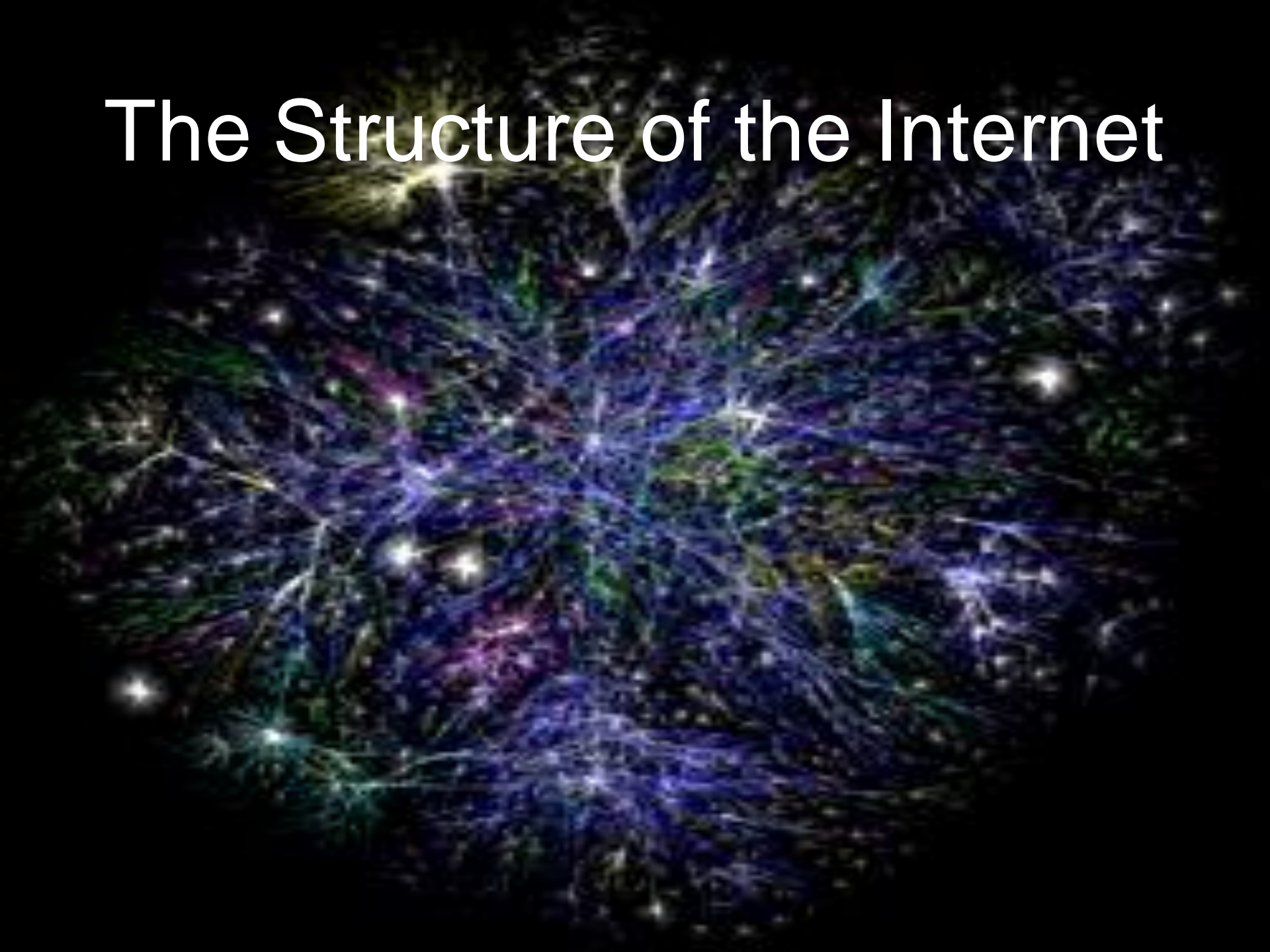
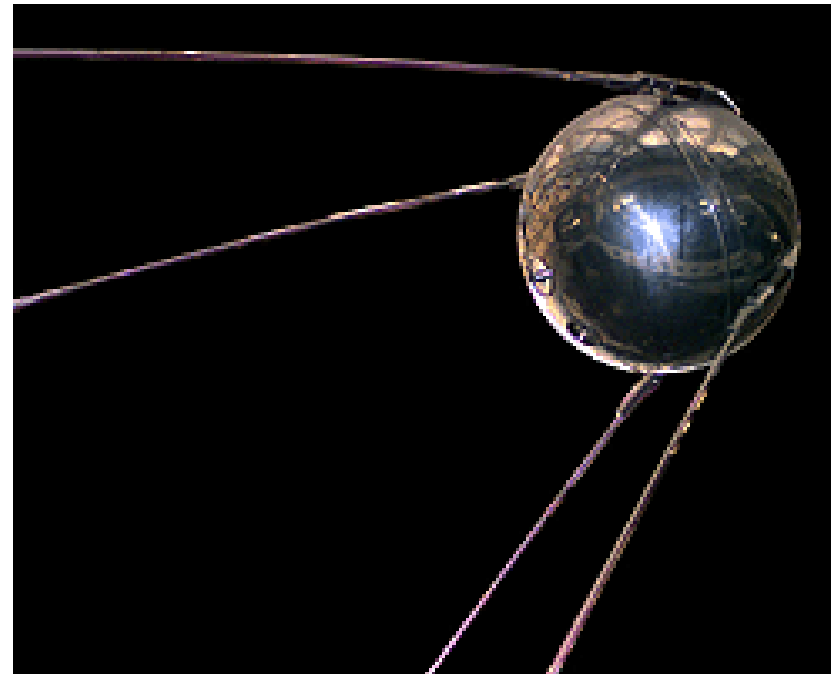


The Structure of the Internet



History

- ❑ Soviet Union first to launch a satellite into orbit
- ❑ Cold war: space race begins
- ❑ U.S. military launches Defence Advanced Research Projects Agency (DARPA)
 - Formed in 1962 to link military computers



Sputnik 1

Launched 1957 by USSR

ARPANET

- DARPA mission: keep U.S. technologically ahead of it's enemies
- created ARPANET
- started in California between UCLA and Stanford
 - Went live Oct. 29, 1969
- added universities and military sites
- evolved into the Internet
 - The term internet first appears in 1974
 - Meant any network using TCP/IP
 - Became global in the 1980's

Internet Protocols

The language at the heart of the Internet is
TCP/IP...

(actually a protocol stack – 4 layers)

Transmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol

... that allows cross-network
communication

Internet Protocols

- **TCP breaks messages into packets**
 - Each packet has all the information needed to travel from network to network
 - Host systems called *Routers* determine how to route transmissions

Packet - E-mail Example		
Header	Sender's IP address Receiver's IP address Protocol Packet number	96 bits
Payload	Data	896 bits
Trailer	Data to show end of packet Error correction	32 bits

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Internet Protocols

IP is about...

■ Addressing & Delivery

- Each Internet host computer has a unique *IP Address*
- Each address is comprised of four sets of numbers separated by periods, such as
142.104.95.126
- Each set can contain numbers from 0 to 255
- Separated into classes – A to E

Looking to the Future

IPv4 – (Internet Protocol version 4)

- e.g. 142.104.231.5
- addresses available: 4,294,967,296 (~4.3 billion)
- number of humans on the planet: ~6.5 billion
- Static vs. dynamic
- All have been allocated as of Feb. 3, 2011

IPv6 – (Internet Protocol version 6)

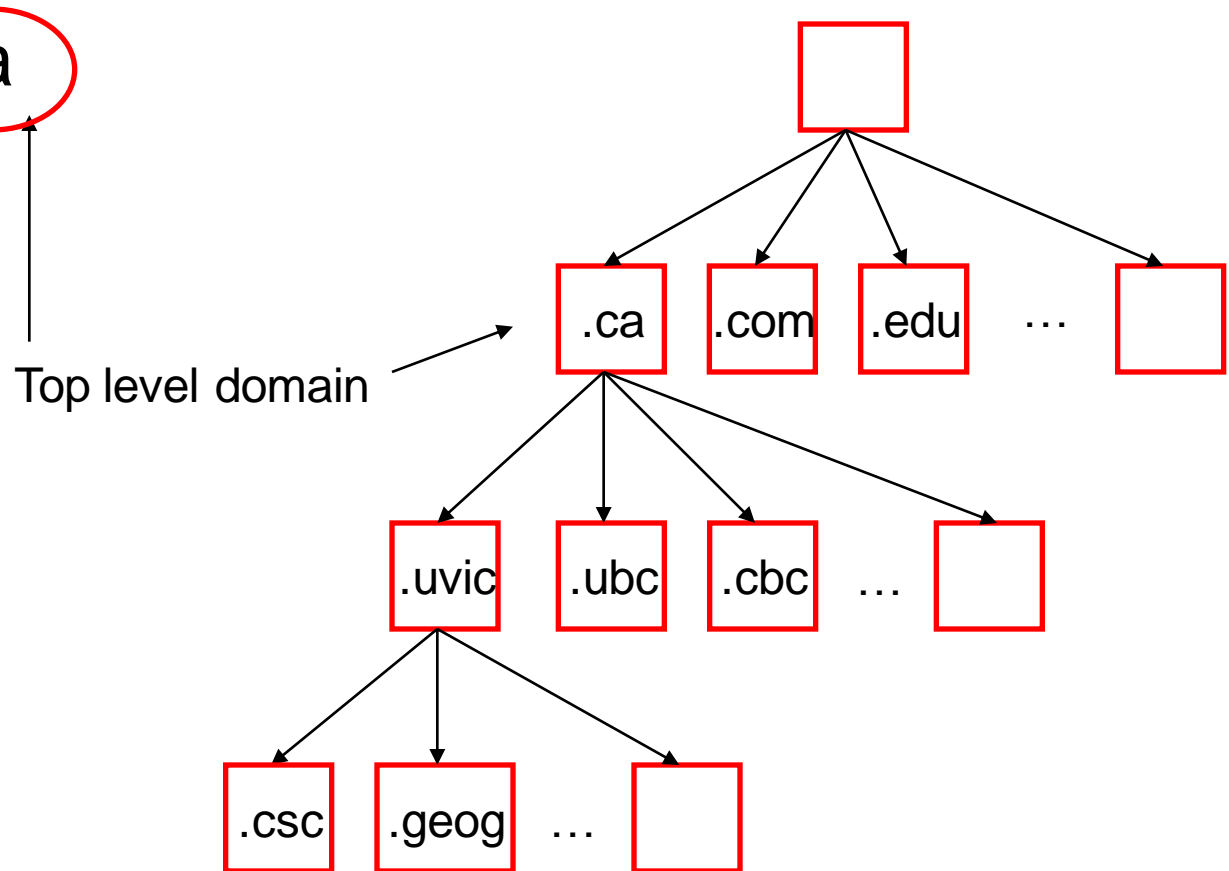
- Started in 1998
- e.g. 2001:0db8:0000:0000:0000:0000:1428:57ab
- addresses available:
340,282,366,920,938,463,463,374,607,431,768,211,456
- enough to give

Domain Name System

- translate domain names into internet addresses
- E.g. `www.uvic.ca` = `142.104.5.64`
- Started in 1983
- Distributed database
- Complex, well-hidden task
 - Billions of IP addresses
 - Billions of DNS requests per day
 - Domain names and IPs change daily
 - New domain names created daily
 - Millions of people work on multiple systems

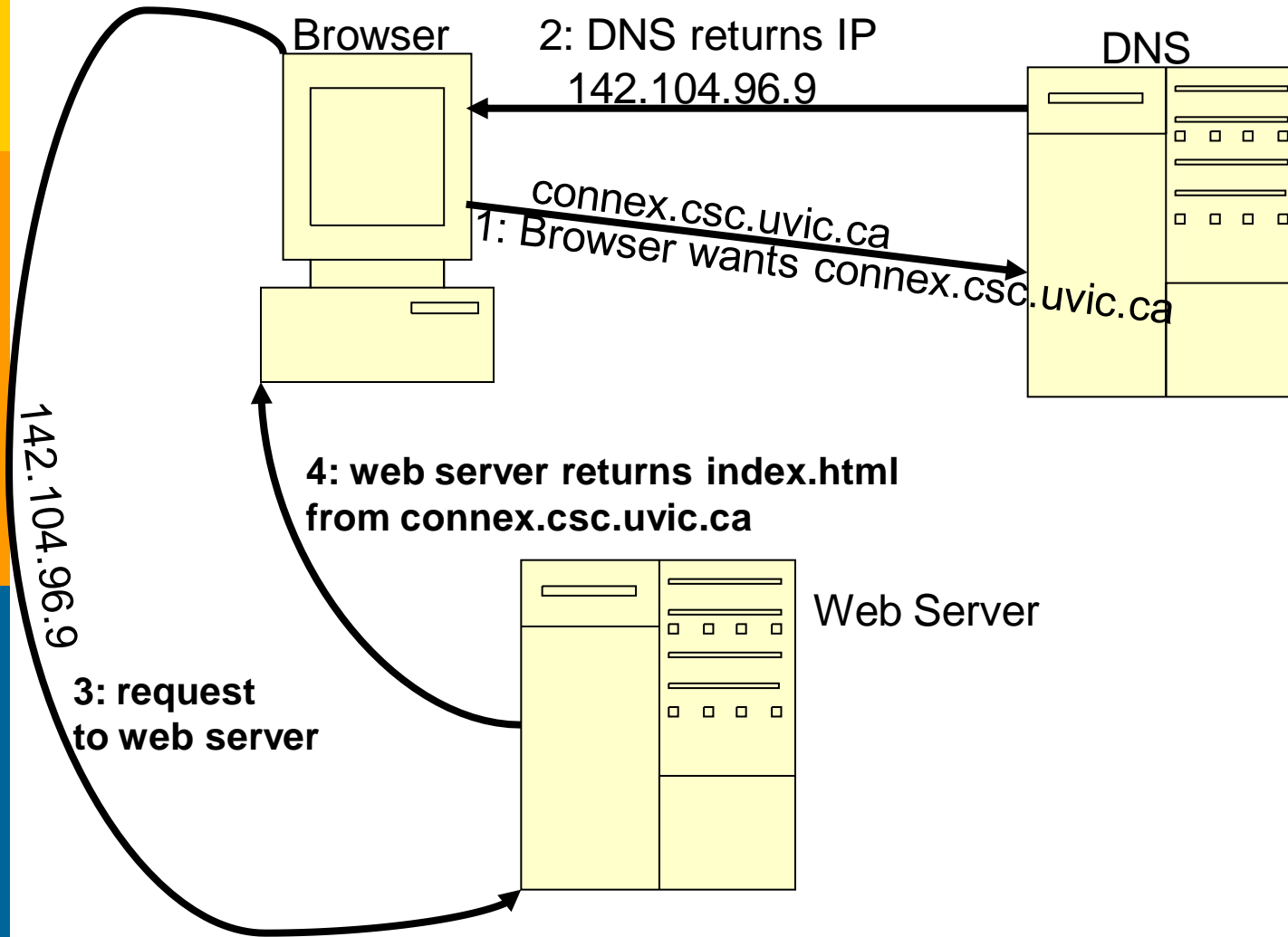
Domains

□ www.uvic.ca



TCP-IP, the Domain Name System and Internet Routers

In-class diagram example



Internet Services

The Internet provides a variety of services such as:

- Electronic mail (send/receive mail messages)
- Remote login (Telnet - access to other computers)
- File transfer (ftp)
- WWW
- Talk/chat (instant messenger)
- Video conference
- VoIP

What's the common theme with all these services?

Internet and World Wide Web

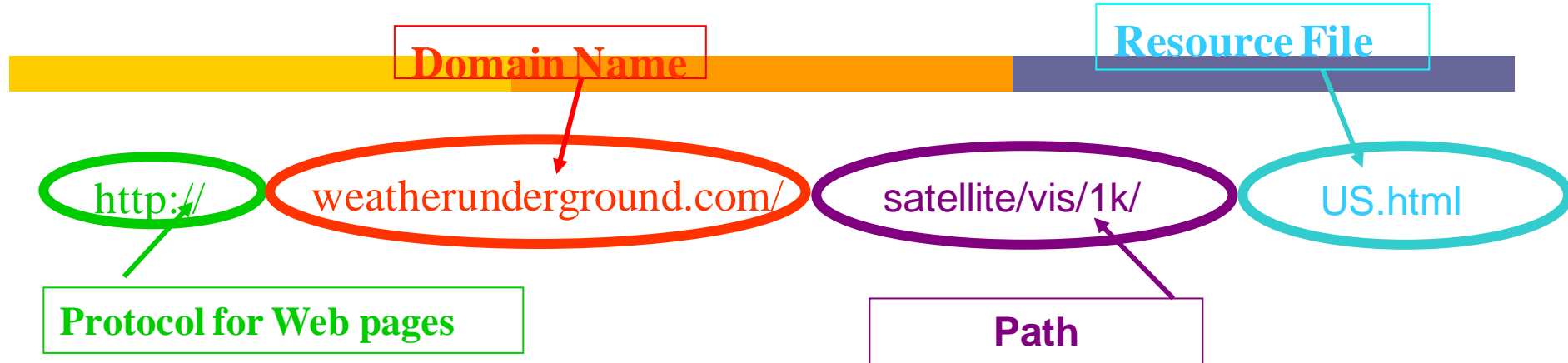
The Internet and the World Wide Web are NOT the same thing

- **Internet:** A global interconnected network of computer networks that transmit data by packet switching
- **World Wide Web:** A collection of multimedia documents linked by hyperlinks. The WWW forms part of the Internet.

Inside the Web

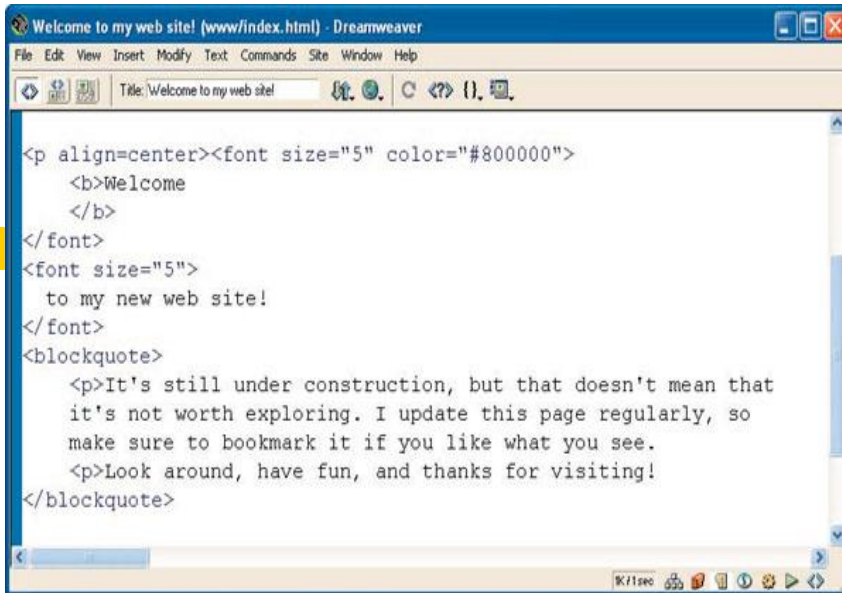
Web Protocols: HTTP and HTML

- ✓ HTTP (Hypertext transfer protocol) used to transfer Web pages



- ✓ HTML (HyperText Markup Language) created for encoding and displaying documents

Inside the Web



A screenshot of the Adobe Dreamweaver application window. The title bar reads "Welcome to my web site! (www/index.html) - Dreamweaver". The menu bar includes File, Edit, View, Insert, Modify, Text, Commands, Site, Window, and Help. The address bar shows "File: 'Welcome to my web site!'" and navigation icons. The main workspace contains the following HTML code:

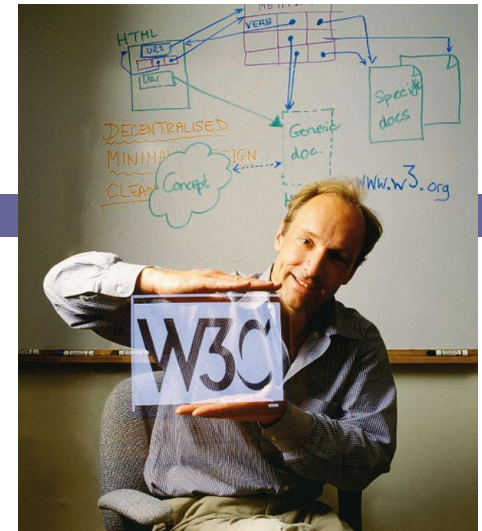
```
<p align=center><font size="5" color="#800000">  
  <b>Welcome  
  </b>  
</font>  
<font size="5">  
  to my new web site!  
</font>  
<blockquote>  
  <p>It's still under construction, but that doesn't mean that  
  it's not worth exploring. I update this page regularly, so  
  make sure to bookmark it if you like what you see.  
  <p>Look around, have fun, and thanks for visiting!  
</p>  
</blockquote>
```



- ✓ HTML is not WYSIWYG (What You See Is What You Get).

Tim Berners-Lee Weaves the Web for Everybody

- ✓ Born in London in 1955
- ✓ Wanted to create an open-ended distributed hypertext system with no boundaries, so scientists everywhere could link their work together
- ✓ Invented the World Wide Web and gave it to all
- ✓ Now works at MIT
- ✓ Heads the World Wide Web Consortium (W3C)



Example

- Let's take an example and see how these pieces fit together.
- Example:
 - Your friend suggests that you take a look at Flickr, one of many places to share photos on the web. She sends you a link to: <http://www.flickr.com/explore/>
 - You open the link in a web browser.

HTTP Protocol

Step 1:

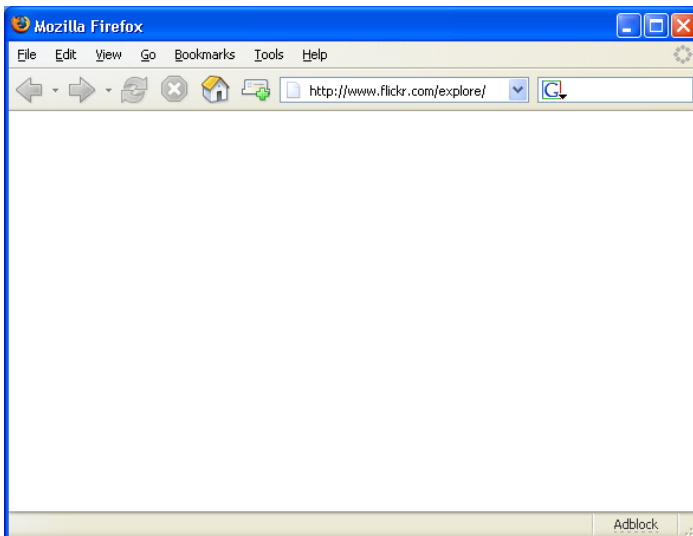
- The web browser prepares a request using the **http protocol**.

The address you entered:

<http://www.flickr.com/explore>

becomes the request:

```
GET /explore HTTP/1.1  
Host: www.flickr.com
```



Uniform Resource Locator (URL)

Step 2:

- The Internet Protocol must interpret the web address – **Universal Resource Locator (URL)** – you entered.

```
GET /explore HTTP/1.1  
Host: www.flickr.com
```

Domain Name System

Step 3:

- Access the Domain Name System (DNS) to **translate the URL into an IP address.**

www.flickr.com

68.142.214.24

Transmission Control Protocol (TCP)/ Internet Protocol (IP)

Step 4:

- We can now split the message into **packets** and add **headers**
- **Address** the packets
- **Send the message** out.

Packet #: 1

Sender: 142.104.5.63

Receiver: 68.142.214.24

Other header info....

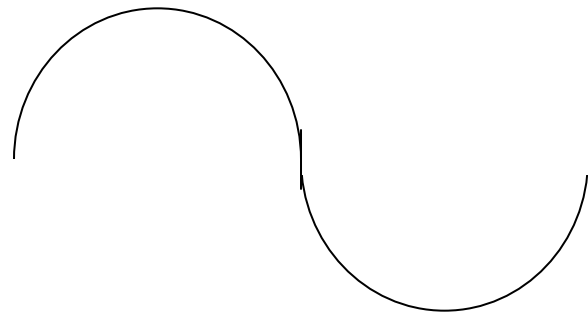
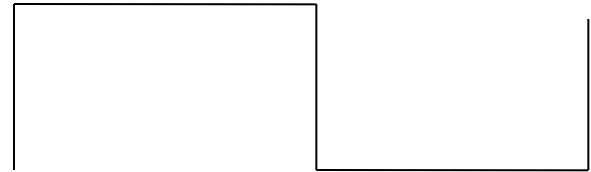
GET /explore HTTP/1.1

Host: www.flickr.com

ADSL, Cable and Phone

Step 5:

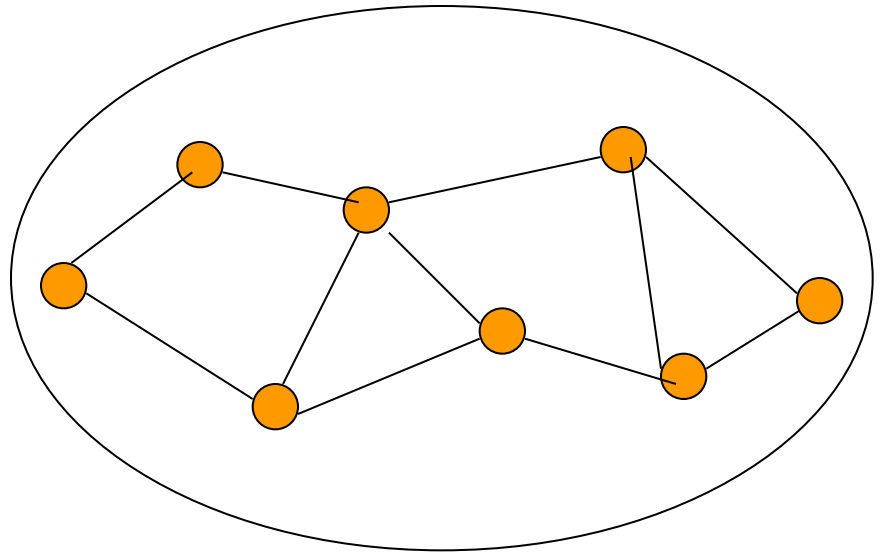
- ❑ The message passes through the modem – whether it is an ADSL, cable or phone modem.
- ❑ The modem converts from **digital to analog**, as necessary.



Routing

Step 6:

- The message is routed through the Internet.



Client / Server

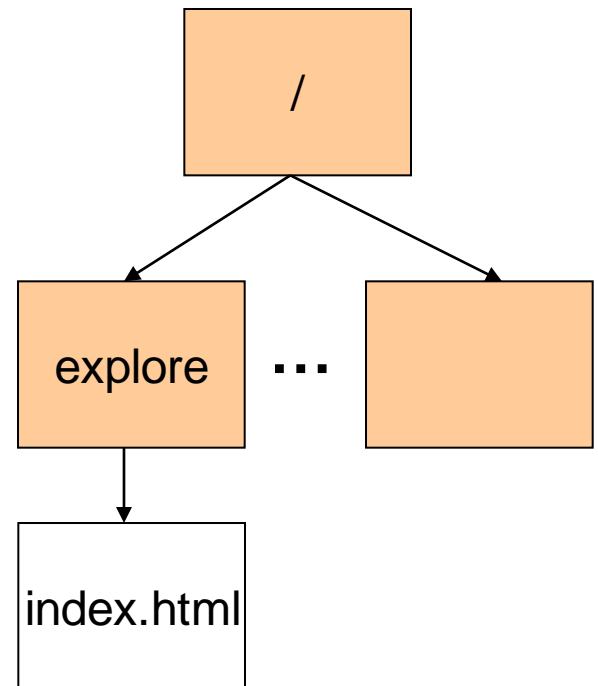
Step 7:

- The appropriate web server receives the request and uses the **path** to find the files.

http://www.flickr.com/explore

↑ ↑ ↑ ↑

protocol subdomain domain directory



Response

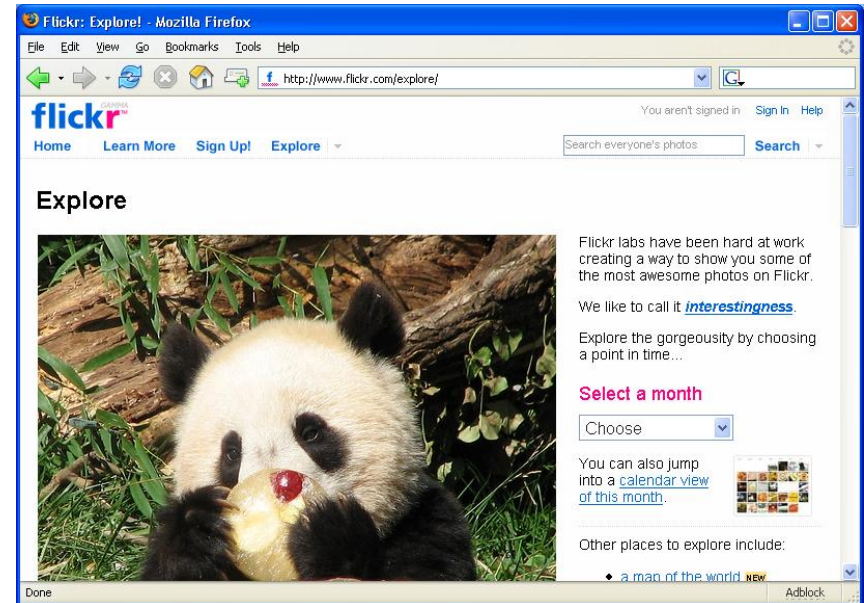
Step 8:

- Send a response
 - Prepare files
 - IP protocol
 - TCP protocol
 - Send through hardware
 - Route through Internet

Receive response

Step 9:

- ❑ Received by your computer
 - Converted through modem
 - Collected by TCP
 - Reassembled by IP
 - Rendered by your web browser



Tools

- Can we see this routing?
 - `tracert domain name`
- What's your IP address
 - `ipconfig/all`

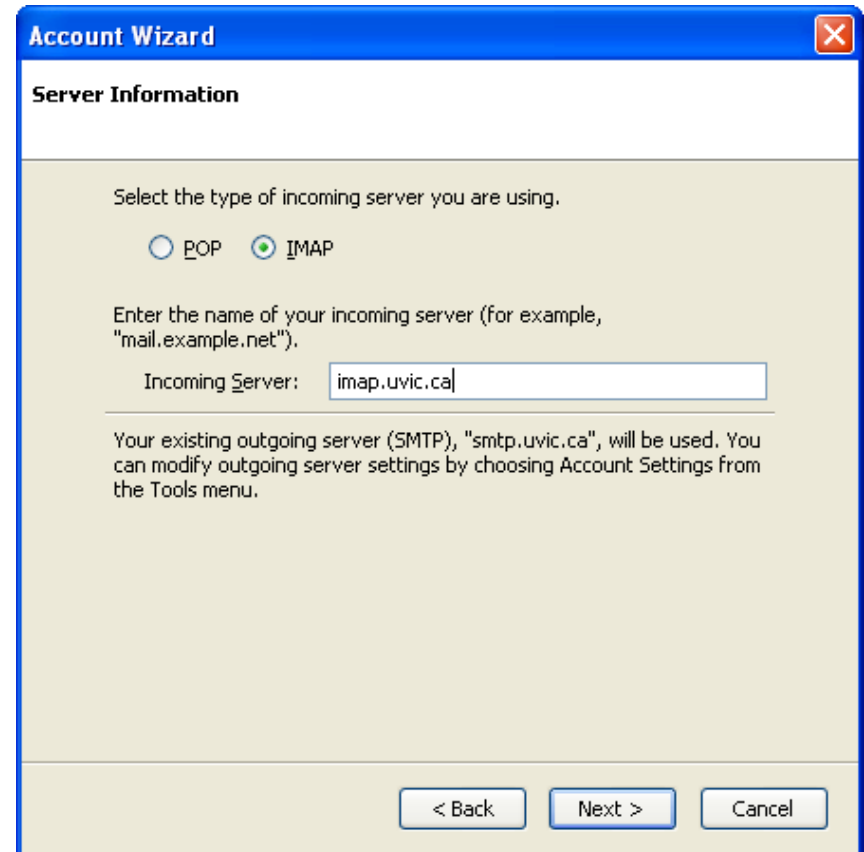
E-mail Addresses

An Internet address includes:
username@hostname.sub.dom

- **username** is the person's "mailbox"
- **hostname** is the name of the host computer and is followed by one or more domains separated by periods:
 - host.subdomain.domain
 - host.domain
 - host.subdomain.subdomain.domain

How does email work?

- ❑ We saw how messages are divided up when they are sent
- ❑ But where is the mailbox actually kept?
 - They are kept on a server
 - We tell our email client (application) where to look for our messages
- ❑ Example email clients:
 - Microsoft Outlook
 - Microsoft Outlook Express
 - Mozilla Thunderbird



Account Wizard

Server Information

Select the type of incoming server you are using.

☐ POP ☒ IMAP

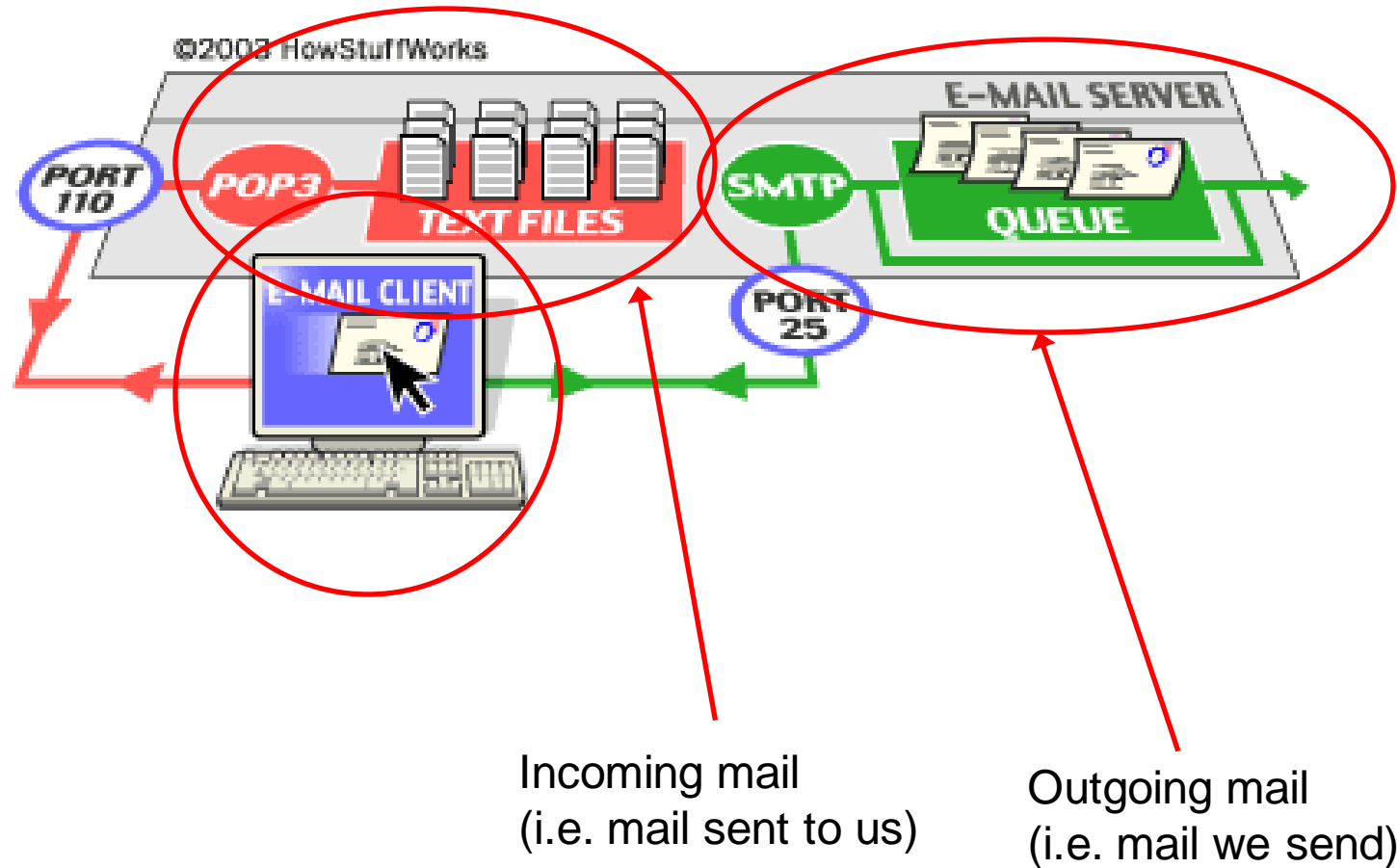
Enter the name of your incoming server (for example, "mail.example.net").

Incoming Server:

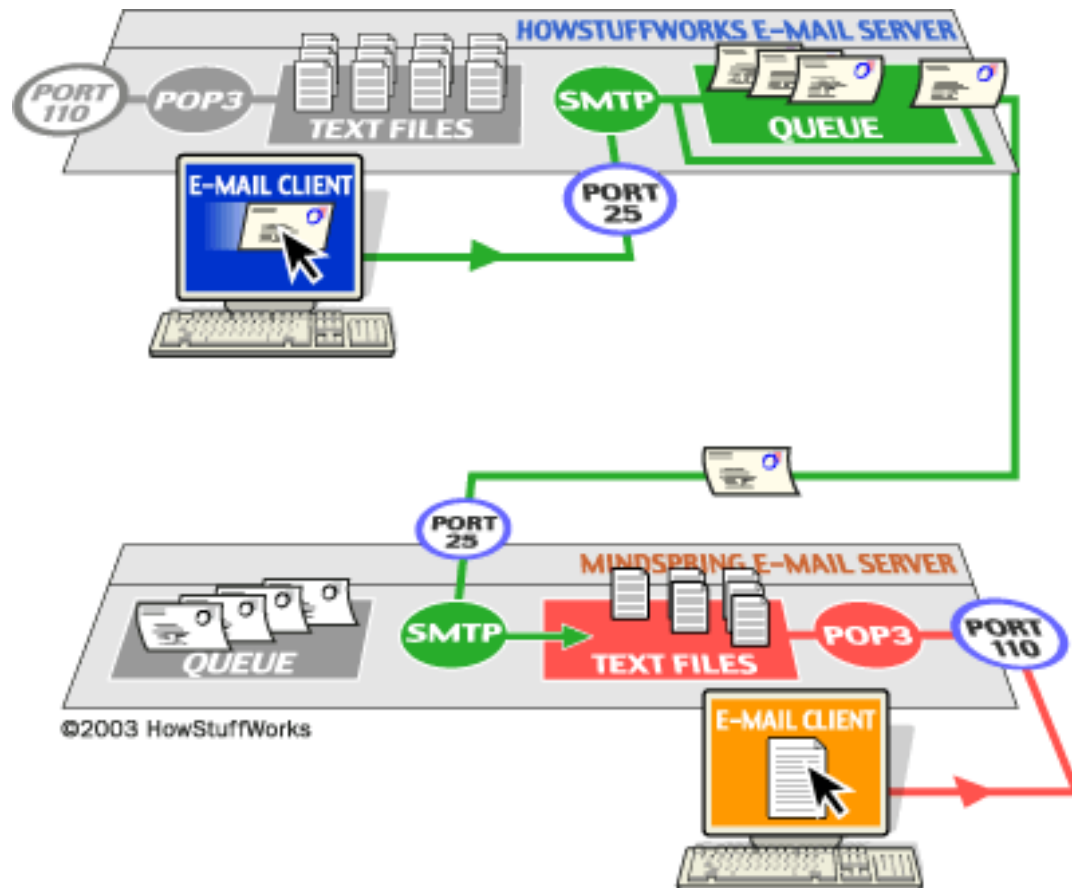
Your existing outgoing server (SMTP), "smtp.uvic.ca", will be used. You can modify outgoing server settings by choosing Account Settings from the Tools menu.

< Back Next > Cancel

Accessing Email



Sending and Receiving Email



How does email work?

- When you set up your email client, it will ask you for information about the servers to use.
 - What is your incoming server?
 - What is your outgoing server?



Account Wizard

Server Information

Select the type of incoming server you are using.

☐ POP ☒ IMAP

Enter the name of your incoming server (for example, "mail.example.net").

Incoming Server:

Your existing outgoing server (SMTP), "smtp.uvic.ca", will be used. You can modify outgoing server settings by choosing Account Settings from the Tools menu.

< Back Next > Cancel

What's with all the protocols?

- POP (Post Office Protocol) – e.g. pop.uvic.ca
 - messages downloaded to computer, not kept on server
 - once downloaded, can only be viewed on that computer, but you don't need access to the Internet to read them

- IMAP (Internet Messaging Access Protocol) - imap.uvic.ca
 - messages kept on server
 - messages accessible anywhere, but requires Internet connection

- SMTP (Simple Mail Transfer Protocol) – e.g. smtp.uvic.ca
 - common protocol for sending email

Online email

The screenshot shows a Mozilla Firefox browser window titled "UVic WebMail - Login - Mozilla Firefox". The address bar displays "https://wm2.uvic.ca/". The page header includes the University of Victoria logo and the text "WebMail". Below the header is a navigation bar with links: "LOGIN", "UVic Home", "Computer Helpdesk", "Login", "Quick Reference", "WebMail Help", and "Netlink ID". The main content area is titled "WebMail Login" and contains two input fields: "Netlink ID:" and "Email password:". A "Login" button is positioned to the right of the password field. Below the login fields, there is a note: "To enter secure mode click on the link at bottom of this page." followed by a link to a "feedback form". A section titled "About WebMail" provides information about the service: "UVic WebMail provides a secure, easy to use mail service that is accessible from a browser, for students who access their e-mail from home or from multiple workstations located in public facilities, and for faculty and staff who access their e-mail from conferences, libraries and from other remote locations." The browser's status bar at the bottom shows "Done", "wm2.uvic.ca", and "Adblock".

UVic WebMail - Login - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://wm2.uvic.ca/

Google Chisel UVic CSc Dept Post to CiteULike CiteULike

University of Victoria WebMail

Mail - Mail Inbox Go!

LOGIN UVic Home | Computer Helpdesk

Login Quick Reference WebMail Help Netlink ID

WebMail Login

Netlink ID:

Email password:

To enter secure mode click on the link at bottom of this page.

Questions, comments or problems? Fill out a [feedback form](#).

About WebMail

UVic WebMail provides a secure, easy to use mail service that is accessible from a browser, for students who access their e-mail from home or from multiple workstations located in public facilities, and for faculty and staff who access their e-mail from conferences, libraries and from other remote locations.

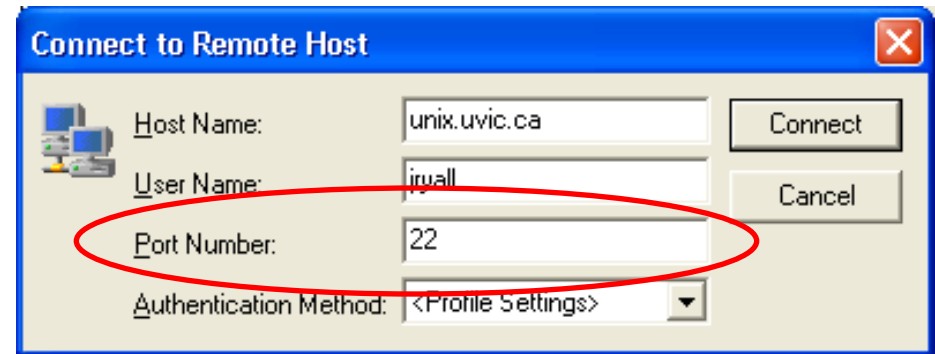
Done wm2.uvic.ca Adblock

With online email, this process still exists.

However, since you're viewing them in a web browser and not downloading them, these details are hidden from you.

Ports

- ❑ How does a server know it is receiving an http request?
- ❑ How does a server know it is receiving an ftp request?
- ❑ How does a server know it is receiving an e-mail request?



Port Numbers

- Specify the type of communication
- In the header of the packet
- Maps the body of the packet to the proper application
- There are 50,000 ports with some conventions:
 - smtp = 25
 - pop3 = 110
 - http = 80
 - ftp = 22
 - https = 443