

# Internet

## IP Addresses

- **Last class:** IP addresses, gateways (a.k.a. routers), routing tables
- How many IP addresses do you know by heart?

www.google.com → 72.14.207.104

www.mcgill.ca → 132.216.177.140

www.rateyourteacher.com → 204.13.161.23

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## Domain Names

- A domain name is a **placeholder** for some IP address
- Each domain name can be **broken down** into levels

www.mcgill.ca



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## Top-level domain names

- **com, net, org, name, gov, edu, biz**
- Assigned to **countries:** ca, fr, de, fj, tv (Tuvalu)
- In Canada, managed by Canadian Internet Registration Authority (CIRA)
- Holder must meet **Canadian Presence Requirements**
  - a Canadian citizen of the age of majority
  - a permanent resident of Canada
  - a legally recognized Canadian organization
  - an Inuit, First Nation, Métis or other people indigenous to Canada
  - an Indian Band as defined in the Indian Act of Canada
  - a foreign resident of Canada that holds a registered Canadian trademark
  - a division of the government
  - Her Majesty Queen Elizabeth II

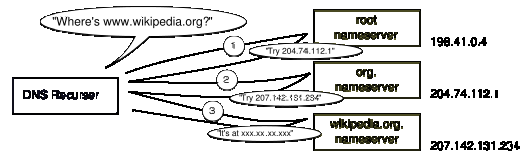
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## Domain Name System: DNS

- Translates **domain names** to **IP addresses**
- A request to resolve a domain name to an IP address might need to travel through several servers before being answered
- The full route is **root server**, **top-level server**, **second-level server**, etc.

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## DNS



- In this example need to ask 3 servers before discovered the IP address
- What are potential problems with this approach?

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## DNS Caching

- If all queries were to go through root nameserver it would not be able to handle the load
- To overcome this problem lower level domain servers “remember” the names they have resolved in the past
- Subsequent queries would not have to go through all servers

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## DNS Caching Examples

- Local McGill workstation tries to resolve mail.yahoo.com
- The workstation will ask local McGill's DNS server to resolve the address for it
- McGill's server will check its cache,
  - If someone has accessed any .com domain or third level domain on yahoo.com, or, even better, mail.yahoo.com, the search length will be reduced
  - If not, McGill's server will have to start at the root name server

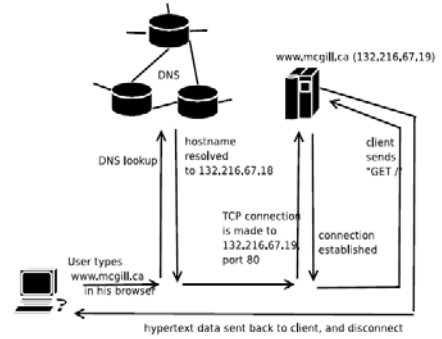
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## Hypertext Transfer Protocol (HTTP)

- Application layer communication protocol used to send and receive information on WWW
- Created in 1990, at CERN, the European Particle Physics Laboratory in Geneva, Switzerland, as a means for sharing scientific data internationally, instantly, and inexpensively
- Request/Response protocol between client and server
- Request Example
  - GET /page.html HTTP/1.1 Host: www.mcgill.ca
- Response Examples (status line)
  - HTTP/1.1 200 OK
  - HTTP/1.1 404 Not Found

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## WWW Example



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## HTTP

- The client sends a **request**:

```
GET /page.html HTTP/1.0
```

The Date of the Request

- The server **responds** with:

```
HTTP/1.0 200 OK
Date: Fri, 31 Dec 1999 23:59:59 GMT
Last-Modified: Wed, 29 Dec 1999 23:11:55 GMT
Content-Type: text/html
Content-Length: 1354
<html>
<body>
<h1>Happy New Millennium! </h1>
(more file contents)
...
</body>
</html>
```

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## HTML

- HTML documents are made up of **plain text**, mixed up with **special tags**
- Start-tags are written like: `<element name>`, end-tags like: `</element name>`
- Formatting:
  - `<b>...</b>`
  - `<i>...</i>`
  - `<u>...</u>`
  - `<br>`
- **Hyperlinks:**
  - `<a href=html://www.cim.mcgill.ca/~sveta/COMP102/>COMP102</a>`

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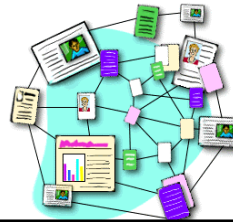
## HTML

```
<html>
<head>
<title> Simple document </title>
</head>
<body>
<p>The text of the document goes
  here.</p>
</body>
</html>
```

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## World Wide Web

- Collection of hypertext documents accessible for download from web (HTTP) servers.
- Each document has links that point to local files, or other pages at other locations.



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## Dynamic Web Content

- **Static Web page:** displays the same information for all users
- **Dynamic Web Page:** content (text, images, etc.) can change, reacting for different context conditions.

This interactivity can be:

1. Reaction of a specific page to mouse or keyboard input (e.g. Google Maps, Google Search)
2. Reloading of web pages, that are produced on-the-fly, reacting to browser-type parameters, to time, etc.



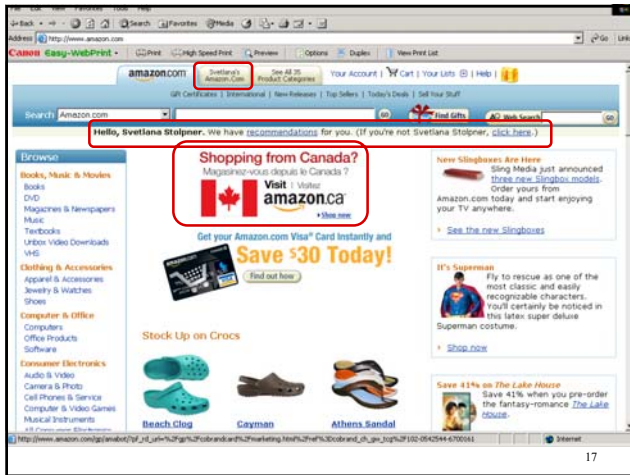
**\*Made to Order\***

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## Dynamic Web Content

- Separation of **content** and **presentation**:
1. Enter your request into a page
  2. Request goes to web server
  3. Server find the necessary information in its database and applies it against the template
  4. Server sends the page back to you

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## Email

- More Protocols (application layer, like HTTP)
- **SMTP** (Simple Mail Transfer Protocol)
  - for sending mail
- **POP3** (Post Office Protocol v.3)
  - for receiving mail

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## Mail Exchange (MX) Records

- Resource record in the **Domain Name System (DNS)** specifying how Internet e-mail should be routed
- MX records point to the **servers that accept e-mail**
- Sending an email to **friend@example.com**:
  - the sending mail transfer agent makes a DNS query requesting the MX record for example.com
  - this query returns a list of host names of mail exchange servers accepting incoming mail for that domain
  - the sending agent then attempts to establish an SMTP connection to one of these servers

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## SMTP – Sending Mail

Allowed commands:

HELO <ip addr>

MAIL FROM: <email addr>

RCPT TO: <email addr>

DATA

– After receiving this message, all text sent from client will be part of the email

– Stops accepting text for the email when it a line containing only '!'

QUIT

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## SMTP

```
S: 220 www.example.com ESMTP Postfix
C: HELO mydomain.com
S: 250 Hello mydomain.com
C: MAIL FROM:<sender@mydomain.com>
S: 250 Ok
C: RCPT TO:<friend@example.com>
S: 250 Ok
C: DATA
S: 354 End data with <CR><LF>.<CR><LF>
C: Subject: test message
C: From: sender@mydomain.com
C: To: friend@example.com
C:
C: Hello,
C: This is a test.
C: Goodbye.
C: .
S: 250 Ok: queued as 12345
C: QUIT
S: 221 Bye
```

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## POP3 – Receiving Mail

Allowed commands:

APOP <username> <password>

LIST

– once logged in, lists the messages on the server  
– each line contains the message number and size

RETR <msg num>

DELE <msg num>

QUIT

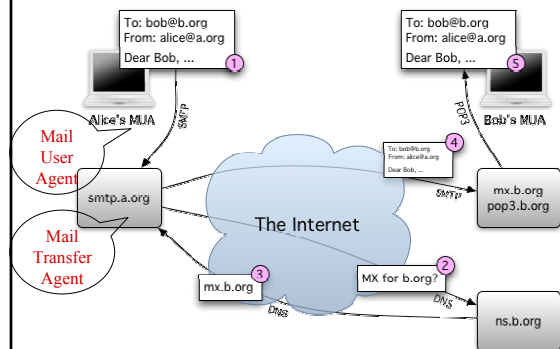
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## POP3

```
S: <wait for connection on TCP port 110>
C: <open connection>
S: +OK POP3 server ready <1896.697170952@dbc.wriw.ca.us>
C: APOP mrose c4e934bae560ecc979e56001b3e22fb
S: +OK mrose's maildrop has 2 messages (320 octets)
C: LIST
S: +OK 2 messages (320 octets)
S: 1 120
S: 2 200
S: .
C: RETR 1
S: +OK 120 octets
S: <the POP3 server sends message 1>
S: .
C: DELE 1
S: +OK message 1 deleted
C: RETR 2
S: +OK 200 octets
S: <the POP3 server sends message 2>
S: .
C: DELE 2
S: +OK message 2 deleted
C: QUIT
S: +OK busy POP3 server signing off (maildrop empty)
C: <close connection>
S: <wait for next connection>
```

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## Email



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## MIME

- Like HTTP responses, emails are **formatted** using MIME rather than HTML
- MIME specifies that a piece of text has:
  - a **header** which is a sequence of **line headers**, one per line
  - each line header has the form “**name: value**”
    - From:, To:, Subject:, Message-ID:, etc.
  - a **body** which contains content

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## MIME

- **From** bob@cim.mcgill.ca **Mon Oct 2 22:23:25 2006**  
**Delivered-To:** sveta@cim.mcgill.ca  
**Received:** from www.cim.mcgill.ca (132.206.73.195)  
by avalanche.cim.mcgill.ca with SMTP id 766F77E5D7  
for <sveta@cim.mcgill.ca>; Mon, 2 Oct 2006 22:23:23 -0400 (EDT)  
Mon, 2 Oct 2006 22:23:25 -0400 (EDT)  
**Received:** from 206.248.136.219  
(SquirrelMail authenticated user bob)  
**Message-ID:** <10747.206.248.156.119.1159842205.squirrel@www.cim.mcgill.ca>  
**Date:** Mon, 2 Oct 2006 22:23:25 -0400 (EDT)  
**Subject:** COMP102 example  
**From:** "Bobby" <bob@cim.mcgill.ca>  
**To:** sveta@cim.mcgill.ca  
**User-Agent:** SquirrelMail/1.4.1  
**MIME-Version:** 1.0  
**Content-Type:** text/plain;charset=iso-8859-1  
**Content-Transfer-Encoding:** 8bit  
**X-Priority:** 3  
**Importance:** Normal

And here is the message!

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## MIME, another example

- **From** bob@yahoo.com **Fri Oct 6 15:09:17 2006**  
**Return-Path:** <bob@yahoo.com>  
**X-Original-To:** sveta@cim.mcgill.ca  
**Delivered-To:** sveta@cim.mcgill.ca  
**Received:** from web60811.mail.yahoo.com (web60811.mail.yahoo.com  
[209.73.178.234])  
by avalanche.cim.mcgill.ca (Postfix) with SMTP id 1891F91196  
for <sveta@cim.mcgill.ca>; Fri, 6 Oct 2006 15:09:13 -0400 (EDT)  
**Received:** (qmail 92815 invoked by uid 60001); 6 Oct 2006 19:09:09 -0000  
**Message-ID:** <20061006190909.92813.qmail@web60811.mail.yahoo.com>  
**Received:** from [132.216.90.251] by web60811.mail.yahoo.com via HTTP; Fri, 06  
Oct 2006 12:09:09 PDT  
**Date:** Fri, 6 Oct 2006 12:09:09 -0700 (PDT)  
**From:** "Bobby" <bob@yahoo.com>  
**Subject:** Hello from Bob  
**To:** sveta@cim.mcgill.ca  
**MIME-Version:** 1.0  
**Content-Type:** multipart/alternative; boundary="0-1738738341-  
1160161749=91950"  
**Content-Transfer-Encoding:** 8bit

And here is the message!

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## Email security issues

- Email goes unsecured
- Can construct email so that it seems to have come from someone else (one can still recognize this by looking at the IP address of the sender, but this is not always easy)
- By making an appropriate MIME header, can make email look like it came from anyone

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