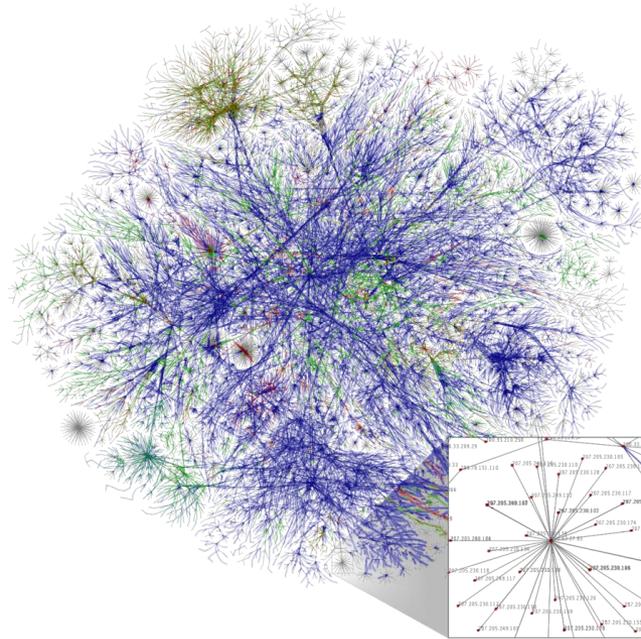


What is the Internet



Acknowledgment and Disclaimer: This presentation is supported in part by the National Science Foundation under Grant 1240841. Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The Internet, a Big Idea

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 - What aspects of the Internet's design and development have enabled it to grow so large and be so influential?

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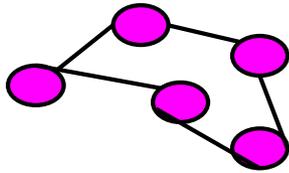
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 - How does cybersecurity affect what we do on the Internet?

Computer Networks

- An *computer network* is a group of two or more computers that are linked together.

Computer Networks

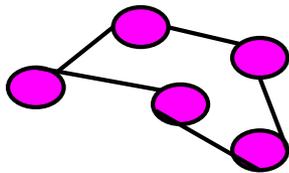
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Token Ring Protocol

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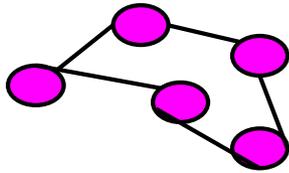
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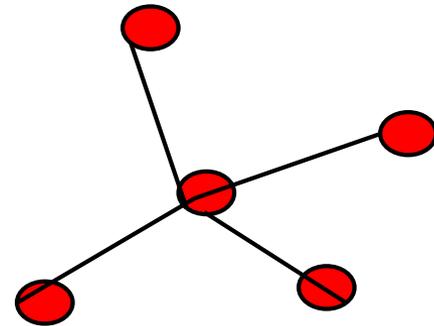
Ethernet Protocol

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Token Ring Protocol



Wifi Protocol



Ethernet Protocol

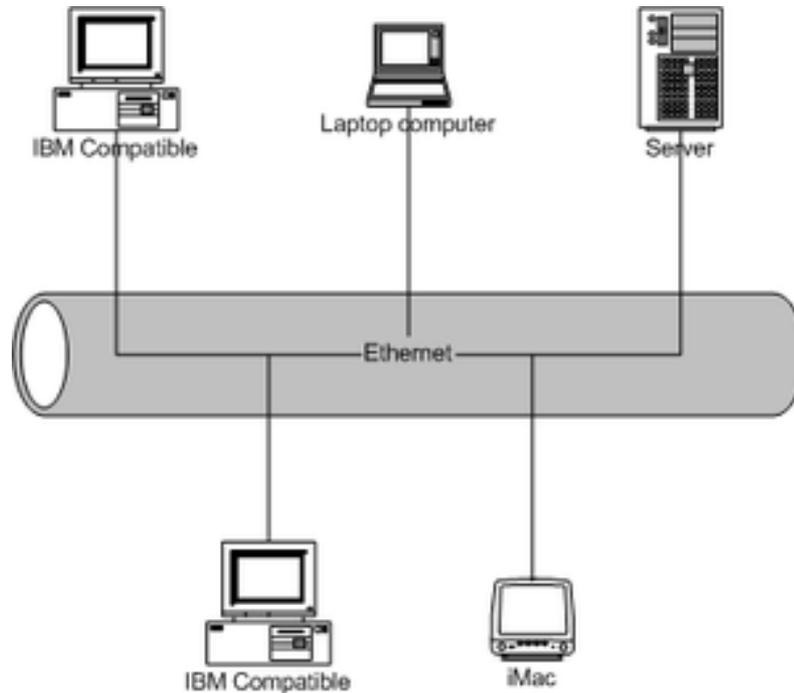
Local Area Network (LAN)

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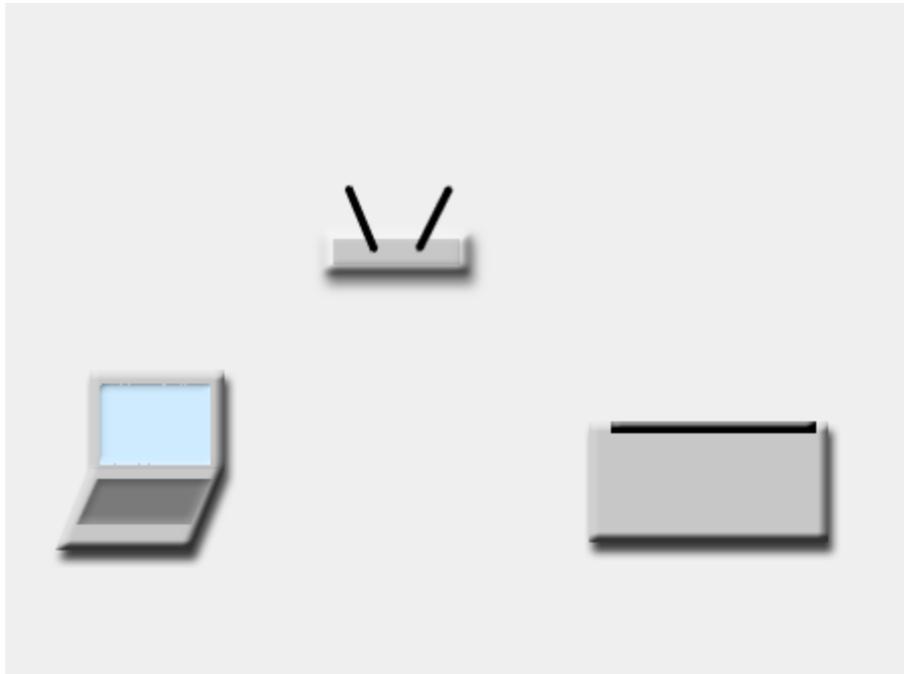
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- Example: An *ethernet* network uses wires () to connect computers.



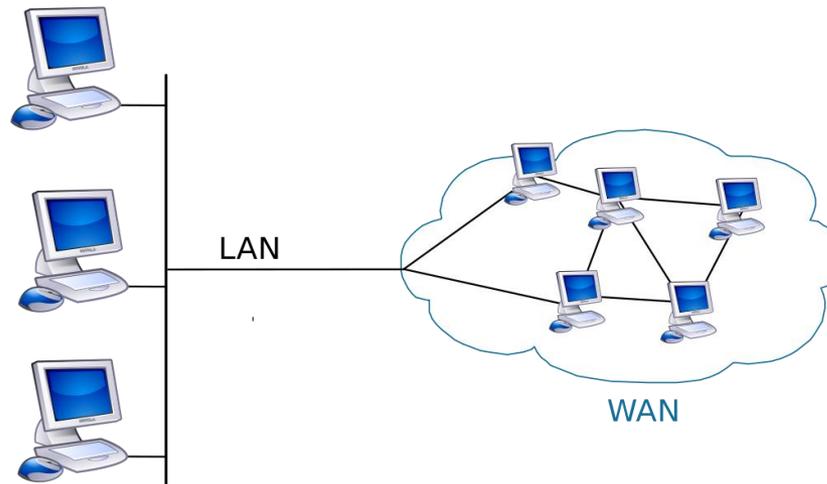
Wifi: A Wireless LAN

- Example: A *Wifi* network uses radio waves () to connect devices (computers, smart phones, printers).



Wide Area Network (WAN)

- Example: A *wide area network (WAN)* connects devices over a broad geographic region.
- An example might be a telephone network.



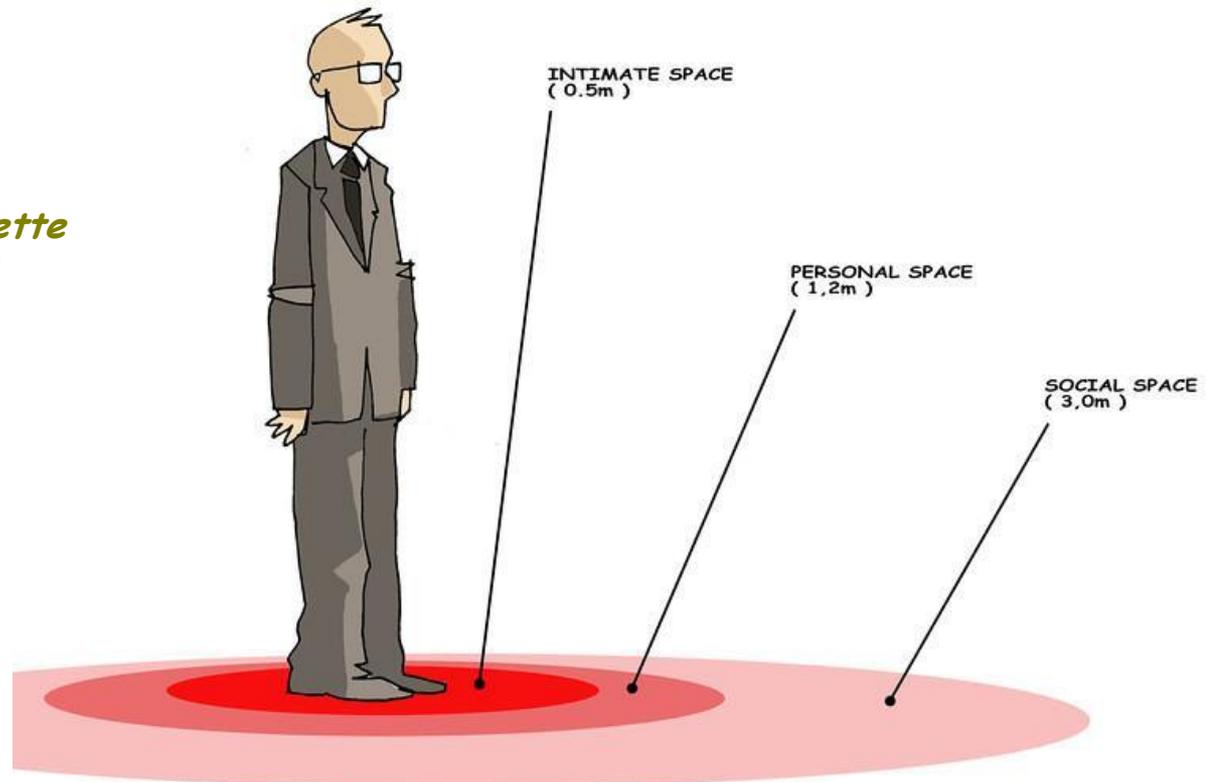
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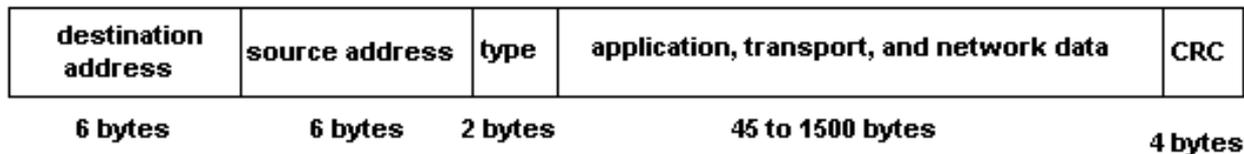
Diplomatic protocol or *etiquette* governs how diplomats should behave.



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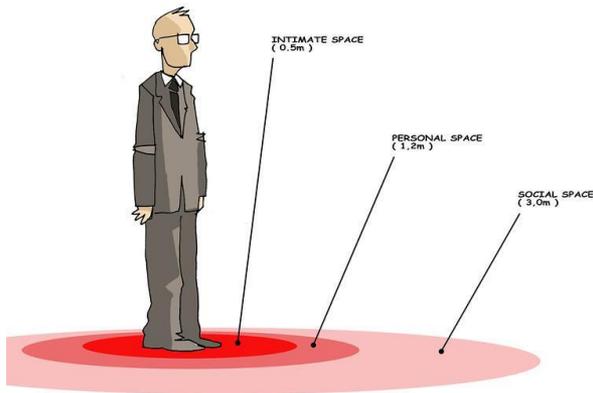
Ethernet Data



Digital protocol determines how digital devices should behave.

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Ethernet Data

destination address	source address	type	application, transport, and network data	CRC
6 bytes	6 bytes	2 bytes	45 to 1500 bytes	4 bytes

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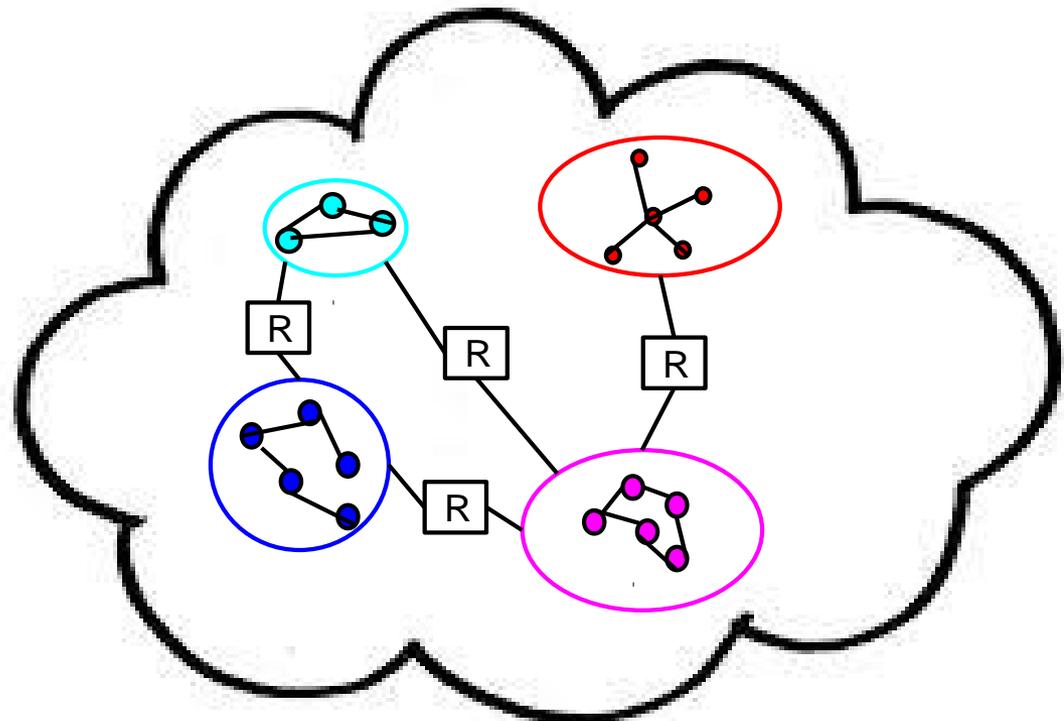
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An Internetwork

An *internetwork* or *internet* (small 'i') is a collection of disparate networks that are connected together via *gateways* or *routers (R)*.

An Internetwork

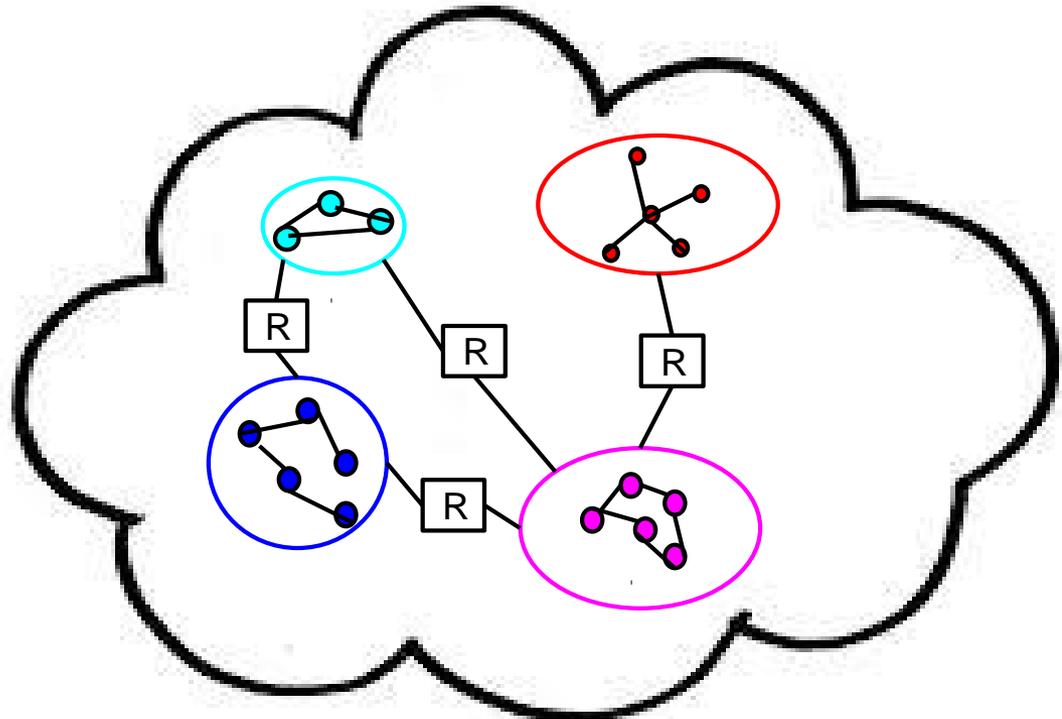
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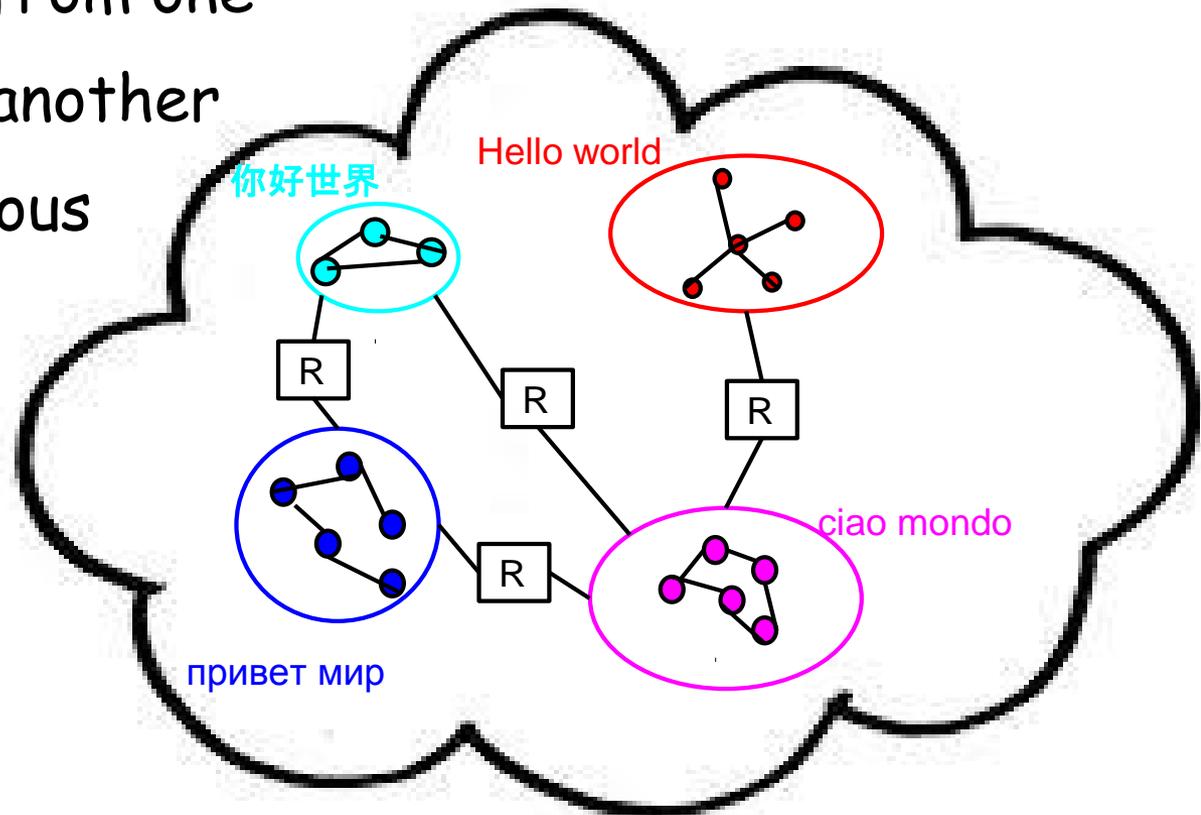
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A *router* (R) is a device that transmits data between two different networks.



Internetwork Analogy

Think of an internet as the collection of different language communities around the globe, with the translators from one language to another being analogous to internet routers.



Routers

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 - A *cable modem* or *DSL modem* connects your home to your Internet Service Provider (ISP).



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 - An *enterprise-level* router connects the ISP to the core Internet backbone routers.



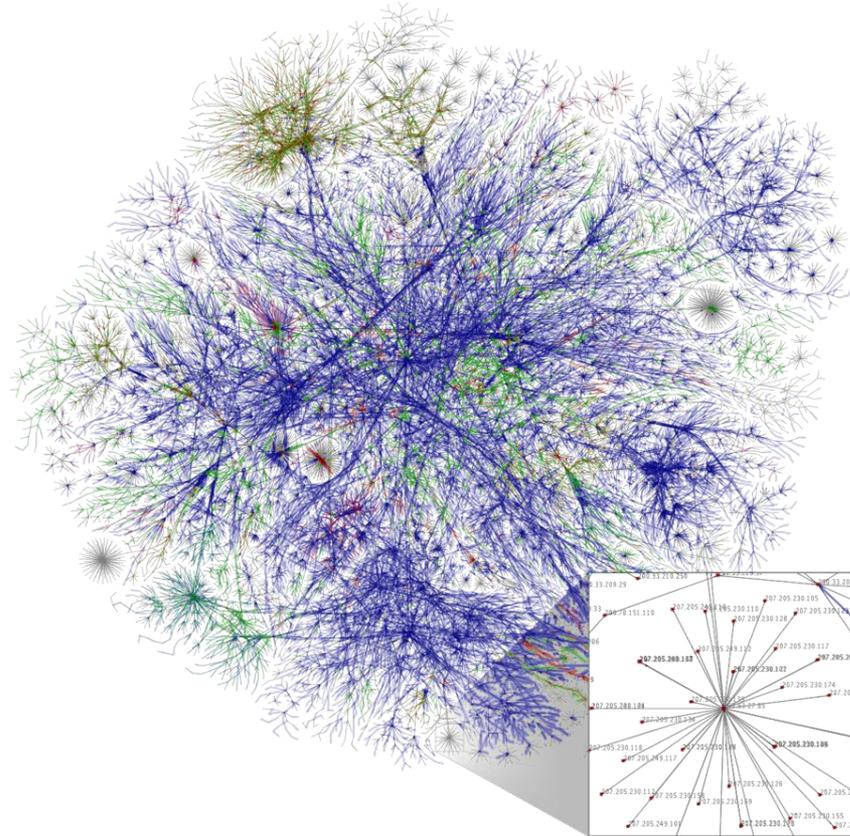
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A partial map of the Internet based on 2005 data produced by [the Opte project](#). Each line is drawn between nodes or addresses on the Internet. The colors represent different top-level domains, such as com, edu and org. Click the map to zoom in.

Wikipedia Definition

- The [Internet](#) is a global system of interconnected [computer networks](#) that use the standard [Internet protocol suite](#) (TCP/IP) to link several billion devices worldwide.

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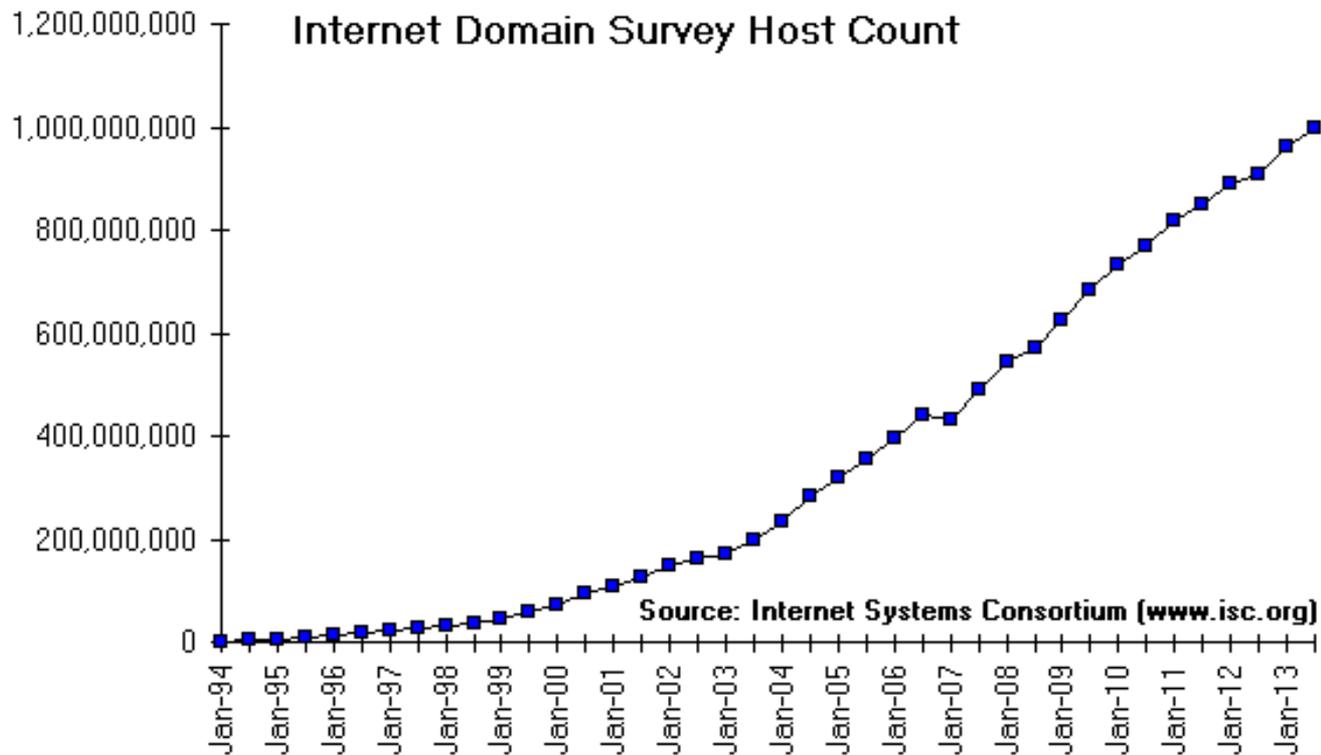
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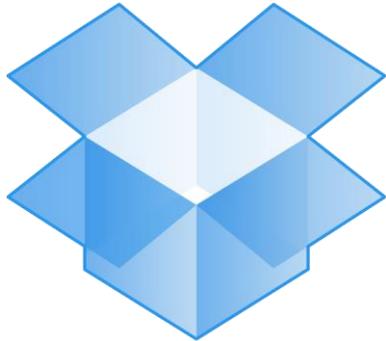
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- The Internet carries an extensive range of information resources and services, such as the inter-linked [hypertext](#) documents and [applications](#) of the [World Wide Web](#) (WWW), the [infrastructure](#) to support email, and [peer-to-peer](#) networks for [file sharing](#) and [telephony](#).

Growth of the Internet

- A *host* is a computer connected to the Internet.
- The Internet has grown exponentially since its inception in 1984 (this graph shows since 1994).



Internet Enables Collaboration

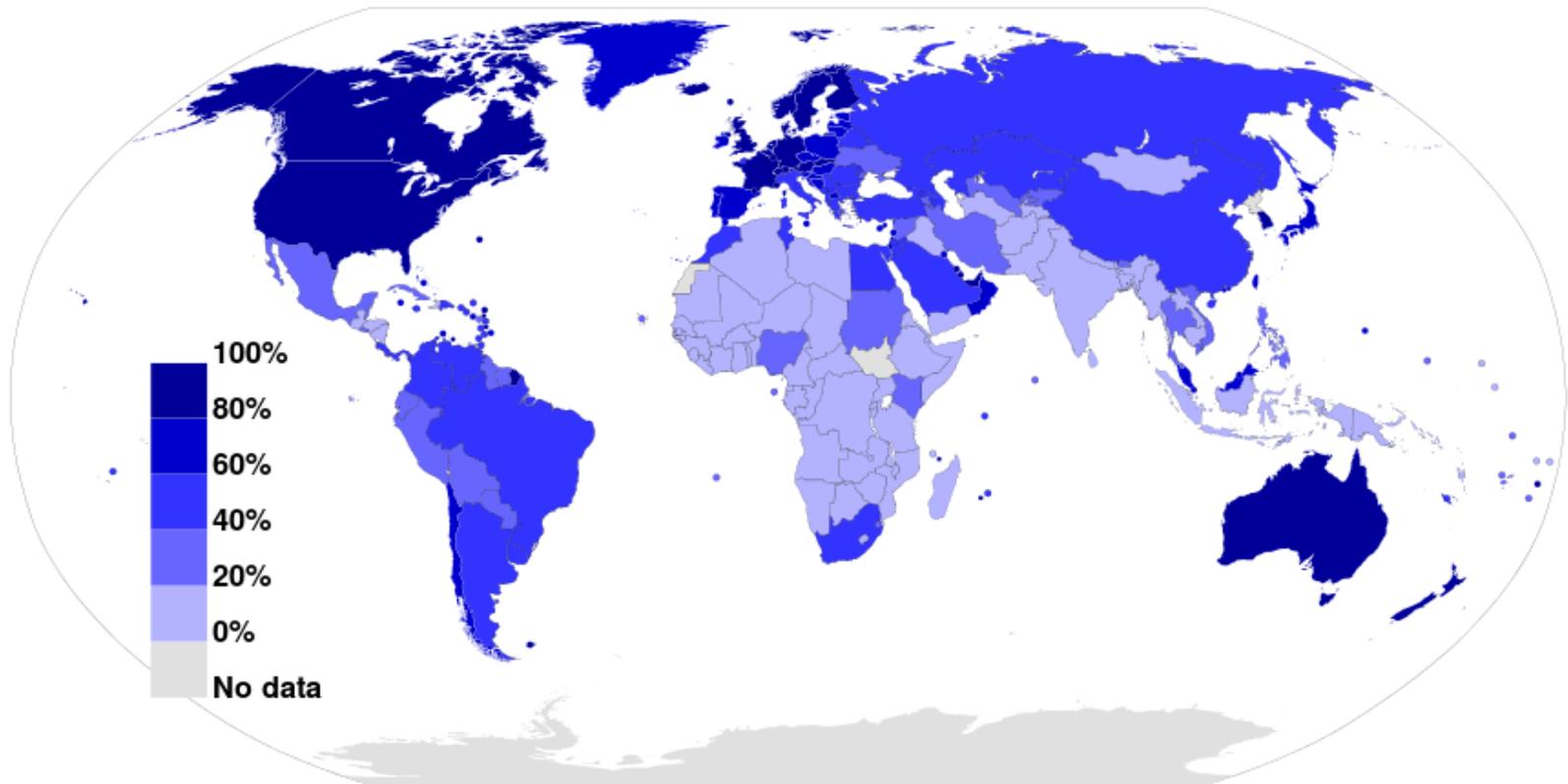


Dropbox



Internet Connectivity

- Today, basically, the entire world is connected.
- [Internet users in 2012](#) as % of country's population.



The Internet and the WWW



A Common Misconception

- The *World Wide Web (WWW)* is **NOT** the same as the Internet.

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- The WWW is **NOT** a network.

WWW is an Application Service

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- Other application services include:
 - E-mail: *Simple Mail Transfer Protocol (SMTP)* or *Post Office Protocol (POP)*
 - File transfer: *File Transfer Protocol (FTP)*
 - Instant Messaging: *Internet Relay Chat (IRC)*
 - Telephony: *Voice Over IP (VoIP)*

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- These are ***distributed applications*** because they run on a network, not on a single computer.

Sir Tim Berners-Lee

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"I just had to take the hypertext idea and connect it to the [Transmission Control Protocol](#) and [domain name system](#) ideas and—ta-da!—the World Wide Web ... Creating the web was really an act of desperation, because the situation without it was very difficult when I was working at CERN later. Most of the technology involved in the web, like the hypertext, like the Internet, multifont text objects, had all been designed already. I just had to put them together. It was a step of generalising, *going to a higher level of abstraction*, thinking about all the documentation systems out there as being possibly part of a larger imaginary documentation system."

The HTTP Protocol

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Open Standards

- HTTP is one of many examples of the open standards that characterize the Internet.

Why open?

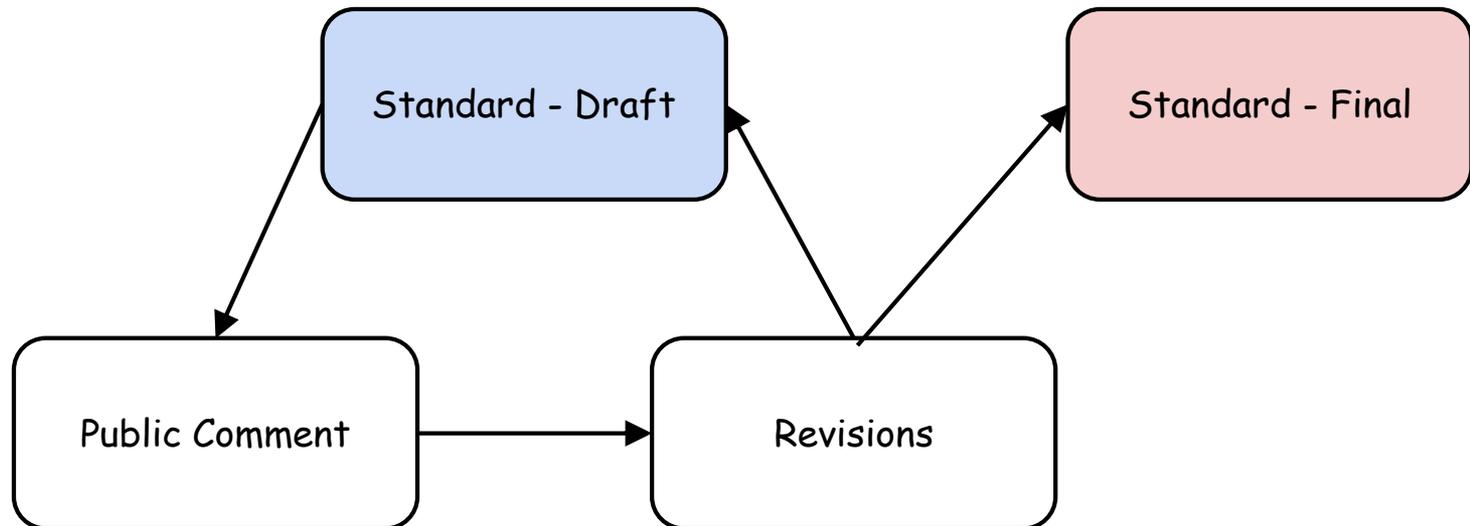
- “The Internet is fundamentally based on the existence of open, non-proprietary standards. They are key to allowing devices, services, and applications to work together across a wide and dispersed network of networks.”

-- Internet Society

Open Standards



Standards:
HTTP, SMTP, IP, etc.



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- Web resources are hosted by **Web servers** which respond to HTTP requests.

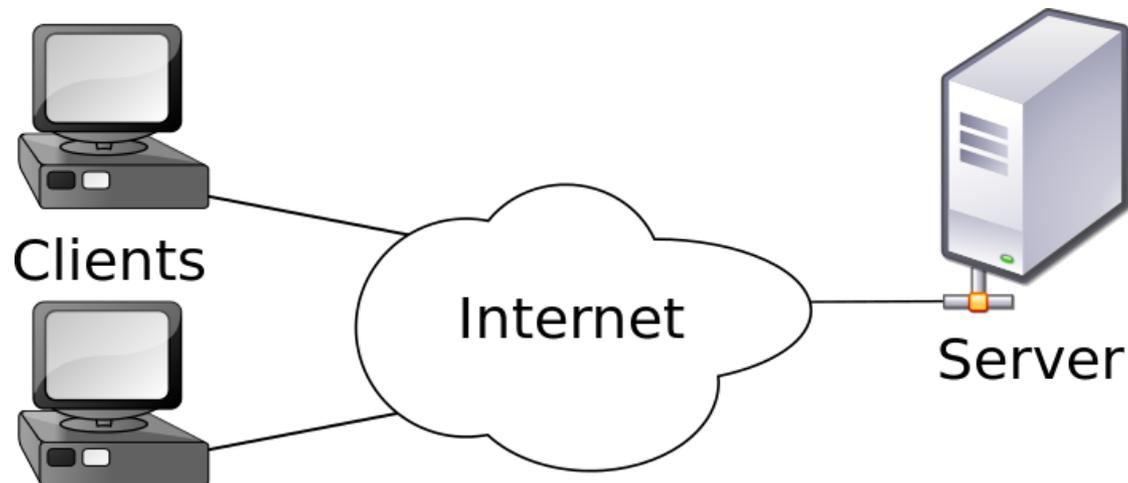


The Client/Server Model

- Client computers request services from a server located on the internet.

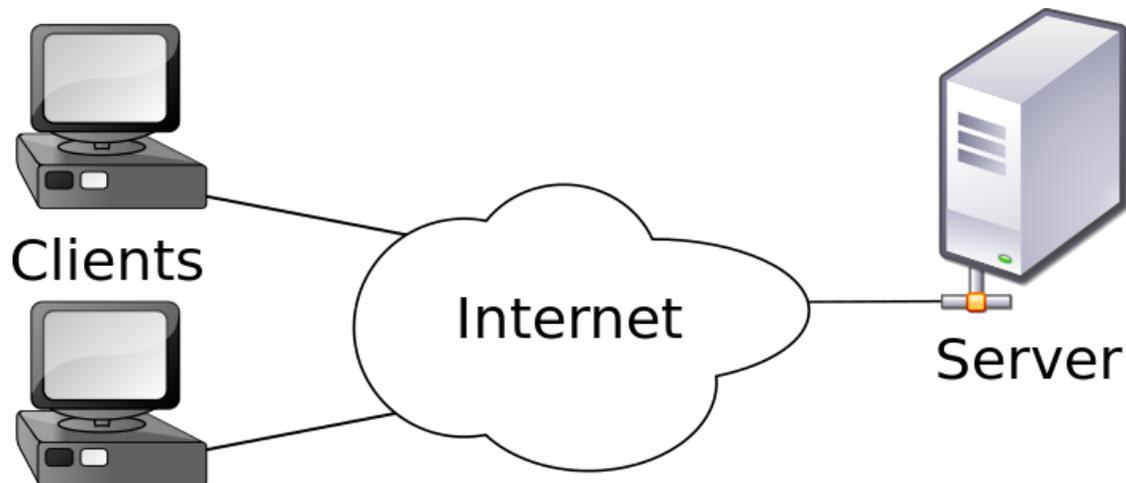
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- EG: Gmail stores messages on Google's servers and processes requests to send/retrieve messages.



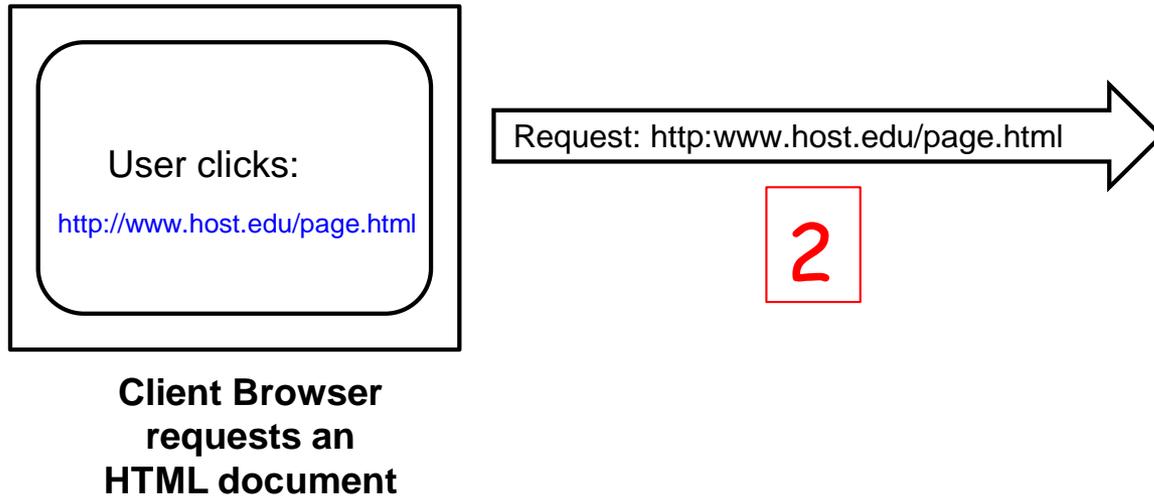
The HTTP Client/Server Model



**Client Browser
requests an
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1

The HTTP Client/Server Model



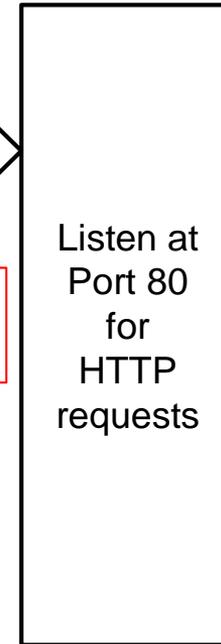
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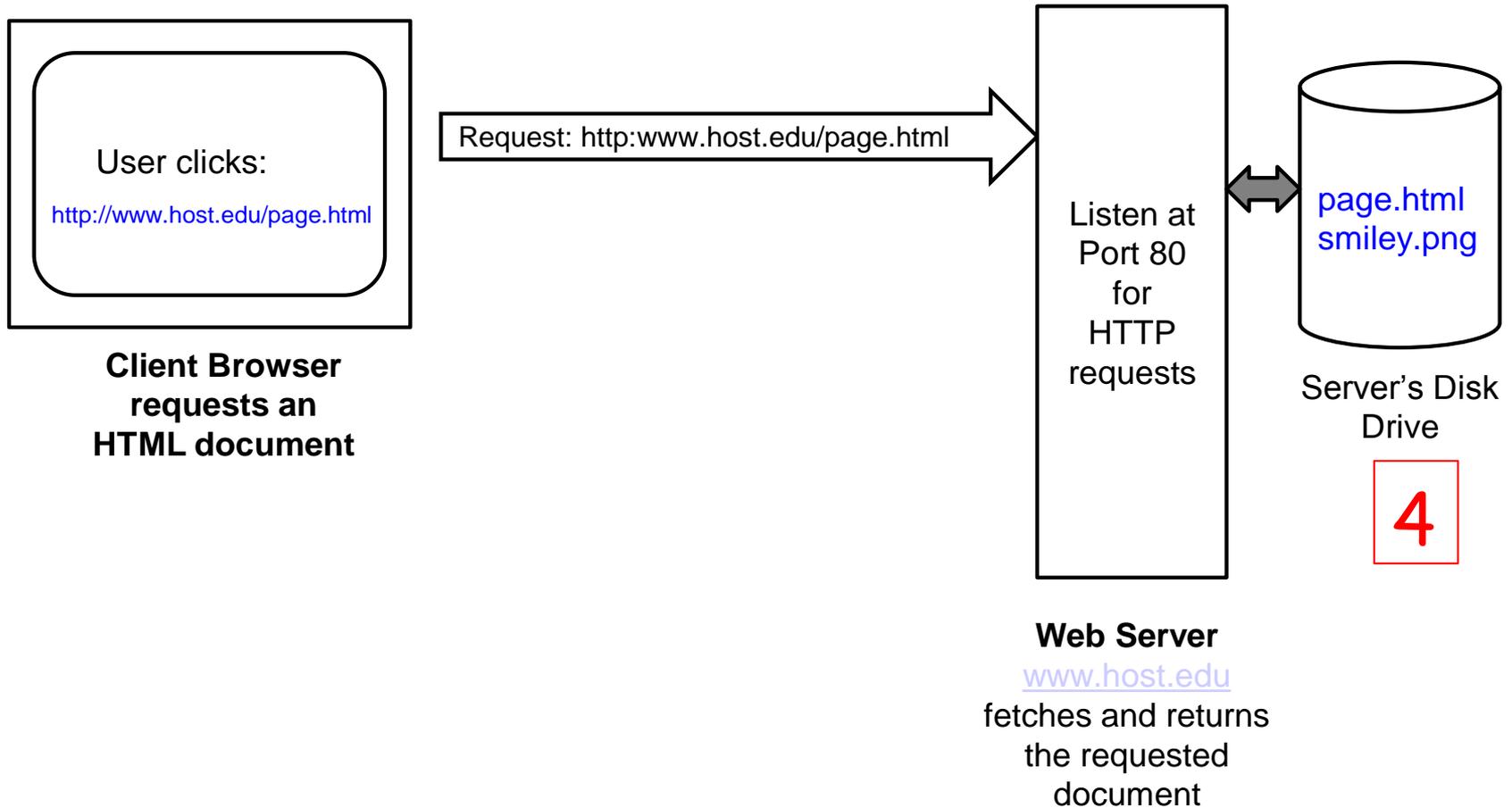


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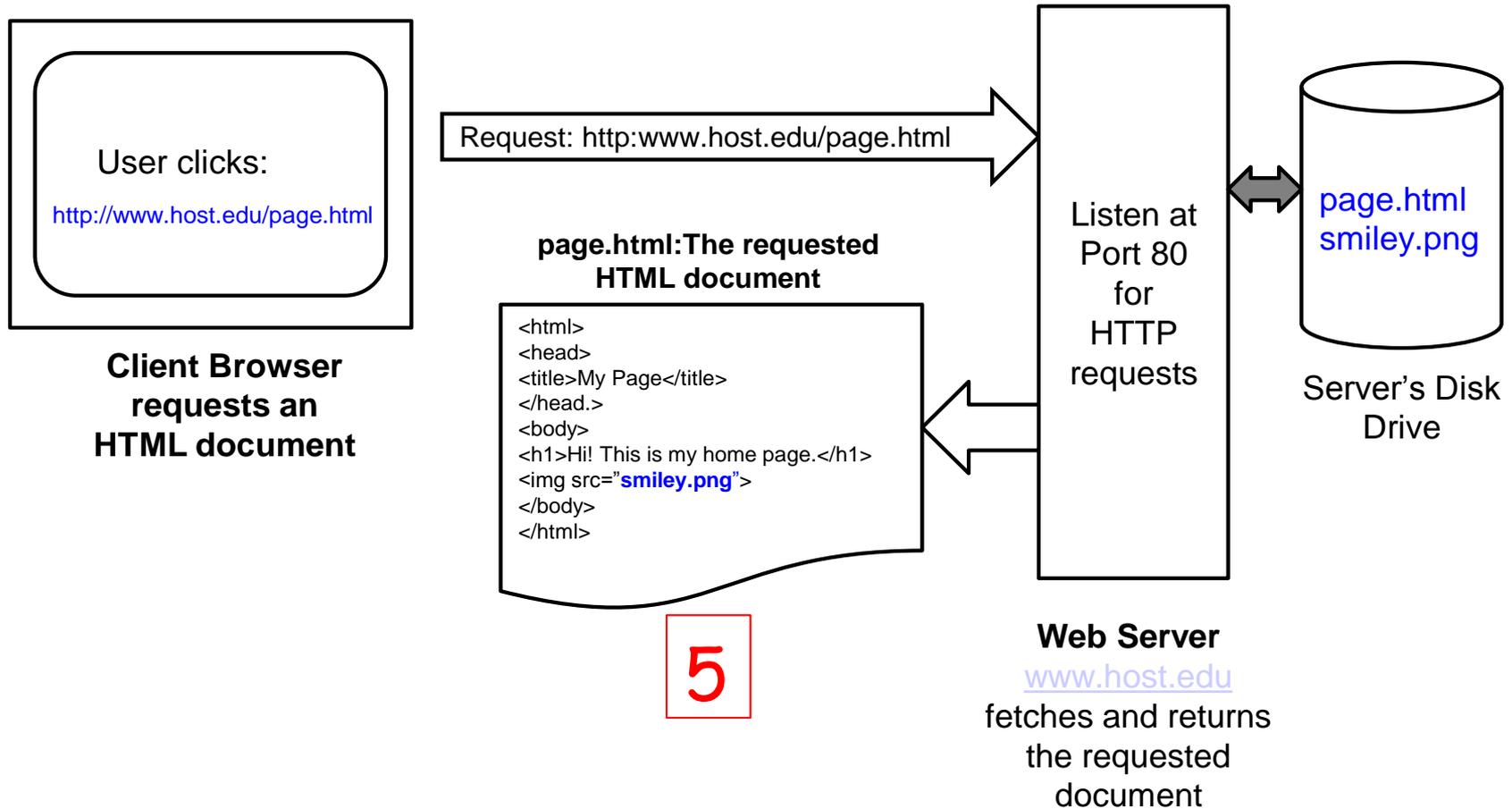


Web Server
www.host.edu
fetches and returns
the requested
document

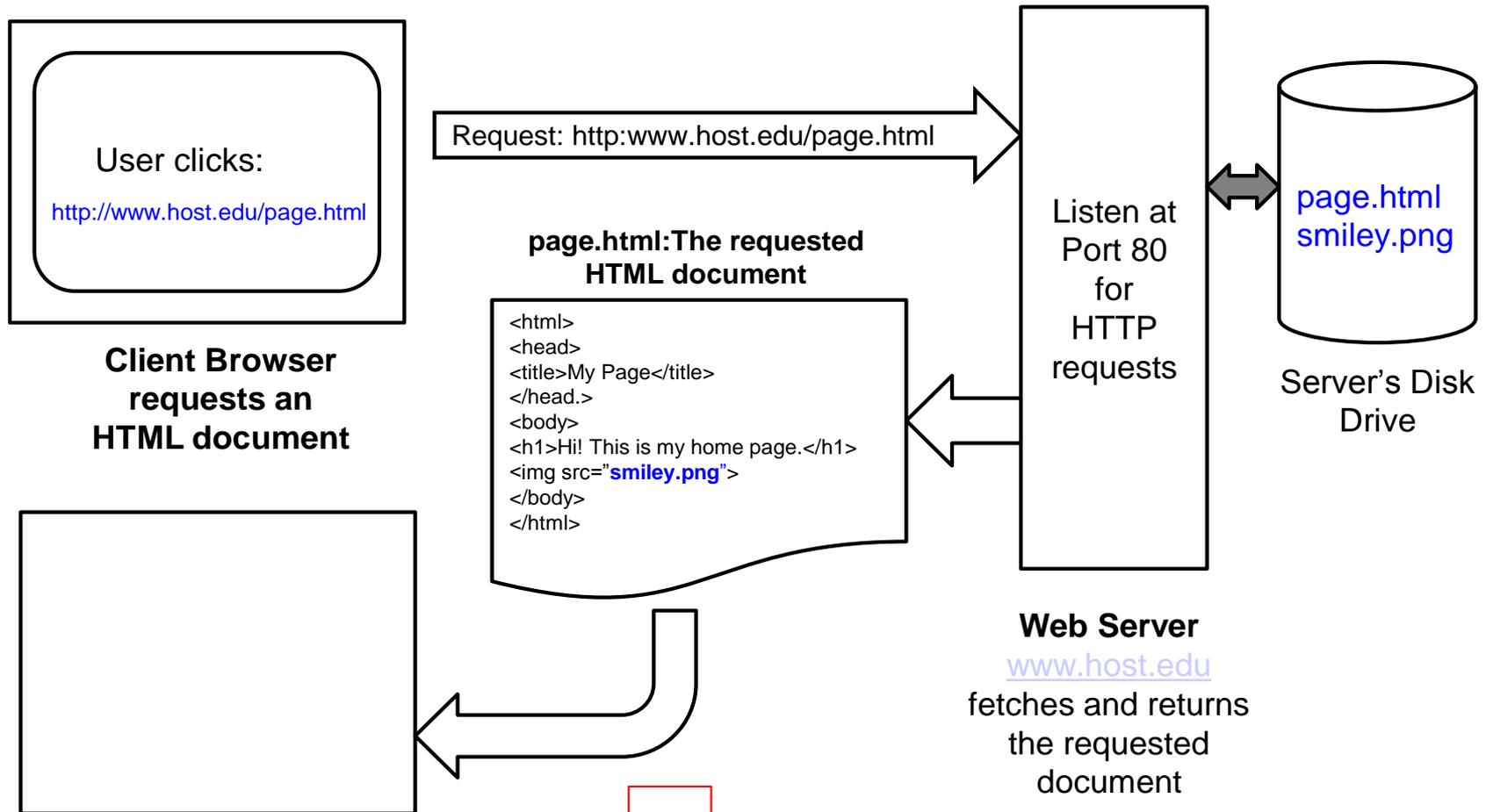
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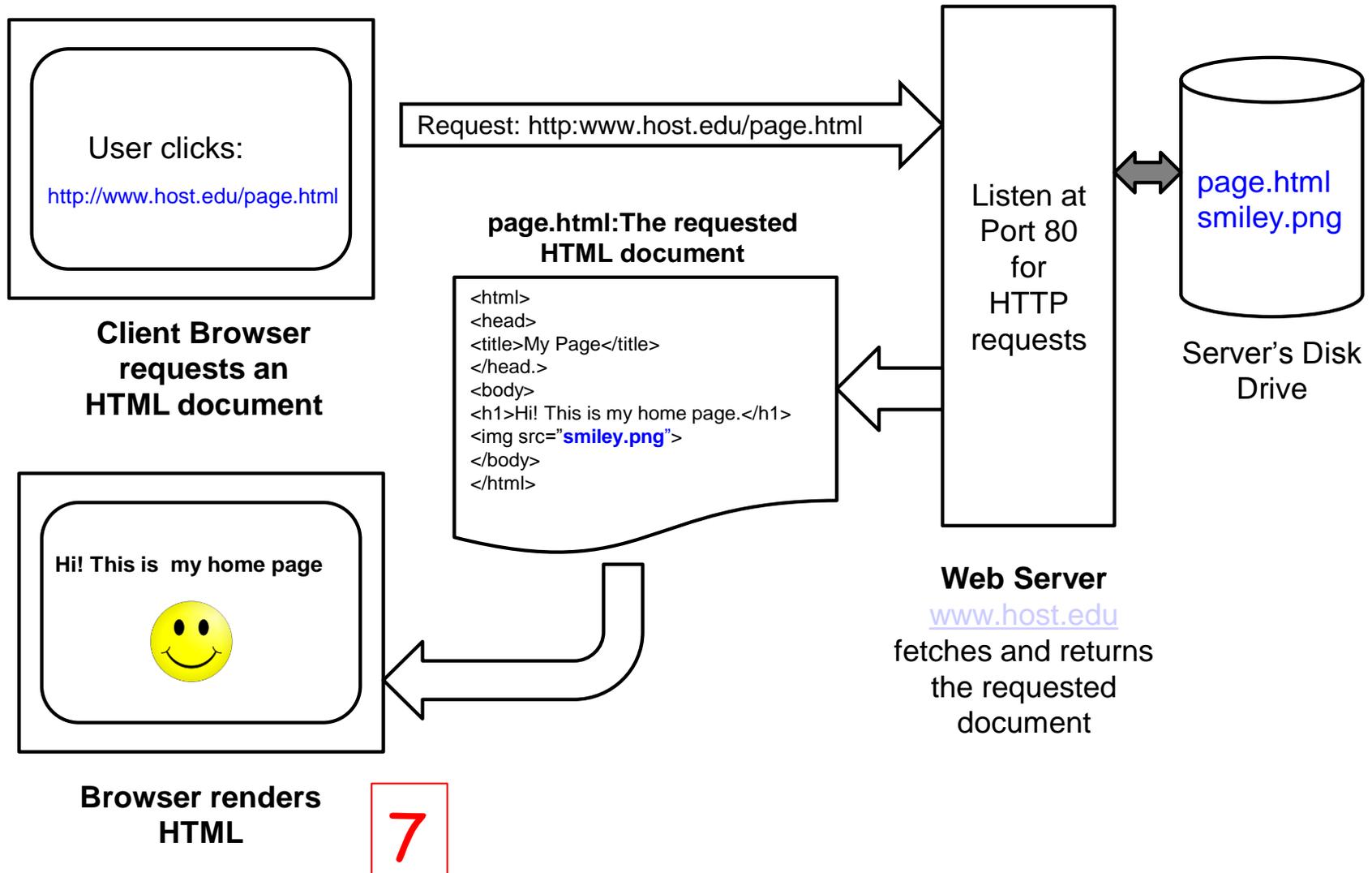
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Internet Performance

Bandwidth

- *Bandwidth* or *throughput* is the rate at which data are downloaded or uploaded in a network.

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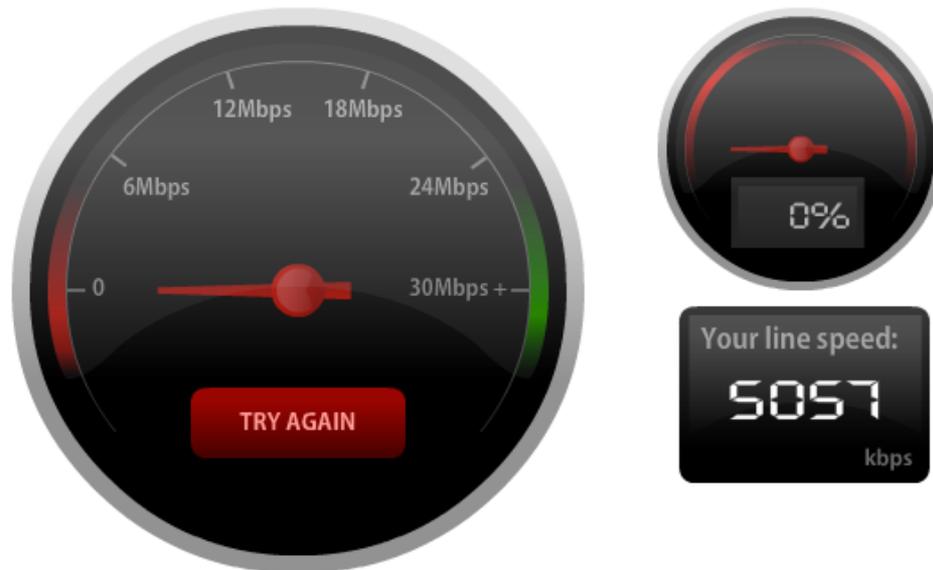
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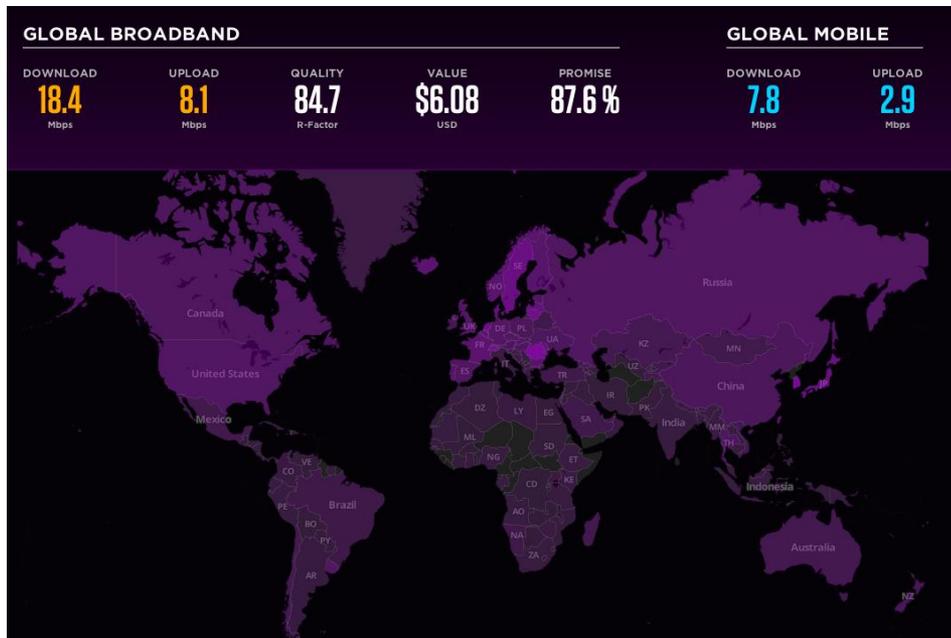
Click on the meter to test your bandwidth.

Global Bandwidth

- *Bandwidth* speeds vary across the globe.
- The current global average is 18.4 Mbps download.

Global Bandwidth

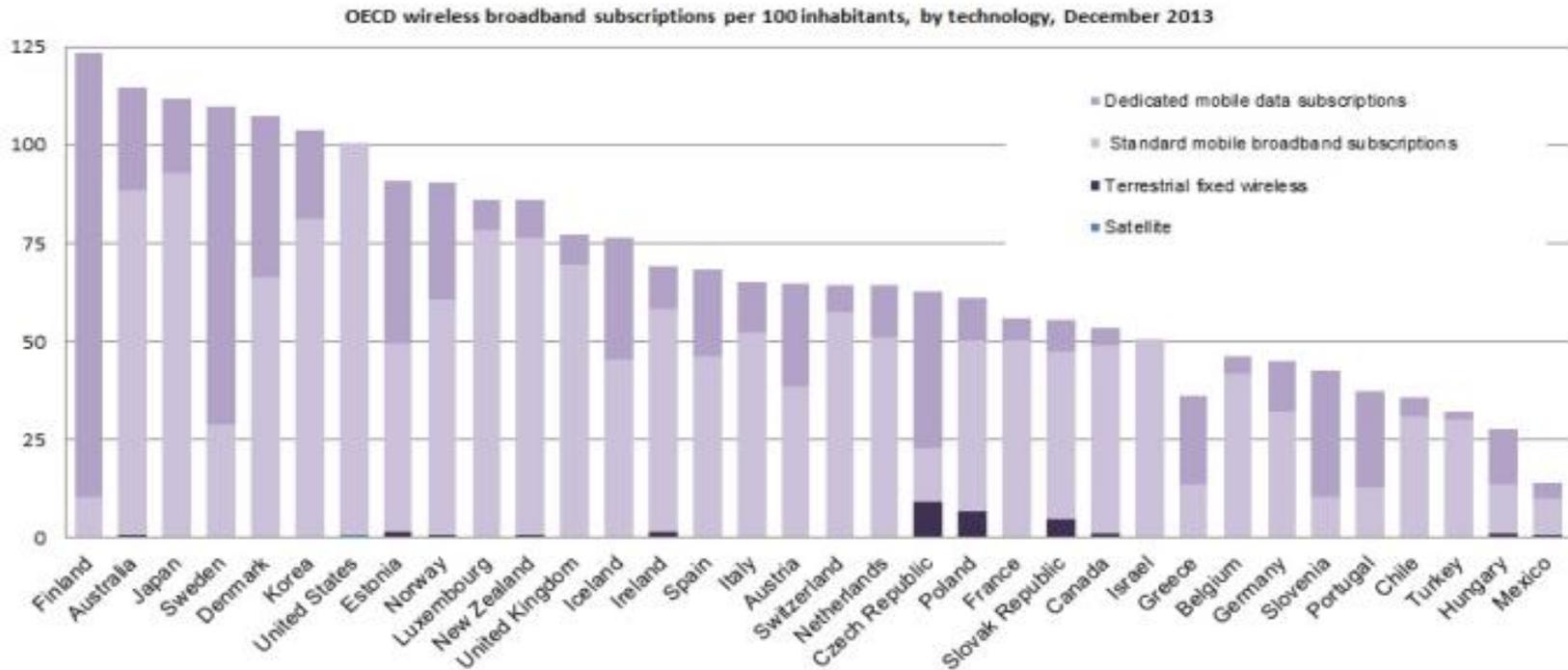
- *Bandwidth* speeds vary across the globe.
- The current global average is 18.4 Mbps download.
- Korea leads the world with 52.6 Mbps.
- In the US the average is 24.4 Mbps.



Click this interactive map to explore by country and within the U.S.

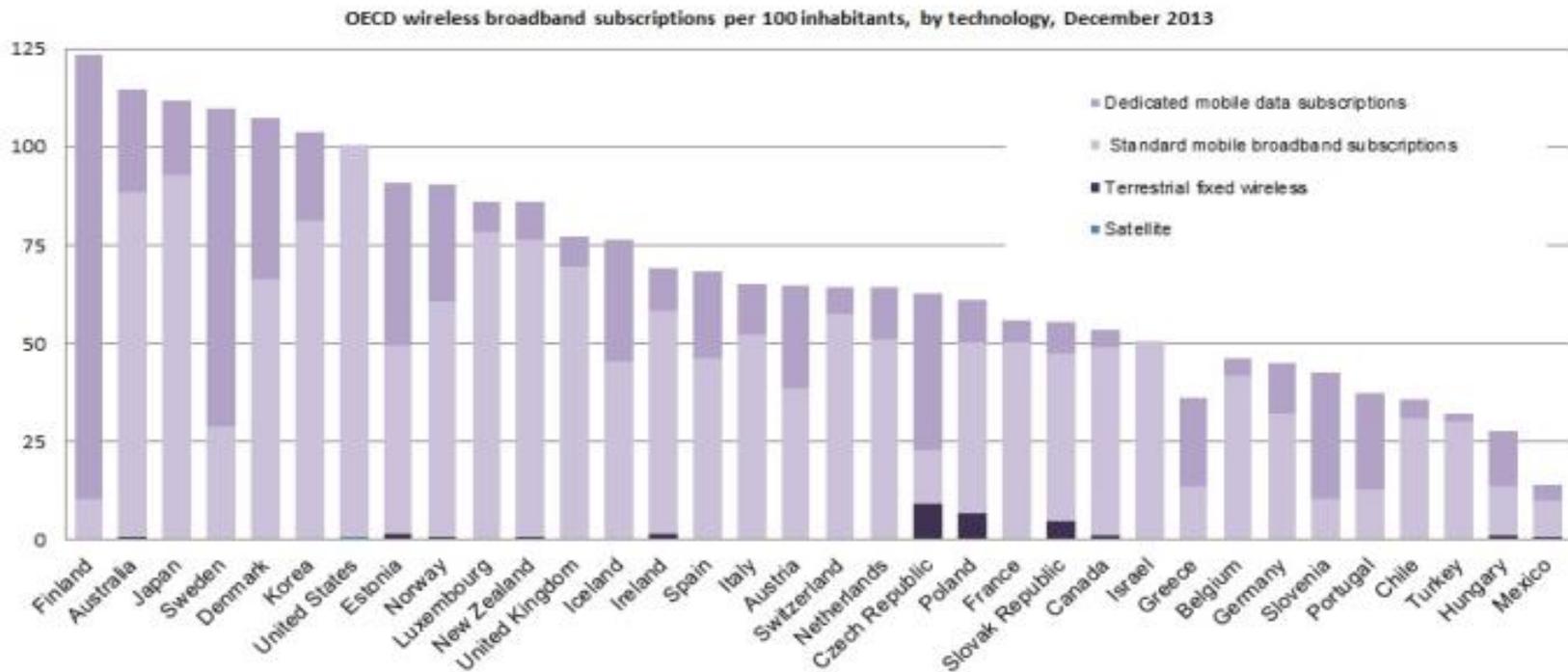
Broadband Access

- *Broadband* refers to high speed Internet service that is always on, typically through cable or DSL modems (Src: [OECD](#)).



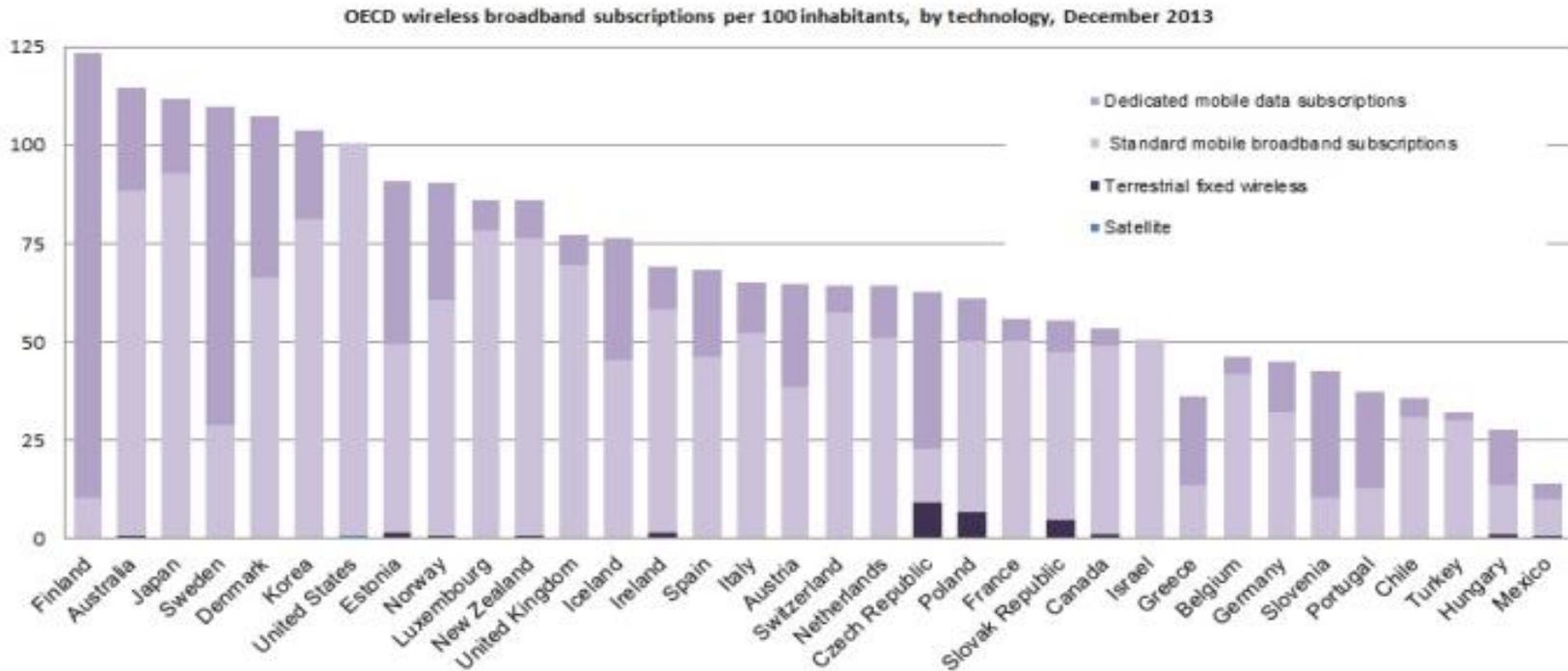
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- 72.4% Penetration in OECD Countries.
- 6 Countries, including the U.S. have over 100% penetration.



Latency

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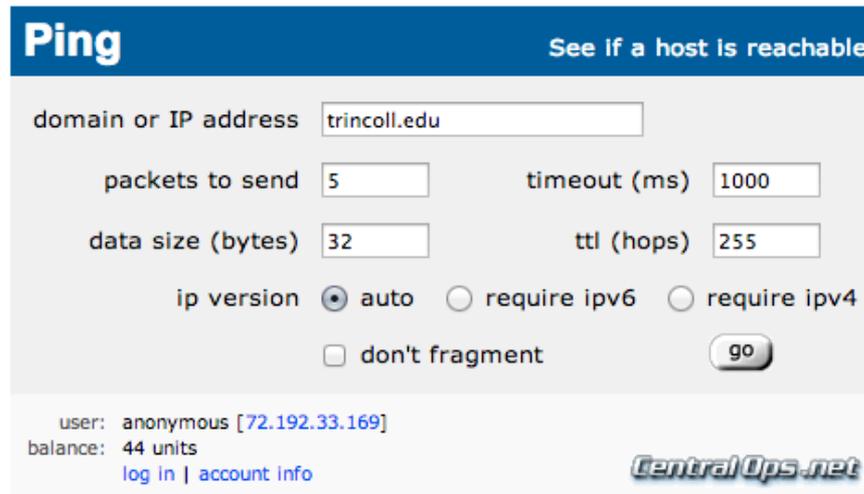
Activity: Ping Measuring Latency

Activity: Ping the Internet

- Ping is a networking utility used by network administrators to measure the *latency* on the Internet.

Activity: Ping the Internet

- Try it. Use CentralOps.net Ping utility to test the reachability of certain hosts. (Click the image. Then select the Ping tool.)



The image shows a web-based utility titled "Ping" with the subtitle "See if a host is reachable". The interface includes several input fields and controls:

- domain or IP address:** A text input field containing "trincoll.edu".
- packets to send:** A numeric input field containing "5".
- timeout (ms):** A numeric input field containing "1000".
- data size (bytes):** A numeric input field containing "32".
- ttl (hops):** A numeric input field containing "255".
- ip version:** Three radio buttons: "auto" (selected), "require ipv6", and "require ipv4".
- don't fragment:** A checkbox that is currently unchecked.
- go:** A button to execute the ping command.

At the bottom of the form, it displays user information: "user: anonymous [72.192.33.169]" and "balance: 44 units", along with links for "log in" and "account info". The CentralOps.net logo is visible in the bottom right corner.

- Some hosts to try. Report back the average latency of these servers.
 - www.cs.trincoll.edu (Trinity College CS department server)
 - mit.edu (Main gateway to MIT)
 - mobile-csp.org (Mobile CSP web site server)

Latency

- *Latency* is a measure of the time it takes a piece of data to reach its destination.
- It is typically measured in *milliseconds (ms)*, thousandths of a second.
- *Ping* is a utility that can be used to measure network latency.



Enter IP # or hostname:

Enter the IP number or hostname you would like to ping.
Five pings will be sent.

Click on the ping gateway to try some latency tests.