Internet Technologies
1- Introduction

F. Ricci
2010/2011
Contact Details

- Francesco Ricci
  - Room 204 (POS)
  - fricci@unibz.it

- Availability Hours:
  - Thursday 16:00 – 18:00
  - by prior arrangement via e-mail

- Course web site
  - http://www.inf.unibz.it/~ricci/IT/
Course Structure

- **Lectures**: 24 hours
- **Labs**: 12 hours

**Timetable:**
- Lectures: Thursday 10:30 – 12:30, Room C4.01
- Labs:
  - Dario Cavada: Thu 15:00 - 16:00 Room E531
  - Mehdi Elahi: Thu 15:00 - 16:00 Room E431
- Today (Feb 24th) all students in room E531

**Assessment:**
- final exam, written, 50% of the grade
- project (1 student per project !) 50%.
Motivations

- **Internet** and **World Wide Web** is modifying in a radical way how individuals and organizations interacts, for **business**, **learning** or **leisure**.

- Millions of people around the world have access to an **extraordinary amount of information**, they can **search** it, exchange **email**, make **phone calls**, **buy and sell** goods and services.

- All of this **is changing and will keep changing the world we live**.
Goals

- Introduction - both *methodological* and *practical* - to the *most basic* Internet:
  - Languages
  - Protocols
  - Standards
  - Application Architectures
  - Tools
- But also illustrate some of the most challenging and *innovative techniques* on the fore
- Self contained introduction to motivate further study and provide *prerequisite material* for more advanced courses on internet and www ("Advanced Internet Technologies" and "Internet and Mobile Services").
What you should learn

- A catalogues of **languages (API) and protocols**
- The **basic elements required for building a dynamic, database supported, web application**
- To reason about the **benefits** of a language or protocol
- The capability to **decide** when (in which context, where in your application) a technique can be **useful** or not recommendable
- **How many things you have seen does actually work?**
Course Format

- **12 Lectures** on various topics in Internet Technologies
- **12 Labs** where we shall
  - Run yourself the examples (software) shown during the lectures
  - Solve some new exercises
  - Build your own example applications
  - Work on your final exam project

- **Books**
Syllabus

- Architecture of the web
- Networking fundamentals
- HTML and HTTP
- Dynamic web sites:
  - Client Side: Java Script
  - Server Side: CGI, Perl, Java Servlets and Server Pages
- Web application model
- Java servlets: generating dynamic content, session management, connecting to a data repository
- Java server pages
- XML
- Web 2.0
Challenges

- Internet technologies are evolving very fast.
- To build a Web-based application you should have a very wide knowledge of many software and communication technologies.
- There are dozens of competing approaches for building web applications.
- You must learn the most updated information from Internet.
- We cannot cover all possible approaches and languages in this course.
- BUT you have a lot of space to build something innovative and useful!
What we shall **not** cover

- Ajax-enabled rich Internet applications
- Adobe Flash
- Adobe Dreamweaver
- PHP
- Ruby on Rails
- ASP.NET
- C#
- JavaServer Faces
- Java FX
- Objective C
- Web services
- Google Web Toolkit
- ...

Project

- The project is conducted **individually**
- The objective is to develop **your dynamic, database supported**, web site:
  - Choose an **application domain**: music, trekking, soccer, photography, etc.
  - Manage **items** (music tracks, trekking paths, soccer matches, cameras, ...) and users of the application
  - Identify the functionality (extending the base functionality describe later)
  - Enable **users** to access items (search, select, comment) and provide new items
- All the techniques illustrated in the lectures must be properly applied (**not a simple, static HTML-based web site**)
- The project results are a **running system** and a written **report**.
Structure of the Project

- The **application** must run on the application server that we shall indicate in the labs.
- The **report** must describe clearly in min **2000**, max **3000** words (plus images):
  - The **functions** of the web application and their **motivation**
  - The **architecture** of the application (modules and their roles) – use figures
  - Main **classes** and main **methods**
  - Major **technical problems** found during the work
- The project will be **evaluated** according to: coverage and complexity of the implemented functions, user interface usability and completeness, organization of the code, **coverage of the required technologies**.
What a student must do to pass

- **Read** the book chapters or articles that will be suggested for each lecture
- The slides should be enough **only for a general understanding of the topic**
- If something is not clear during a lecture you must take a note and **rise a question** (especially in the labs)
- Develop and test the web application - if there are bugs and it will not run on both Firefox and IE you will not pass
- Upload the project and send me the report on time.
Exam

- The final grade is obtained evaluating the project result and the knowledge acquired about the lectures’ topics in an written exam.

- **Written exam:** questions on the topic illustrated – you find on the web site the previous ones.

- The final written report must be sent to me ten days before the written exam (*exact timing will be provided*).

- **You cannot attend the written exam if you have not passed the project part.**

- You will have two grades: P (project), max 15 points, and W (written exam), max 15 points.

- The final grade is $F = P + W$.

- Both $P$ and $W$ must be greater or equal to 9.
1 – Internet and other Networks
Content

- What is Internet and the World Wide Web
- Internet usage and statistics
- Introduction to computer networks
- Distributed systems
- Client-Server Architecture
- Usage of computer networks
- LAN, MAN and WAN
- Internetworks
- ARPANET
- NSFNET
- Internet Architecture
What is the Internet?

- WWW
- Video conferencing
- ftp
- telnet
- Email
- Instant messaging
- ...

A communication infrastructure
Usefulness is in exchanging information
### Internet Usage and Population Statistics

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>1,013,779,050</td>
<td>4,514,400</td>
<td>110,931,700</td>
<td>10.9 %</td>
<td>2,357.3 %</td>
<td>5.6 %</td>
</tr>
<tr>
<td>Asia</td>
<td>3,834,792,852</td>
<td>114,304,000</td>
<td>825,094,396</td>
<td>21.5 %</td>
<td>621.8 %</td>
<td>42.0 %</td>
</tr>
<tr>
<td>Europe</td>
<td>813,319,511</td>
<td>105,096,093</td>
<td>475,069,448</td>
<td>58.4 %</td>
<td>352.0 %</td>
<td>24.2 %</td>
</tr>
<tr>
<td>Middle East</td>
<td>212,336,924</td>
<td>3,284,800</td>
<td>63,240,946</td>
<td>29.8 %</td>
<td>1,825.3 %</td>
<td>3.2 %</td>
</tr>
<tr>
<td>North America</td>
<td>344,124,450</td>
<td>108,096,800</td>
<td>266,224,500</td>
<td>77.4 %</td>
<td>146.3 %</td>
<td>13.5 %</td>
</tr>
<tr>
<td>Latin America/Caribbean</td>
<td>592,556,972</td>
<td>18,068,919</td>
<td>204,689,836</td>
<td>34.5 %</td>
<td>1,032.8 %</td>
<td>10.4 %</td>
</tr>
<tr>
<td>Oceania / Australia</td>
<td>34,700,201</td>
<td>7,620,480</td>
<td>21,263,990</td>
<td>61.3 %</td>
<td>179.0 %</td>
<td>1.1 %</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>6,845,609,960</td>
<td>360,985,492</td>
<td>1,966,514,816</td>
<td>28.7 %</td>
<td>444.8 %</td>
<td>100.0 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>8,214,160</td>
<td>6,143,600</td>
<td>74.8 %</td>
<td>192.6 %</td>
<td>1.3 %</td>
</tr>
<tr>
<td>Belgium</td>
<td>10,423,493</td>
<td>8,113,200</td>
<td>77.8 %</td>
<td>305.7 %</td>
<td>1.7 %</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>7,148,785</td>
<td>3,395,000</td>
<td>47.5 %</td>
<td>689.5 %</td>
<td>0.7 %</td>
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<tr>
<td>Cyprus</td>
<td>1,102,677</td>
<td>433,800</td>
<td>39.3 %</td>
<td>261.5 %</td>
<td>0.1 %</td>
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<tr>
<td>Czech Republic</td>
<td>10,201,707</td>
<td>6,680,800</td>
<td>65.5 %</td>
<td>568.1 %</td>
<td>1.4 %</td>
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<tr>
<td>Denmark</td>
<td>5,515,575</td>
<td>4,750,500</td>
<td>86.1 %</td>
<td>143.6 %</td>
<td>1.0 %</td>
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<tr>
<td>Estonia</td>
<td>1,291,170</td>
<td>969,700</td>
<td>75.1 %</td>
<td>164.5 %</td>
<td>0.2 %</td>
</tr>
<tr>
<td>Finland</td>
<td>5,255,695</td>
<td>4,480,900</td>
<td>85.3 %</td>
<td>132.5 %</td>
<td>0.9 %</td>
</tr>
<tr>
<td>France</td>
<td>64,768,389</td>
<td>44,625,300</td>
<td>68.9 %</td>
<td>425.0 %</td>
<td>9.4 %</td>
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<tr>
<td>Germany</td>
<td>62,282,986</td>
<td>65,123,800</td>
<td>79.1 %</td>
<td>171.3 %</td>
<td>13.7 %</td>
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<tr>
<td>Greece</td>
<td>10,749,943</td>
<td>4,970,700</td>
<td>46.2 %</td>
<td>397.1 %</td>
<td>1.0 %</td>
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<tr>
<td>Hungary</td>
<td>9,992,339</td>
<td>6,176,400</td>
<td>61.8 %</td>
<td>763.8 %</td>
<td>1.3 %</td>
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<td>Ireland</td>
<td>4,622,917</td>
<td>3,042,600</td>
<td>65.8 %</td>
<td>286.1 %</td>
<td>0.5 %</td>
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<tr>
<td>Italy</td>
<td>58,090,681</td>
<td>30,026,400</td>
<td>51.7 %</td>
<td>127.5 %</td>
<td>6.3 %</td>
</tr>
<tr>
<td>Latvia</td>
<td>2,217,969</td>
<td>1,503,400</td>
<td>67.8 %</td>
<td>902.3 %</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Lithuania</td>
<td>3,546,319</td>
<td>2,103,471</td>
<td>59.3 %</td>
<td>834.9 %</td>
<td>0.4 %</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>497,538</td>
<td>424,500</td>
<td>85.3 %</td>
<td>324.5 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Malta</td>
<td>406,771</td>
<td>240,600</td>
<td>59.1 %</td>
<td>501.5 %</td>
<td>0.1 %</td>
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<tr>
<td>Netherlands</td>
<td>16,783,092</td>
<td>14,872,200</td>
<td>88.6 %</td>
<td>281.3 %</td>
<td>3.1 %</td>
</tr>
<tr>
<td>Poland</td>
<td>38,463,689</td>
<td>22,450,600</td>
<td>58.4 %</td>
<td>701.8 %</td>
<td>4.7 %</td>
</tr>
<tr>
<td>Portugal</td>
<td>10,735,765</td>
<td>5,168,800</td>
<td>48.1 %</td>
<td>106.8 %</td>
<td>1.1 %</td>
</tr>
<tr>
<td>Romania</td>
<td>21,859,278</td>
<td>7,786,700</td>
<td>35.5 %</td>
<td>873.3 %</td>
<td>1.5 %</td>
</tr>
<tr>
<td>Slovakia</td>
<td>5,470,306</td>
<td>4,063,600</td>
<td>74.3 %</td>
<td>525.2 %</td>
<td>0.9 %</td>
</tr>
<tr>
<td>Slovenia</td>
<td>2,005,692</td>
<td>2,003,136</td>
<td>64.8 %</td>
<td>332.8 %</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Spain</td>
<td>46,505,963</td>
<td>29,093,984</td>
<td>62.6 %</td>
<td>440.0 %</td>
<td>6.1 %</td>
</tr>
<tr>
<td>Sweden</td>
<td>9,074,055</td>
<td>8,397,900</td>
<td>92.5 %</td>
<td>107.5 %</td>
<td>1.8 %</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>62,348,447</td>
<td>51,442,100</td>
<td>82.5 %</td>
<td>234.0 %</td>
<td>10.8 %</td>
</tr>
<tr>
<td>European Union</td>
<td>499,671,847</td>
<td>337,779,055</td>
<td>67.6 %</td>
<td>257.8 %</td>
<td>100.0 %</td>
</tr>
</tbody>
</table>
Web access by OS and Browser

http://marketshare.hitslink.com
## Generation Y, X and Baby Boomers

<table>
<thead>
<tr>
<th>Generation Name*</th>
<th>Birth Years, Ages in 2009</th>
<th>% of total adult population</th>
<th>% of internet-using population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen Y (Millenials)</td>
<td>Born 1977-1990, Ages 18-32</td>
<td>26%</td>
<td>30%</td>
</tr>
<tr>
<td>Gen X</td>
<td>Born 1965-1976, Ages 33-44</td>
<td>20%</td>
<td>23%</td>
</tr>
<tr>
<td>Younger Boomers</td>
<td>Born 1955-1964, Ages 45-54</td>
<td>20%</td>
<td>22%</td>
</tr>
<tr>
<td>Older Boomers</td>
<td>Born 1946-1954, Ages 55-63</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>Silent Generation</td>
<td>Born 1937-1945, Ages 64-72</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>G.I. Generation</td>
<td>Born -1936, Age 73+</td>
<td>9%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Pew Internet & American Life Project December 2008 survey. N=2,253 total adults, and margin of error is ±2%. N=1,650 total internet users, and margin of error is ±3%.

## Teens and Gen Y dominant activities

### Generational Differences in Online Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Online Teens (12-17)</th>
<th>Gen Y (18-32)</th>
<th>Gen X (33-44)</th>
<th>Younger Boomers (45-54)</th>
<th>Older Boomers (55-63)</th>
<th>Silent Generation (64-72)</th>
<th>G.I. Generation (73+)</th>
<th>All Online Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go online</td>
<td>93%</td>
<td>87%</td>
<td>82%</td>
<td>79%</td>
<td>70%</td>
<td>56%</td>
<td>31%</td>
<td>74%</td>
</tr>
<tr>
<td>Play games online</td>
<td>78%</td>
<td>50%</td>
<td>38%</td>
<td>26%</td>
<td>28%</td>
<td>25%</td>
<td>18%</td>
<td>35%</td>
</tr>
<tr>
<td>Watch videos online</td>
<td>57%</td>
<td>72%</td>
<td>57%</td>
<td>49%</td>
<td>30%</td>
<td>24%</td>
<td>14%</td>
<td>52%</td>
</tr>
<tr>
<td>Get info about a job</td>
<td>30%</td>
<td>64%</td>
<td>55%</td>
<td>43%</td>
<td>36%</td>
<td>11%</td>
<td>10%</td>
<td>47%</td>
</tr>
<tr>
<td>Send instant messages</td>
<td>68%</td>
<td>59%</td>
<td>38%</td>
<td>28%</td>
<td>23%</td>
<td>25%</td>
<td>18%</td>
<td>38%</td>
</tr>
<tr>
<td>Use social networking sites</td>
<td>65%</td>
<td>67%</td>
<td>36%</td>
<td>20%</td>
<td>9%</td>
<td>11%</td>
<td>4%</td>
<td>35%</td>
</tr>
<tr>
<td>Download music</td>
<td>59%</td>
<td>58%</td>
<td>46%</td>
<td>22%</td>
<td>21%</td>
<td>16%</td>
<td>5%</td>
<td>37%</td>
</tr>
<tr>
<td>Create an SNS profile</td>
<td>55%</td>
<td>60%</td>
<td>29%</td>
<td>16%</td>
<td>9%</td>
<td>5%</td>
<td>4%</td>
<td>29%</td>
</tr>
<tr>
<td>Read blogs</td>
<td>49%</td>
<td>43%</td>
<td>34%</td>
<td>27%</td>
<td>25%</td>
<td>23%</td>
<td>15%</td>
<td>32%</td>
</tr>
<tr>
<td>Create a blog</td>
<td>28%</td>
<td>20%</td>
<td>10%</td>
<td>6%</td>
<td>7%</td>
<td>6%</td>
<td>6%</td>
<td>11%</td>
</tr>
<tr>
<td>Visit a virtual world</td>
<td>10%</td>
<td>2%</td>
<td>3%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>
## Dominant activities for Gen X and older

<table>
<thead>
<tr>
<th>Activities where Gen X users or older generations dominate:</th>
<th>Online Teens</th>
<th>Gen Y (18-22)</th>
<th>Gen X (33-44)</th>
<th>Younger Boomers (45-54)</th>
<th>Older Boomers (55-63)</th>
<th>Silent Generation (64-72)</th>
<th>G.I. Generation (73+)</th>
<th>All Online Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get health info</td>
<td>28</td>
<td>68</td>
<td><strong>82</strong></td>
<td>74</td>
<td>81</td>
<td>70</td>
<td>67</td>
<td>75</td>
</tr>
<tr>
<td>Buy something online</td>
<td>38</td>
<td>71</td>
<td><strong>80</strong></td>
<td>68</td>
<td>72</td>
<td>56</td>
<td>47</td>
<td>71</td>
</tr>
<tr>
<td>Bank online</td>
<td>*</td>
<td>57</td>
<td>65</td>
<td>53</td>
<td>49</td>
<td>45</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>Visit govt sites</td>
<td>*</td>
<td>55</td>
<td><strong>64</strong></td>
<td>62</td>
<td>63</td>
<td>60</td>
<td>31</td>
<td>59</td>
</tr>
<tr>
<td>Get religious info</td>
<td>26</td>
<td>31</td>
<td>38</td>
<td>42</td>
<td>30</td>
<td>30</td>
<td>26</td>
<td>35</td>
</tr>
</tbody>
</table>

### And for some activities, the youngest and oldest cohorts may differ, but there is less variation overall:

| Use email                                                  | 73           | 94            | 93            | 90                      | 90                    | 91                        | 79                  | 91               |
| Use search engines                                        | *            | 90            | 93            | 90                      | 89                    | 85                        | 70                  | 89               |
| Research products                                          | *            | 84            | 84            | 82                      | 79                    | 73                        | 60                  | 81               |
| Get news                                                   | 63           | 74            | 76            | 70                      | 69                    | 56                        | 37                  | 70               |
| Make travel reservations                                   | *            | 65            | 70            | 69                      | 66                    | 69                        | 65                  | 68               |
| Research for job                                           | *            | 51            | 59            | 57                      | 48                    | 33                        | 9                   | 51               |
| Rate a person or product                                   | *            | 37            | 35            | 29                      | 30                    | 25                        | 16                  | 32               |
| Download videos                                            | 31           | 38            | 31            | 21                      | 16                    | 13                        | 13                  | 27               |
| Participate in an online auction                           | *            | 26            | 31            | 27                      | 26                    | 16                        | 6                   | 26               |
| Download podcasts                                          | 19           | 25            | 21            | 19                      | 12                    | 10                        | 10                  | 19               |
Compare prices on millions of products, read reviews & find deals from over 100,000 stores.

Popular Categories...

Electronics
- Digital Cameras, TVs,
- Cell Phones, More...

Computers
- Laptops, Desktops, Software,
- PDAs, More...

Clothing & Accessories
- Women, Men, Shoes,
- Handbags, Lingerie

Jewelry & Watches
- Diamonds, Watches,
- Engagement Rings, More...

Home & Garden
- Kitchen, Bed & Bath,
- Furnishings, More...

Flowers & Gifts
- Roses, Gifts by Occasion,
- Gourmet Foods, More...

Featured Categories

Auctions

Automotive
# Online shopping activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>% of internet users who have ever done this</th>
<th>% of internet users who did this yesterday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research online a product they are thinking of buying</td>
<td>81%</td>
<td>20%</td>
</tr>
<tr>
<td>Purchase a product online such as books, music, or clothing</td>
<td>66</td>
<td>6</td>
</tr>
<tr>
<td>Bought or made travel reservations online</td>
<td>64</td>
<td>4</td>
</tr>
<tr>
<td>Participated in an online auction</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Paid to access or download digital content</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Bought or sold stocks online</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>


http://www.pewinternet.org/pdfs/PIP_Online%20Shopping.pdf
People Online in Tourism Market

http://www.newmediatrendwatch.com
Total Sites Across All Domains August 1995 - November 2007

Much of the growth in sites this year has come from the increasing number of blogging sites, in particular at Live Spaces, Blogger and MySpace.

An active web site every 18 users!

http://news.netcraft.com
# Top Global Web Properties

**What are the top three Web properties?**

with respect to the number of visitors

<table>
<thead>
<tr>
<th>Property</th>
<th>Total Unique Visitors (000)</th>
<th>% Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Sites</td>
<td>643,809</td>
<td>75.5</td>
</tr>
<tr>
<td>Microsoft Sites</td>
<td>572,016</td>
<td>67.1</td>
</tr>
<tr>
<td>Yahoo Sites</td>
<td>514,831</td>
<td>60.3</td>
</tr>
<tr>
<td>Wikipedia Sites</td>
<td>263,120</td>
<td>30.8</td>
</tr>
<tr>
<td>AOL LLC</td>
<td>252,394</td>
<td>29.6</td>
</tr>
<tr>
<td>eBay</td>
<td>247,791</td>
<td>29.0</td>
</tr>
<tr>
<td>Fox Interactive Media</td>
<td>168,301</td>
<td>19.8</td>
</tr>
<tr>
<td>Amazon Sites</td>
<td>159,281</td>
<td>18.7</td>
</tr>
<tr>
<td>Apple Inc.</td>
<td>140,380</td>
<td>16.5</td>
</tr>
<tr>
<td>CNET Networks</td>
<td>133,480</td>
<td>15.6</td>
</tr>
<tr>
<td>Ask Network</td>
<td>127,769</td>
<td>15.0</td>
</tr>
<tr>
<td>FACEBOOK.COM</td>
<td>123,851</td>
<td>14.5</td>
</tr>
<tr>
<td>Adobe Sites</td>
<td>107,361</td>
<td>12.6</td>
</tr>
<tr>
<td>Time Warner - Excluding AOL</td>
<td>98,000</td>
<td>11.5</td>
</tr>
<tr>
<td>Wordpress</td>
<td>96,394</td>
<td>11.3</td>
</tr>
<tr>
<td>Viacom Digital</td>
<td>86,546</td>
<td>10.1</td>
</tr>
<tr>
<td>Baidu.com Inc.</td>
<td>80,201</td>
<td>9.4</td>
</tr>
<tr>
<td>TENCENT Inc.</td>
<td>77,885</td>
<td>9.1</td>
</tr>
<tr>
<td>Glam Media</td>
<td>77,391</td>
<td>9.1</td>
</tr>
<tr>
<td>New York Times Digital</td>
<td>77,172</td>
<td>9.0</td>
</tr>
</tbody>
</table>

* Excludes traffic from public computers such as Internet cafes and access from mobile phones or PDAs.
Top Web Sites in Italy

1. google.it
   Versione italiana del popolare motore e directory. Utilizza inoltre... More

2. facebook.com
   A social utility that connects people, to keep up with friends, u... More

3. youtube.com
   YouTube is a way to get your videos to the people who matter to y... More

4. google.com
   Enables users to search the Web, Usenet, and images. Features inc... More

5. yahoo.com
   Personalized content and search options. Chatrooms, free e-mail, ... More

6. live.com
   Search engine from Microsoft.

7. libero.it

8. wikipedia.org
   An online collaborative encyclopedia.

9. blogger.com
   Free, automated weblog publishing tool that sends updates to a si... More

10. ebay.it
    Community di compravendita per effettuare transazioni online senza... More
Capture - Recapture

- **SE1** = reported size of search engine 1
- **Q** = set of queries
- **QSE1** and **QSE2** = pages returned for **Q** from two engines
- **OVR** = overlap of **QSE1** and **QSE2**

Estimate of **Web** size:
- **SE1/Web** = **OVR/QSE2**
- **Web** = \((QSE2 \times SE1) / OVR\)
Concentration in one day (Dec. 97)

Power-law: 
\[ y = Cx^{-a} \]
\[ \log(y) = \log(C) - a \log(x) \]
The simplest network?

The computers have their NIC (Network Interface Card) with a socket (RJ-45 jack) and a wire (crossover cable) that goes from one computer to another.
Computer Networks

- A **computer network** is two or more computers connected together using a telecommunication system for the purpose of communicating and sharing resources.

- Why they are interesting?
  - Overcome geographic limits
  - Access remote data
  - Separate clients and server

- Goal: Universal Communication (any to any)
Distributed Systems

- Internet is not a "computer network" – it is a network of networks
- The World Wide Web is a distributed system that runs on top of the Internet
- A distributed system is a collection of independent computers that appears to its users as a single coherent system
  - Example: in the WWW everything looks like a document (Web page)
- The distinction between CN and DS lies on the software not on the hardware.
Client-Server Model

- A network with two clients and one server
- **Server:** store data on some powerful computer
- **Client:** access data on server and process locally on a simpler machine
Client-Server Model (2)

- The client-server model involves requests and replies

- Examples
  - e-mail
  - Video conferencing
  - File downloading
  - Instant messaging
  - Chatting
Network Applications

- Some forms of e-commerce

<table>
<thead>
<tr>
<th>Tag</th>
<th>Full name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2C</td>
<td>Business-to-consumer</td>
<td>Ordering books on-line</td>
</tr>
<tr>
<td>B2B</td>
<td>Business-to-business</td>
<td>Car manufacturer ordering tires from supplier</td>
</tr>
<tr>
<td>G2C</td>
<td>Government-to-consumer</td>
<td>Government distributing tax forms electronically</td>
</tr>
<tr>
<td>C2C</td>
<td>Consumer-to-consumer</td>
<td>Auctioning second-hand products on-line</td>
</tr>
<tr>
<td>P2P</td>
<td>Peer-to-peer</td>
<td>File sharing</td>
</tr>
</tbody>
</table>

B2B and B2C
Peer-to-Peer Systems

- In peer-to-peer system there are no fixed clients and servers

- Examples?
  - Skype, Kazaa, eMule, exchanging business cards with bluetooth, ...
Transmission Technologies

- **Broadcast links**
  - A *single* communication channel is shared by all the machines on the network
  - Packets sent by a machine to another brings the address of the recipient
  - Avoid collision in sharing the medium (channel)

- **Point-to-point links**
  - Many connections between *individual pairs* of machines
  - A packet is *routed* from one machine to another
**Networks scale**

- Classification of interconnected processors by scale.

<table>
<thead>
<tr>
<th>Interprocessor distance</th>
<th>Processors located in same</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m</td>
<td>Square meter</td>
<td>Personal area network</td>
</tr>
<tr>
<td>10 m</td>
<td>Room</td>
<td>Local area network</td>
</tr>
<tr>
<td>100 m</td>
<td>Building</td>
<td>Metropolitan area network</td>
</tr>
<tr>
<td>1 km</td>
<td>Campus</td>
<td>Wide area network</td>
</tr>
<tr>
<td>10 km</td>
<td>City</td>
<td>The Internet</td>
</tr>
<tr>
<td>100 km</td>
<td>Country</td>
<td></td>
</tr>
<tr>
<td>1000 km</td>
<td>Continent</td>
<td></td>
</tr>
<tr>
<td>10,000 km</td>
<td>Planet</td>
<td></td>
</tr>
</tbody>
</table>
Type of Networks

- **PAN:** A **personal area network** is a computer network (CN) used for communication among computer devices (including telephones and personal digital assistants) close to one person.
  - **Technologies:** USB and Firewire (wired), IrDA and Bluetooth (wireless)

- **LAN:** A **local area network** is a CN covering a small geographic area, like a home, office, or group of buildings.
  - **Technologies:** Ethernet (wired) or Wi-Fi (wireless)

- **MAN:** **Metropolitan Area Networks** are large CNs usually spanning a city.
  - **Technologies:** Ethernet (wired) or WiMAX (wireless)

- **WAN:** **Wide Area Network** is a CN that covers a broad area, e.g., cross metropolitan, regional, or national boundaries.
  - **Examples:** Internet
  - **Wireless Technologies:** HSDPA, EDGE, GPRS, GSM.
Local Area Networks

- Two broadcast networks: (a) Bus, (b) Ring
- LAN can use cables (Ethernet protocol) or electromagnetic waves (Wi-Fi) to transmit information
Wireless Networks

- (a) Bluetooth configuration
- (b) Wireless LAN

---

(a)

(b)

Base station

To wired network
Metropolitan Area Networks

- A metropolitan area network based on cable TV
Wide Area Networks

- **Host** are owned by users
- **Subnet** is owned by the telephone company or an Internet service provider
- A subnet is composed by *transmission lines* connecting two *switching* elements (*router*) – not the hosts.
Wide Area Networks (2)

- A stream of packets from sender to receiver
- A routers **store-and-forward** each packet
- The decision of where to send a packet is taken according to a **routing algorithm**
Internetworks and Internet

- Many networks exist in the world.
- In order to establish a communication between "different" networks (hardware and software), there are gateways.
- A collection of interconnected networks is called internetworks or internet.
- The Internet, with a capital "I", is the network of networks which either use the TCP/IP protocol or can interact with TCP/IP networks via gateways (the interpreters).
- The Internet presents these networks as one, seamless network for its users.
- Internet is a particular internetwork.
ARPANET

- 1950 Department of Defence wanted a command-and-control network that could survive nuclear war
- At that time, there was only the telephone network

(a) Structure of the telephone system – vulnerable!
(b) Baran’s proposed distributed switching system.
The original ARPANET

- IMP (Interface Message Processors) are minicomputers connected by 56-Kbps transmission lines (*the grandfathers of the routers*)
- Each IMP is ***connected*** with (at least) 2 IMPs (*why? is this enough?*)
- A host is connected to a IMP – it sends to it a message that is split into packets (1008 bits) forwarded independently to destination.
The Growth of ARPANET

NSFNET

- The NSFNET backbone in 1988
- The computers (fuzzball) where connected with TCP/IP (56 Kbps lines)
- Then to 448Kbps, then 1.5-Mbps, then 45-Mbps (ANSNET – then sold to America Online)
- Connected to ARPANET through a link between an IMP and a fuzzball in the Carnegie Mellon computer room.
History of the Internet

- 1969 - **RFCs** begun by S. Crocker (http://rfc.sunsite.dk/)
- 1972 – First **email** by Ray Tomlinson & Larry Roberts
- 1970’s - TCP by Vint Cerf & Bob Kahn
  - Evolved into TCP/IP, and UDP
- 1980s – Hardware Explosion (LANs, PCs, and workstations)
  - 1983 – Ethernet by Metcalfe
- DNS – Distributed and scalable mechanism for resolving host names into IP addresses
- UC Berkeley implements TCP/IP into Unix BSD
- 1985 – Internet used by researchers and developers.
- 1993 – the first Web Browser (**NCSA Mosaic**)
History of the Internet

- Tim Berners-Lee at CERN in 1989
  - Proposal for WWW in 1990
  - First web page on November 13, 1990
- Hypertext - Text that contains links to other text.
  - Ted Nelson’s Xanadu
  - Vannevar Bush’s Memex
    (http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm)
- W3C

Get more info at: http://www.isoc.org/internet/history/
Bush 1945 – As We May Think

The memex is a desktop machine, consisting of:

1) A user interface
2) A repository of documents
3) A search engine
4) A linking mechanism
5) Memex II can learn from its experience.
Architecture of the Internet

- Internet Service Provider
- Regional ISP
- Backbone
- Network Access Point
- POP (Point of Presence)
- Telephone system
- Corporate LAN
- Router
- Server farm
- Client
Important Terms

- **POP (Point of Presence):** an access point to the Internet. It is a physical location that houses servers, routers, ATM switches and digital/analog call aggregators.

- **ISP (Internet Service Provider):** a business or organization that provides consumers or businesses access to the Internet and related services.

- **Backbone:** a large collection of interconnected commercial, government, academic and other high-capacity data routes and core routers that carry data across the countries, continents and oceans of the world.

- **NAP (Network Access Point):** a network access point where a packet switches from one backbone to another.
IP Addresses Network

A line represents a connection between 2 IP addresses. The length represents the time delay between the 2 nodes.

How to Make the Internet a Lot Faster

- Feb. 2010 - Google announced its plans to build an experimental fiber network that would offer **gigabit-per-second** broadband speeds to U.S. homes

- This will make possible: transfer of very large files, streaming high-definition (and possibly 3-D) video, video conferencing, and gaming

- **BUT** the transmission control protocol (TCP), the 20-year-old algorithm that governs most of the traffic flow over the Internet, doesn't work well at gigabit-per-second speeds

- How it make sure it isn't losing data cause it to use too little of the bandwidth available? (Steven Low, Caltech).

http://www.technologyreview.com/web/24605/