Internet and Standards in the 21st Century

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Internet Evangelist at Work
Internet - Global Statistics

22.5 Million Hosts
(Bellcore June 1997)

50 Million Users
(NUA Jul 1997)

542 Million Hosts
(www.isc.org, Jan 2008)

1,320 Million Users
(InternetWorldStats.com, December 2007)

(approx. 4.1 Billion Telephone Terminations including 3.0 B mobiles and >1 Billion PCs [Comp. Industries Assoc.])
# World Internet Usage and Population Statistics

<table>
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</thead>
<tbody>
<tr>
<td><strong>Africa</strong></td>
<td>941,249,130</td>
<td>14.2 %</td>
<td>44,361,940</td>
<td>4.7 %</td>
<td>3.4 %</td>
<td>882.7 %</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td>3,733,783,474</td>
<td>56.5 %</td>
<td>510,478,743</td>
<td>13.7 %</td>
<td>38.7 %</td>
<td>346.6 %</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td>801,821,187</td>
<td>12.1 %</td>
<td>348,125,847</td>
<td>43.4 %</td>
<td>26.4 %</td>
<td>231.2 %</td>
</tr>
<tr>
<td><strong>Middle East</strong></td>
<td>192,755,045</td>
<td>2.9 %</td>
<td>33,510,500</td>
<td>17.4 %</td>
<td>2.5 %</td>
<td>920.2 %</td>
</tr>
<tr>
<td><strong>North America</strong></td>
<td>334,659,631</td>
<td>5.1 %</td>
<td>238,015,529</td>
<td>71.1 %</td>
<td>18.0 %</td>
<td>120.2 %</td>
</tr>
<tr>
<td><strong>Latin America/Caribbean</strong></td>
<td>569,133,474</td>
<td>8.6 %</td>
<td>126,203,714</td>
<td>22.2 %</td>
<td>9.6 %</td>
<td>598.5 %</td>
</tr>
<tr>
<td><strong>Oceania / Australia</strong></td>
<td>33,569,718</td>
<td>0.5 %</td>
<td>19,175,836</td>
<td>57.1 %</td>
<td>1.5 %</td>
<td>151.6 %</td>
</tr>
<tr>
<td><strong>WORLD TOTAL</strong></td>
<td>6,606,971,659</td>
<td>100.0 %</td>
<td>1,319,872,109</td>
<td>20.0 %</td>
<td>100.0 %</td>
<td>265.6 %</td>
</tr>
</tbody>
</table>

[Internetworldstats.com (Dec 2007)](http://internetworldstats.com)
Internet Users in the World
December 2007

Note: Total World Internet Users estimate is 1,319,872,109 for year-end 2007
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World Internet Penetration Rates
December 2007

- North America: 71.1%
- Oceania / Australia: 57.1%
- Europe: 43.4%
- Latin America / Caribbean: 22.2%
- World, Average: 20.0%
- Middle East: 17.4%
- Asia: 13.7%
- Africa: 4.7%

Source: www.internetworldstats.com
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Internet Users in the World
Growth Between 2000 and 2007

- Middle East: 920.2%
- Africa: 882.7%
- Latin America / Caribbean: 598.5%
- Asia: 346.6%
- World Growth Avg.: 265.6%
- Europe: 231.2%
- Oceania / Australia: 151.6%
- North America: 120.2%

Note: Total World Internet Users estimate is 1,319,872,109 for year-end 2007.
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The Original ARPANET
Dec 1969
First Three-Network Test of Internet

November 22, 1977
Technology Shapers

- Internet uses any communication service (IP on everything!)
- IP carries anything digital
- End/End Principle (neutrality and user freedom)
- Radio supplies mobility
- Fiber/Cable/DSL supplies speed
- Broadband (choice, symmetry)
- IPv6 supplies address space
  - (IPv4 runout in 2011)
IPv4 runout diagram (Geoff Huston)

<table>
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<th>Internet Research Problems</th>
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<td>Security at all levels</td>
<td>Mobility, persistence</td>
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<td>Internet “Erlang” formulas</td>
<td>(processes, connections,</td>
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<td></td>
<td>references)</td>
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<td>QOS debates (smart routers?)</td>
<td>Multihoming</td>
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<td>Internationalized Domain Names (ccTLDs &amp; GTLDs)</td>
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<td>Distributed Algorithms</td>
<td>Broadcast utilization</td>
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<td>Presence (multi-level)</td>
<td>Mesh and Sensor networks</td>
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<td>Virtualization (net, storage, processing)</td>
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Internet Research Problems - 2

Authentication, Identity, Authorization

Multi-core Processor Algorithms

Delay and Disruption Tolerance

Integration of Applications (e.g. drag/drop gadgets in calendar)

Intellectual Property Protection (tracking rights, enforcement)

Role of Layering

Governance

- Law Enforcement

- Policy Development

- Homologation

- Facilitation of electronic commerce

- Privacy and confidentiality
Mobile operation

Dynamic joining (new IP address?, Authentication?)

Dynamic Routing (Dynamic Topology)

Persistent connection (ID at TCP/UDP/RTP layer?)

Interplanetary Long-Haul Architecture (RFC 4838)

  Licklider Transport Protocol (LTP)

  Bundle Protocol (RFC 5050)

  Delayed Binding of Identifiers

  Email-like behavior
Socio-Economic Effects of Internet

• Information Consumers are becoming Producers
  – Blogging, YouTube/Google Video, Personal Web Pages

• Innovation at the edge (e.g. wikipedia)

• Social Networking (Linked in, My Space, Facebook, Orkut…)

• Gameplaying (Second Life, World of Warcraft…)

• New Business Models
  – eBay, Amazon, Dell, Google, Yahoo!, MSN, AOL, iTunes, VOIP…

• Internet can transport and display print, video, audio media

• Internet permits group interaction (not only mass one-way medium)
Critical Role of Standards

• Standards confer interoperability (pick one way to do a particular thing, not two!)

• Standards spur competition (user choice of suppliers)

• Standards spur innovation (standards create common platforms on top of which new inventions can operate. TCP/IP led to HTTP (WWW) and to Java-based applications, cloud computing, etc.)

• Standards enable global communication, information exchange and preservation of information for future generations.

• Standards foster global economic growth
Traffic by type on the Internet
(Source: Sandvine)

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.
• Streaming and Downloading
  – iPod and vPOD behaviors?
• Mixing of all media as IP packets
• Ancillary information access
  – Downloaded texts, programs, videos, audio, captions
  – Advertising material
• Screen Control (icons, widgets)
• Multiple streams to multiple displays (beauty of packet switching)
• Online interaction while viewing
  – Group commentary
  – Advertising and product information
• 3 Billion Mobiles and counting
• Text/Web Access
• Payment systems
• Innovative interfaces (challenges!)
• Navigation systems
  – GPS, Galileo, Google Earth/Maps,…
• Geo-location based services
• Access to Web searching
Internet-enabled Devices
Internet-enabled Devices

Programmable – Java, Python, etc.

Examples:

• WebTV, Personal Digital Assistants, Mobiles, Video games, Picture Frames, Washing Machines, Surf Board!

• Refrigerator (and the bathroom scales)

• Automobiles (Japan, Germany)

• Internet-enabled wine corks (also note new quantum theory of wine: Schrödinger’s wine bottle)

• Internet-enabled socks (clothing)

• Universal Remote Controls
Coming Internet Standards Milestones

• Introduction of Internationalized Top Level Domains
  – See idn.icann.org for current testing
• Introduction of new generic TLDs in 2008
• Introduction of IPv6 (root zone, elsewhere)
• Introduction of DNSSEC (.se, .bg, .br, .pr, …)
Challenges of the Digital Age

• Intellectual property treatment
  – Digital material is easy to copy and distribute

• Semantic Web

• Complex objects that can only be rendered via computer
  – 3D interactive objects
  – Complex spreadsheets
  – Interactive environments

• BIT ROT!
  – Preserving interpretive programs (Windows 3000 and PPT 1997)
  – And the operating systems that run them
  – And the hardware that run the operating systems
  – For thousands of years!!