellow pages of the Internet
- Decentralized management
- Hierarchy of DNS servers
  - Root servers
  - Top-level domain (TLD) servers
  - Authoritative DNS servers

DNS Root Servers

- 13+ root servers (see http://www.root-servers.org/)
- Labeled A through M



Top Level Domain (TLD) Servers

- Top-level domain (TLD) servers
  - Generic domains (e.g., com, org, edu)
  - Country domains (e.g., uk, fr, ca, jp)
  - Typically managed professionally

Nominet www.nic.uk
the Internet registry
for .uk domain names

Authoritative DNS Servers

- Authoritative DNS servers
  - Provide public records for hosts at an organization
  - For the organization's servers (e.g., Web and mail)
  - Can be maintained locally or by a service provider

- START-UP register a new .com?
  - Add to the .com TLD
- Add a new domain to myco.com
  - Add to the myco authoritative sever

SUMMARY

Summary

- Internet – connected networks
  - Independently run
- Agreed protocols
  - 'IP' for an Internet address
- Decentralised control