Web Testing

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The Web

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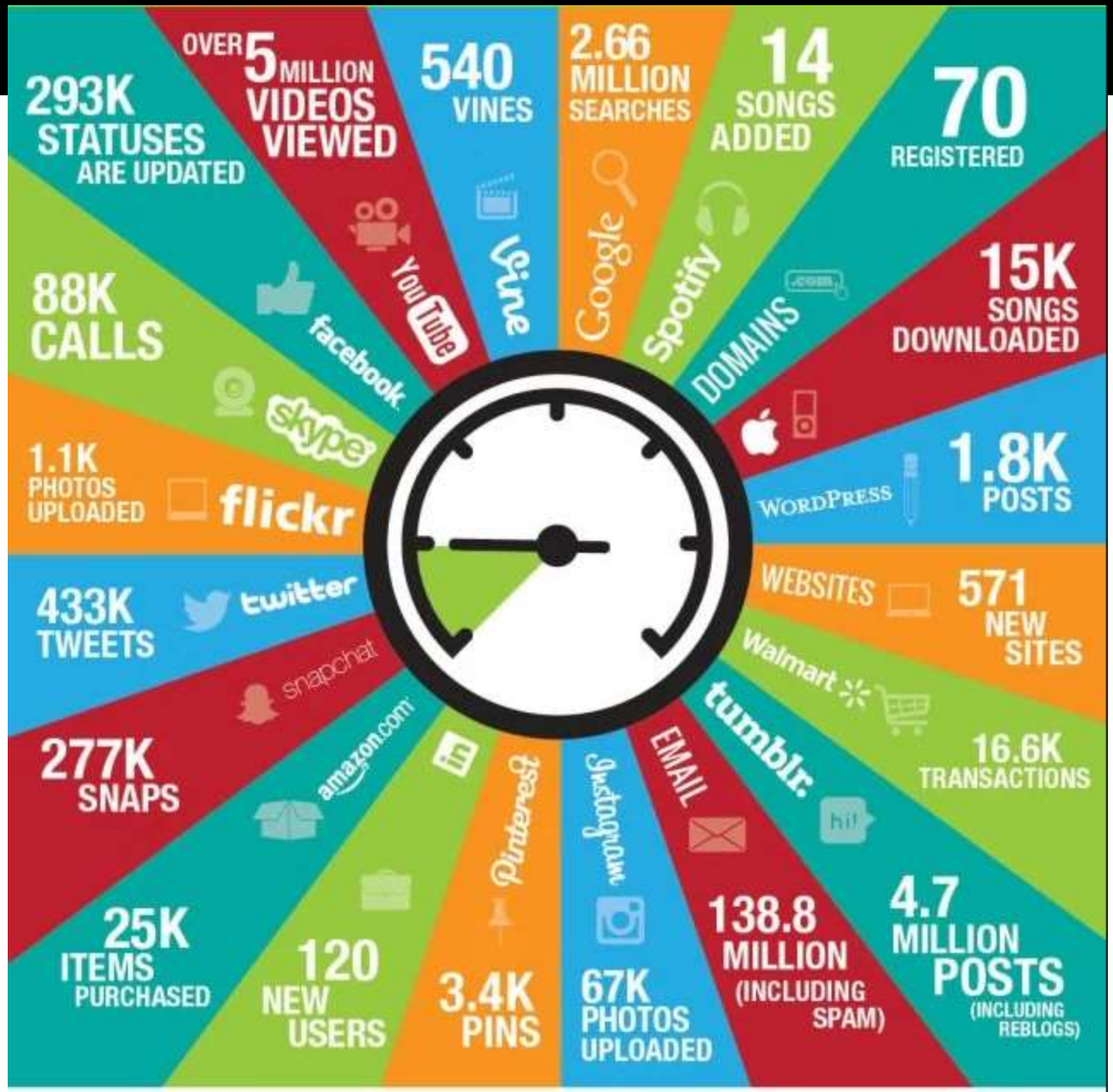
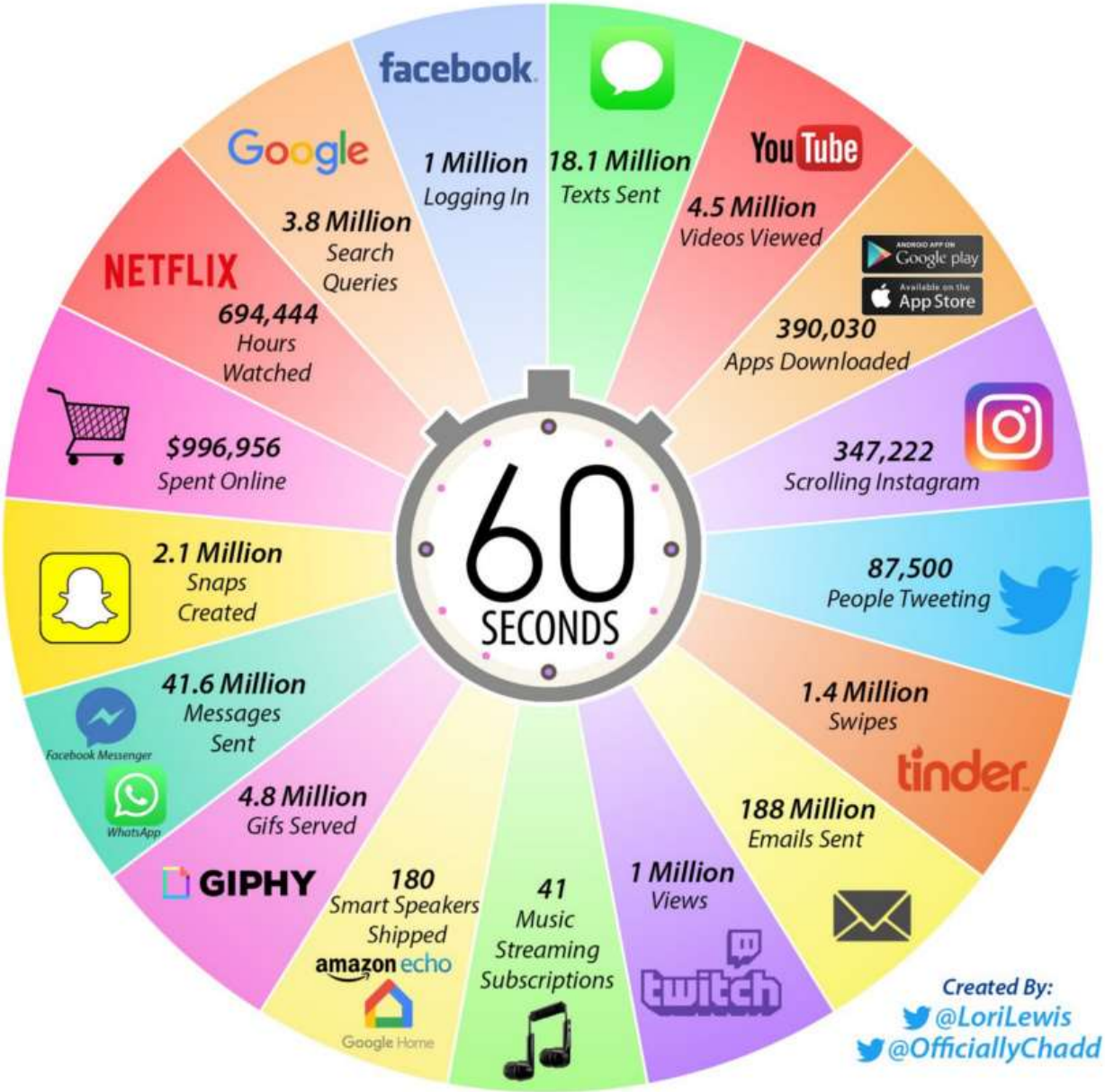
Every 60 seconds on the internet 2018



2019 This Is What Happens In An Internet Minute



2018 This Is What Happens In An Internet Minute

2019 This Is What Happens In An Internet Minute

What is the Internet?

- The Internet is the **global system of interconnected computer networks** that use the Internet protocol suite (TCP/IP) to link devices worldwide.
- It is a **network of networks** that consists of private, public, academic, business, and government networks of local to global scope, linked by electronic, wireless, and optical networking technologies.
- The Internet carries a vast range of **information resources and services**, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and file sharing.

What is the Internet? (2)

The origins of the Internet can be found in the early sixties, when the U.S. Department of Defence sponsored a project to develop a telecommunications network that would survive a nuclear attack.

It had to link together a diverse set of computers and work in a decentralized manner so that, if any part of the network were not functioning, network traffic would automatically be re-routed via other network nodes.

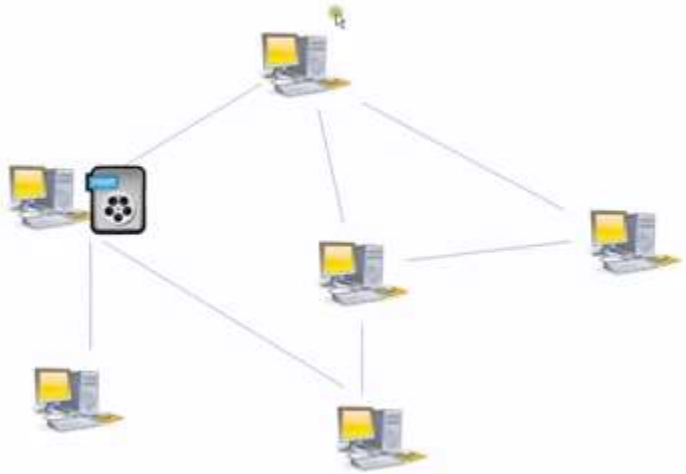
Packet Switching

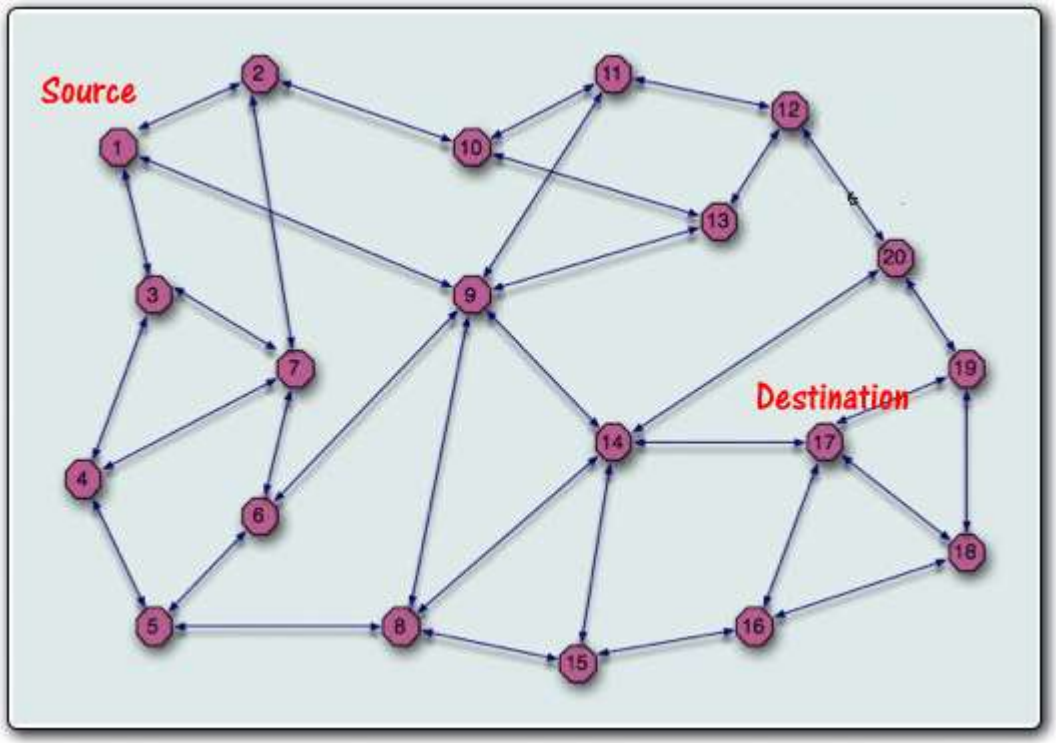
- Packet switching is a digital network transmission process in which **data is broken into suitably-sized pieces or blocks** for fast and efficient transfer via different network devices.

- When a computer attempts to send a file to another computer, the file is broken into packets so that it can be sent across the network in the most efficient way.

Packet Switching

Sending packets - Circuit switching





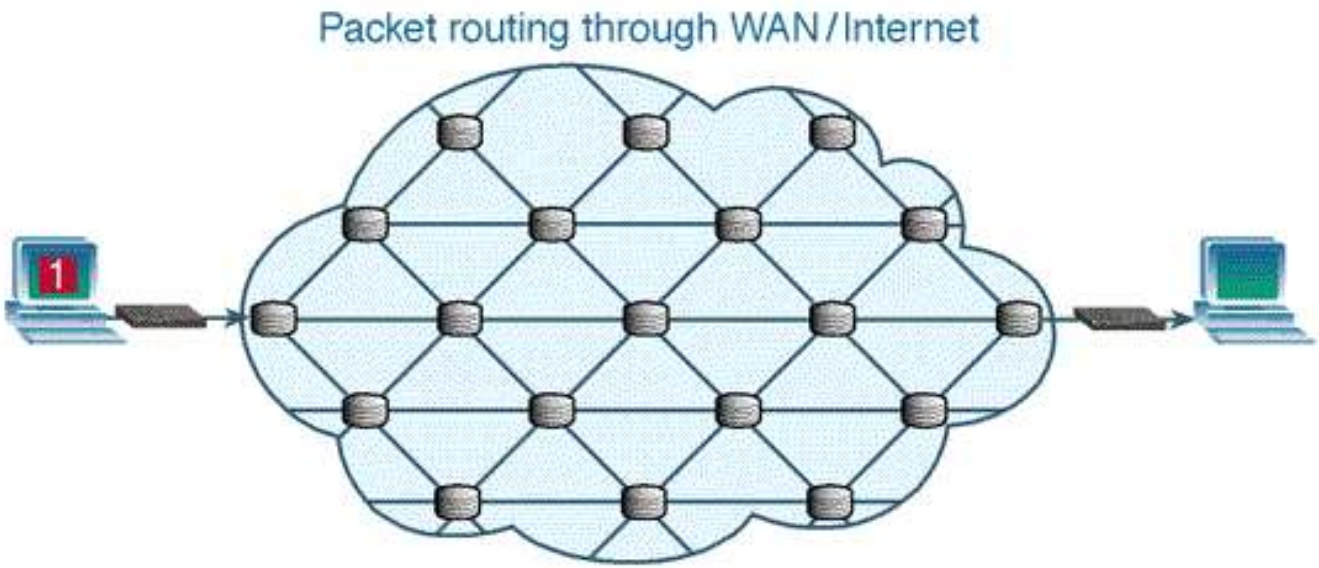
Packet Switching

- When using packet switching, the packets of data are sent at the **most convenient route** at the time of transmission.
- Therefore, the packets take **various different routes**, as each packet tries to find the most efficient route. When a machine receives a packet it checks the destination address to see if has arrived at the correct destination, if not it passes the packet on.

Packet Switching

- Packet switching is a method of grouping data which is transmitted over a digital network into packets. Packets are made of a **header and a payload**.
- Data in the header is used by networking hardware to direct the packet to its destination where the payload is extracted and used by application software. Packet switching is the primary basis for data communications in computer networks worldwide.

Packet Switching



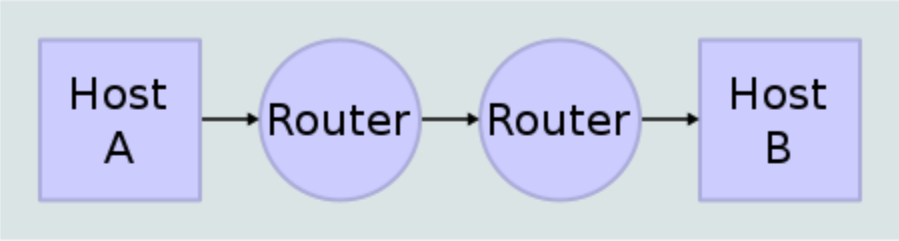
Internet Protocol Suite

- The Internet protocol suite is the conceptual model and set of communications protocols used on the Internet.
- It is commonly known as TCP/IP because the foundational protocols in the suite are the Transmission Control Protocol (TCP) and the Internet Protocol (IP). It is occasionally known as the Department of Defense (DoD) model.

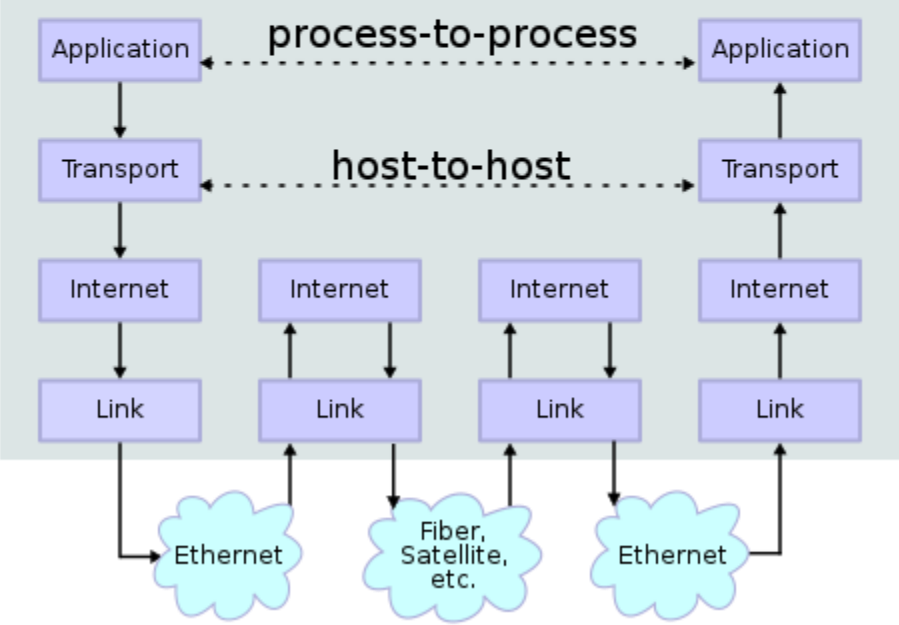
Internet Protocol Suite (2)

- The Internet protocol suite provides end-to-end data communication specifying how data should be packetized, addressed, transmitted, routed, and received.
- This functionality is organized into four abstraction layers, which classify all related protocols according to the scope of networking involved.

Network Topology



Data Flow



Transmission Control Protocol (TCP)

- One of the main protocols of the Internet protocol suite. It complemented the Internet Protocol (IP).
- TCP provides **reliable, ordered, and error-checked delivery of a stream of octets (bytes)** between applications running on hosts communicating via an IP network. Major internet applications such as the World Wide Web, email, remote administration, and file transfer rely on TCP.

Transmission Control Protocol (TCP)

- TCP lets a device reliably send a packet to another device on the same network or on a different network.
- TCP ensures that each packet is delivered if at all possible. It establishes a connection with the receiving device and then sending the packets. If a packet doesn't arrive, TCP resends the packet. The connection is closed only after the packet has been successfully delivered or an unrecoverable error condition has occurred.
- TCP is always used for one-to-one communications. I.e. TCP allows a single network device to exchange data with another single network device.

Internet Protocol (IP)

- The Internet Protocol (IP) is the principal communications protocol in the Internet protocol suite.
- IP has the task of delivering packets from the source host to the destination host solely based on the IP addresses in the packet headers.
- An IP address is a unique address identifying a machine (which can be a computer, a server, an electronic device, a router, a phone etc.) on a network, thus serving for routing and forwarding IP packets from source to destination.
- So, in short, TCP is the data while IP is the location.

How TCP/IP Works

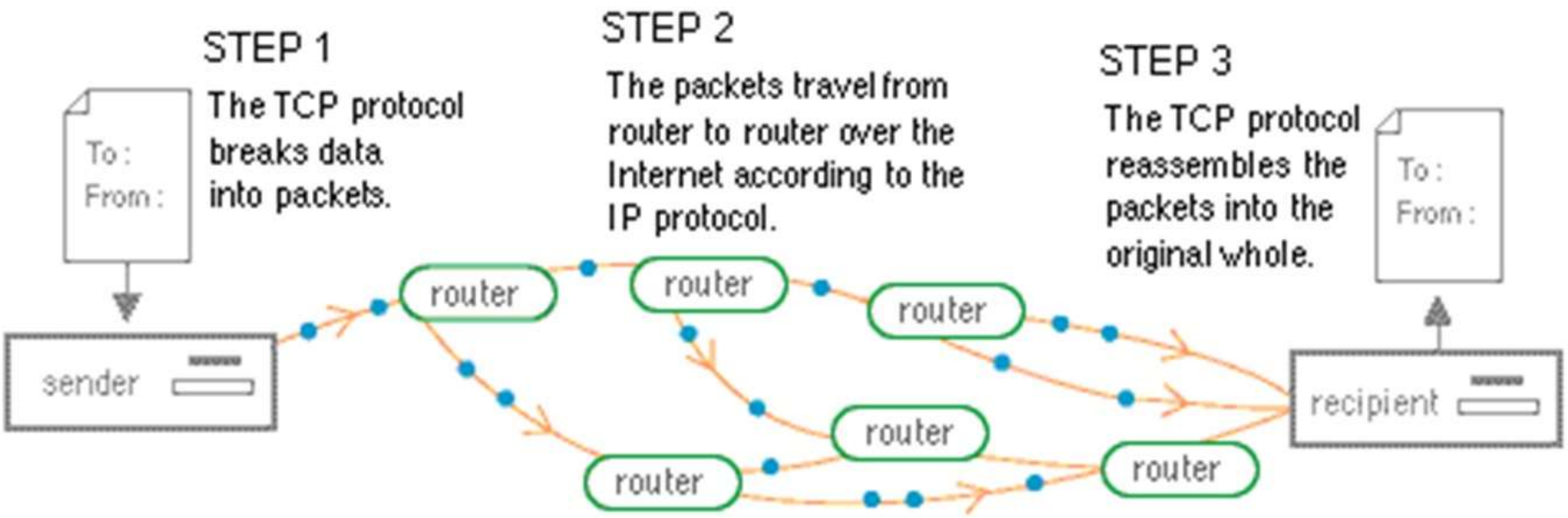


Figure 2. How data travels over the Net.

Dr. Vinton Cerf

MCI

Internet Protocol Address (IP address)

- An Internet Protocol address (IP address) is a numerical label assigned to each device (e.g., computer, printer) participating in a computer network that uses the Internet Protocol for communication.
- An IP address serves two principal functions: host or network interface identification and location addressing. Its role has been characterized as follows: “A name indicates what we seek. An address indicates where it is. A route indicates how to get there.”

Internet Protocol Address (IP address)

- The designers of the Internet Protocol defined an IP address as a 32-bit number and this system, known as Internet Protocol Version 4 (IPv4), is still in use today.
- However, because of the growth of the Internet and the depletion of available addresses, a new version of IP (IPv6), using 128 bits for the address, was developed in 1995. IPv6 was standardized as RFC 2460 in 1998, and its deployment has been ongoing since the mid-2000s.
- IP addresses are written and displayed in human-readable notations, such as
- 172.16.254.1 (IPv4)
- 2001:db8:0:1234:0:567:8:1 (IPv6).

Uniform Resource Identifier (URI)

- A Uniform Resource Identifier (URI) is a string of characters that unambiguously identifies a particular resource.
- Schemes specifying a concrete syntax and associated protocols define each URI. The most common form of URI is the Uniform Resource Locator (URL), frequently referred to informally as a web address. More rarely seen in usage is the Uniform Resource Name (URN), which was designed to complement URLs by providing a mechanism for the identification of resources in particular namespaces.

Uniform Resource Identifier (URI)

- The URI generic syntax consists of a hierarchical sequence of five components:
- `URI = scheme://authority]path[?query][#fragment]`

- where the authority component divides into three subcomponents:
- `authority = [userinfo@]host[:port]`

Uniform Resource Identifier (URI)

Uniform Resource Locator (URL)

- A Uniform Resource Locator (URL), colloquially termed a web address, is a reference to a web resource that specifies its location on a computer network and a mechanism for retrieving it.
- URLs occur most commonly to reference web pages (http), but are also used for file transfer (ftp), email (mailto), database access (JDBC), and many other applications.

Uniform Resource Locator (URL)

- A typical URL could have the form http://www.example.com/index.html
- which indicates a protocol (http),
- a hostname (www.example.com),
- and a file name (index.html).

The Web (1)

- The most popular internet service is the World Wide Web or the Web. The Web is a vast collection of multimedia information located on Web servers attached to the Internet.
- The Web is a collection of interconnected documents (web pages) and other web resources, linked by hyperlinks and URLs.

The Web (2)

- The World Wide Web (WWW), also called the Web, is an information space where documents and other web resources are identified by Uniform Resource Locators (URLs), interlinked by hypertext links, and accessible via the Internet.
- English scientist Tim Berners-Lee invented the World Wide Web in 1989.
- He wrote the first web browser in 1990 while employed at CERN in Switzerland.

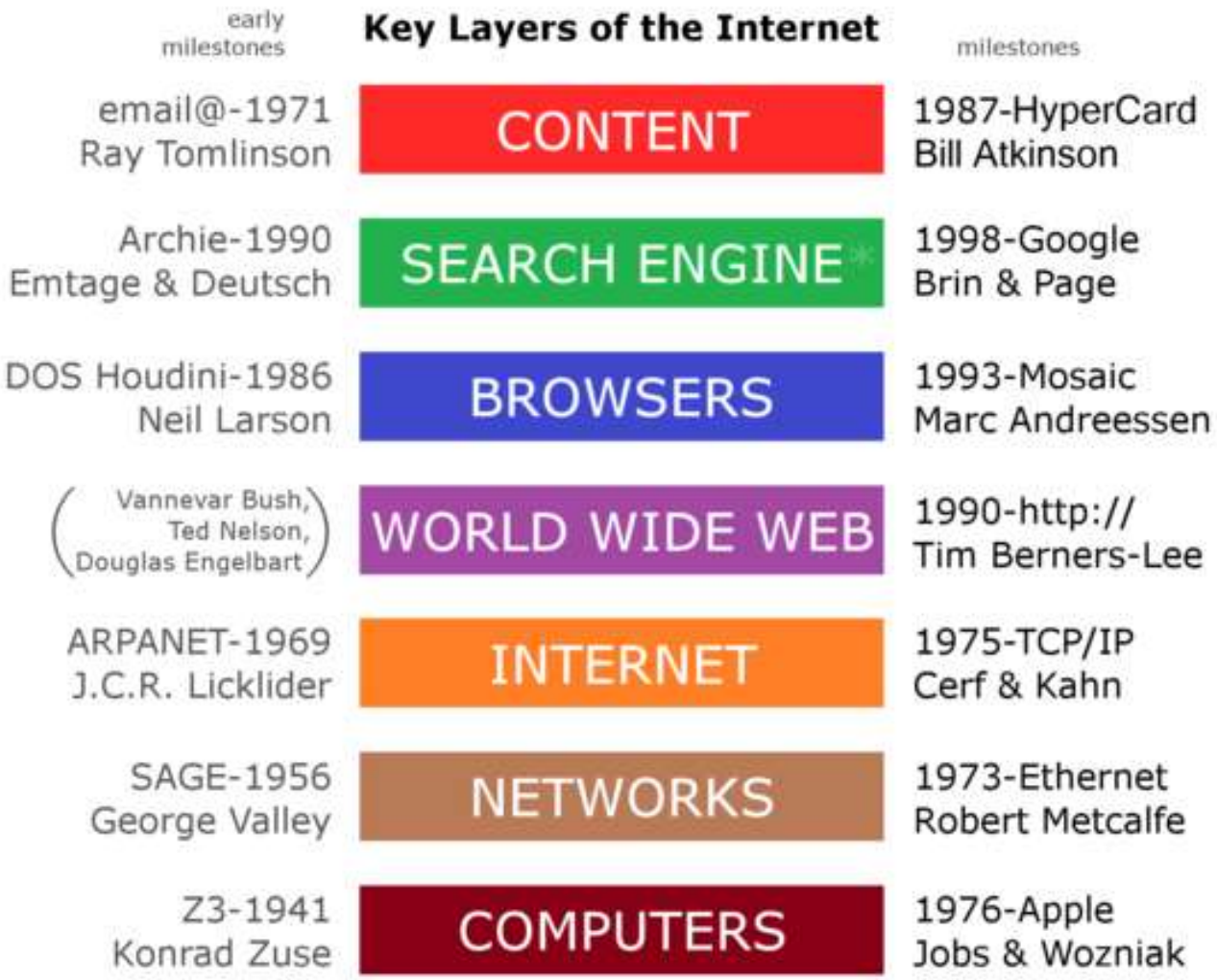
The Web (3)

- A NeXT Computer was used by Berners-Lee as the world's first web server and also to write the first web browser, WorldWideWeb, in 1990.
- By Christmas 1990, Berners-Lee had built all the tools necessary for a working Web:
- the first web browser (which was a web editor as well);
- the first web server;
- and the first web pages, which described the project itself.

The Web (4)

- Tim Berners-Lee developed three essential technologies:
- a system of globally unique identifiers for resources on the Web and elsewhere, the universal document identifier (UDI), later known as uniform resource locator (URL) and uniform resource identifier (URI);
- the publishing language HyperText Markup Language (HTML);
- the Hypertext Transfer Protocol (HTTP).

The Web (5)


early milestones
Key Layers of the Internet
milestones
email@-1971
Ray Tomlinson
CONTENT
1987-HyperCard
Bill Atkinson
Archie-1990
Emtage & Deutsch
SEARCH ENGINE
1998-Google
Brin & Page
DOS Houdini-1986
Neil Larson
BROWSERS
1993-Mosaic
Marc Andreessen
Vannevar Bush,
Ted Nelson,
Douglas Engelbart
WORLD WIDE WEB
1990-http://
Tim Berners-Lee
ARPANET-1969
J.C.R. Licklider
INTERNET
1975-TCP/IP
Cerf & Kahn
SAGE-1956
George Valley
NETWORKS
1973-Ethernet
Robert Metcalfe
Z3-1941
Konrad Zuse
COMPUTERS
1976-Apple
Jobs & Wozniak

The Web (6)

- The terms Internet and World Wide Web are often used without much distinction. However, the two are not the same.
- The Internet is a global system of interconnected computer networks.
- The World Wide Web is a global collection of documents and other resources, linked by hyperlinks and URIs.
- Web resources are usually accessed using HTTP, which is one of many Internet communication protocols.

INTERNET VERSUS WORLD WIDE WEB

INTERNET	WORLD WIDE WEB
A global system of interconnected computer networks that use the TCP/IP protocol to link devices worldwide	Online content that is formatted in HTML and accessed via HTTP protocol
A massive interconnection of computer networks around the world	Service provided by the internet
Uses Transmission Control Protocol/Internet Protocol (TCP/IP)	Uses Hyper Text Transfer Protocol (HTTP)

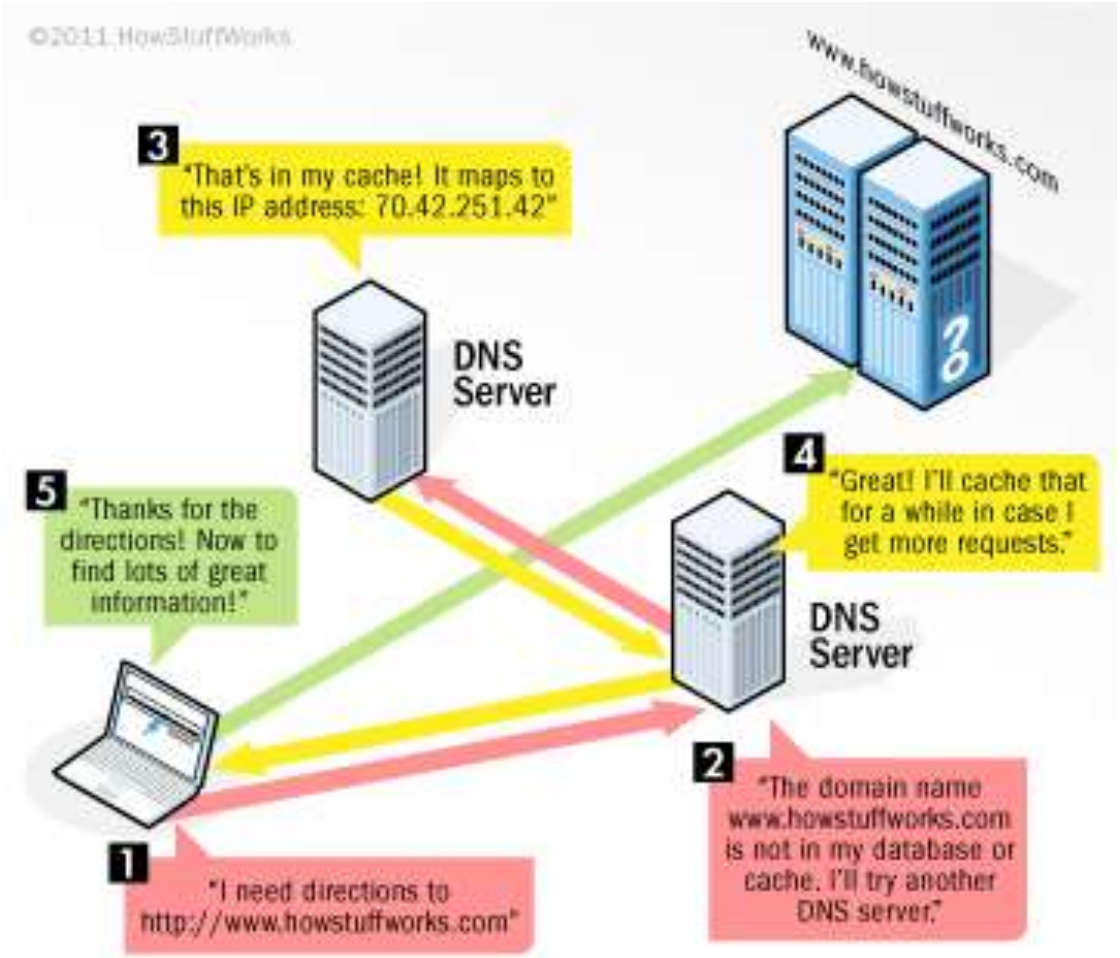
Name server

- A name server is a computer application that implements a network service for providing responses to queries against a directory service.
- It translates an often humanly meaningful, text-based identifier to a system-internal, often numeric identification or addressing component.

Name server

- An example of a name server is the server component of the Domain Name System (DNS), one of the two principal namespaces of the Internet.
- The most important function of DNS servers is the translation (resolution) of human-memorable domain names into the corresponding numeric Internet Protocol (IP) addresses, which is used to identify and locate computer systems and resources on the Internet.

Name server


©2011 HowStuffWorks
www.howstuffworks.com
3
"That's in my cache! It maps to this IP address: 70.42.251.42"
DNS Server
4
"Great! I'll cache that for a while in case I get more requests."
5
"Thanks for the directions! Now to find lots of great information!"
DNS Server
2
"The domain name www.howstuffworks.com is not in my database or cache. I'll try another DNS server."
1
"I need directions to http://www.howstuffworks.com"

Domain Name System (DNS)

- The Domain Name System (DNS) is a hierarchical decentralized naming system for computers, services, or other resources connected to the Internet or a private network.
- It associates various information with domain names assigned to each of the participating entities. Most prominently, it translates more readily memorized domain names to the numerical IP addresses needed for locating and identifying computer services and devices with the underlying network protocols.

Domain Name System (DNS)

- The Domain Name System serves as the phone book for the Internet by translating human-friendly computer hostnames into IP addresses. E.g. the domain name www.example.com translates to the addresses 93.184.216.34 (IPv4).
- DNS can be quickly updated, allowing a service's location on the network to change without affecting the end users, who continue to use the same hostname.

Hypertext Markup Language (HTML)

- Hypertext Markup Language (HTML) is the standard markup language for creating web pages and web applications.

- With Cascading Style Sheets (CSS) and JavaScript, it forms a triad of cornerstone technologies for the World Wide Web.

Hypertext Markup Language (HTML)

- Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages.
- HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.

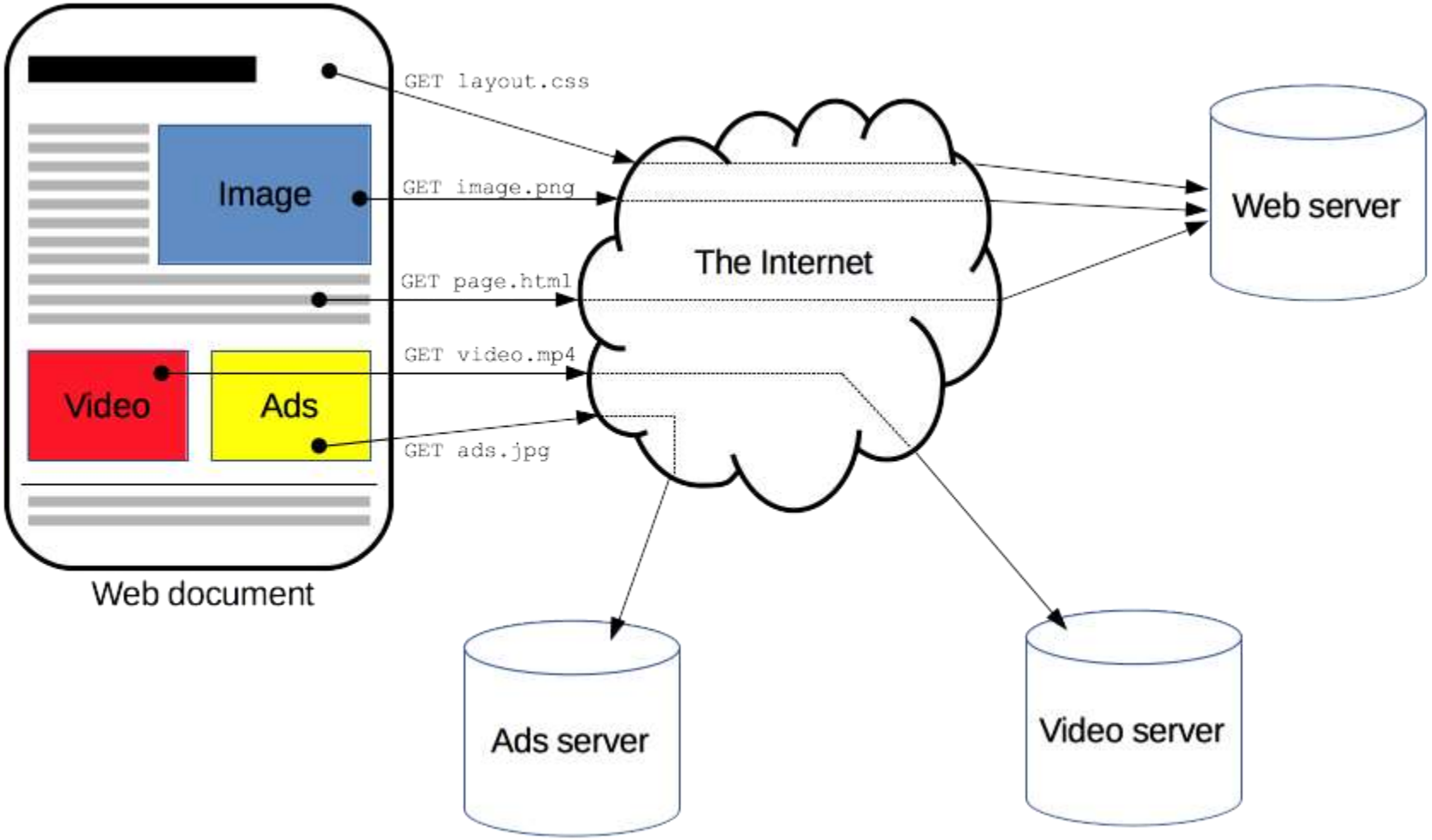
Hypertext Markup Language (HTML)

```html
<!DOCTYPE html>
<html>
<head>
<title>Page Title</title>
</head>
<body>

<h1>My First Heading</h1>
<p>My first paragraph.</p>

</body>
</html>
```

Hypertext Transfer Protocol (HTTP) 1



Hypertext Transfer Protocol (HTTP) 2

- HTTP is an application-layer protocol for transmitting hypermedia documents, such as HTML.
- It was designed for communication between web browsers and web servers, but it can also be used for other purposes.
- HTTP follows a classical client-server model, with a client opening a connection to make a request, then waiting until it receives a response.

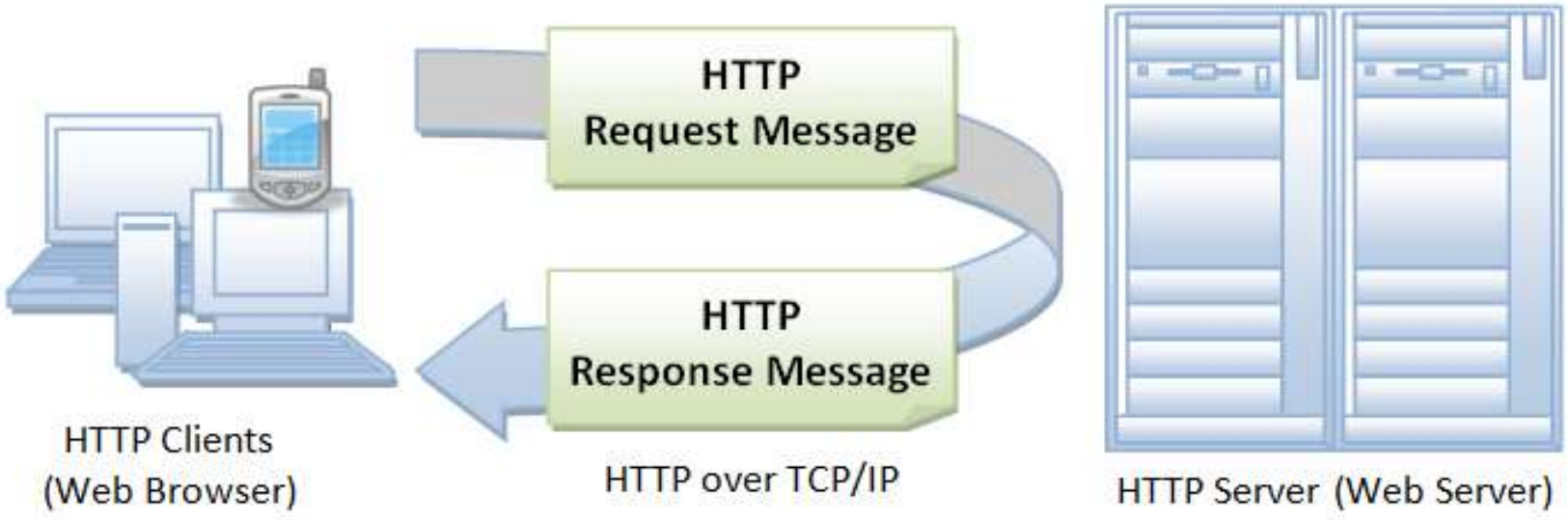
Hypertext Transfer Protocol (HTTP) 3

- HTTP is a protocol which allows the fetching of resources, such as HTML documents.
- It is the foundation of any data exchange on the Web and a client-server protocol, which means requests are initiated by the recipient, usually the Web browser.
- A complete document is reconstructed from the different sub-documents fetched, for instance text, layout description, images, videos, scripts, and more.

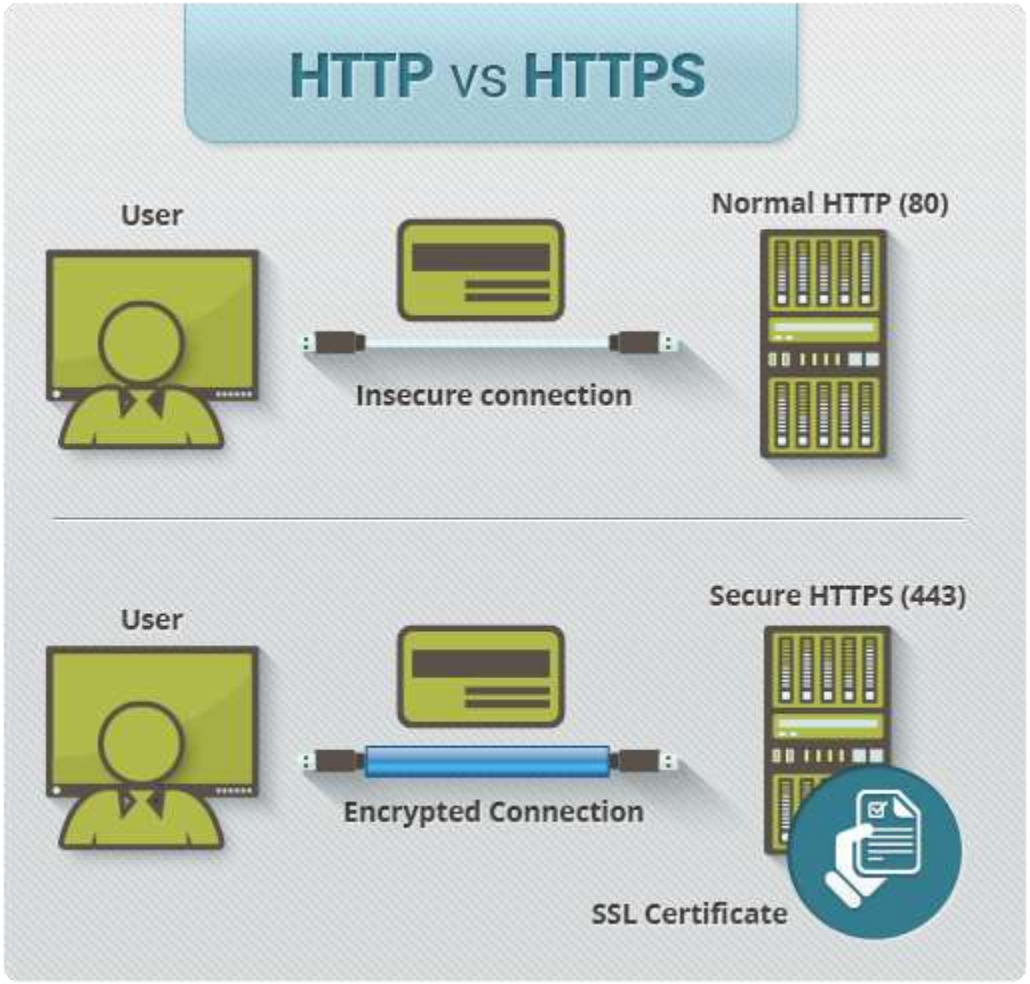
Hypertext Transfer Protocol (HTTP) 4

- HTTP is a client-server protocol: requests are sent by one entity, the user-agent (or a proxy on behalf of it). Most of the time the user-agent is a Web browser, but it can be anything, for example a robot that crawls the Web to populate a search engine index.
- Each individual request is sent to a server, which will handle it and provide an answer, called the response. Between this request and response there are numerous entities, proxies, which perform different operations and act as gateways or caches, for example.

Hypertext Transfer Protocol (HTTP) 5



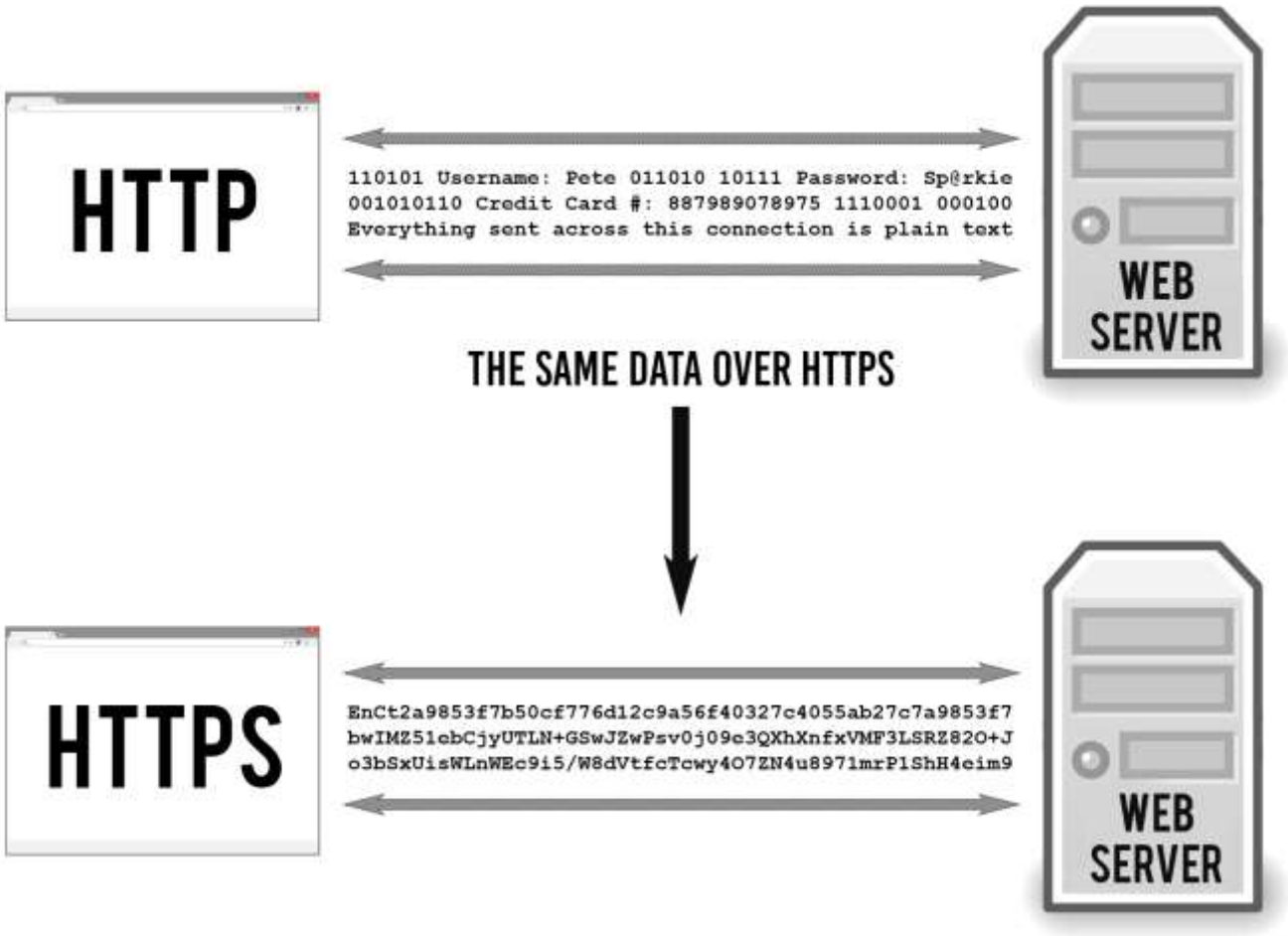
HTTPS


HTTP vs HTTPS
User
Normal HTTP (80)
Insecure connection
User
Secure HTTPS (443)
Encrypted Connection
SSL Certificate

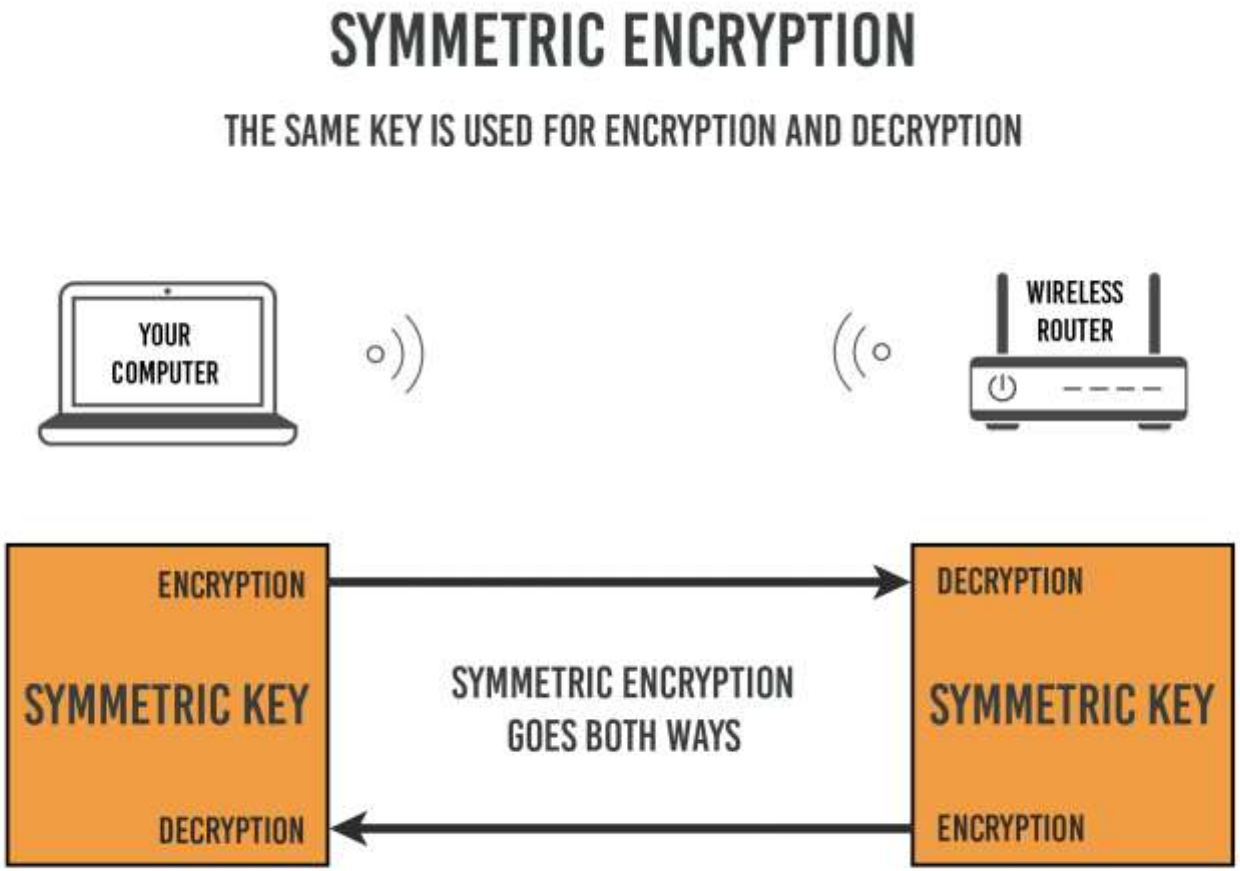
HTTPS

- HTTPS is simply your standard HTTP protocol slathered with a generous layer of delicious SSL/TLS encryption goodness.
- It prevents people from viewing or modifying the requests that make up your browsing experience; it's what keeps your passwords, communications and credit card details safe on the wire between your computer and the servers you want to send this data to.

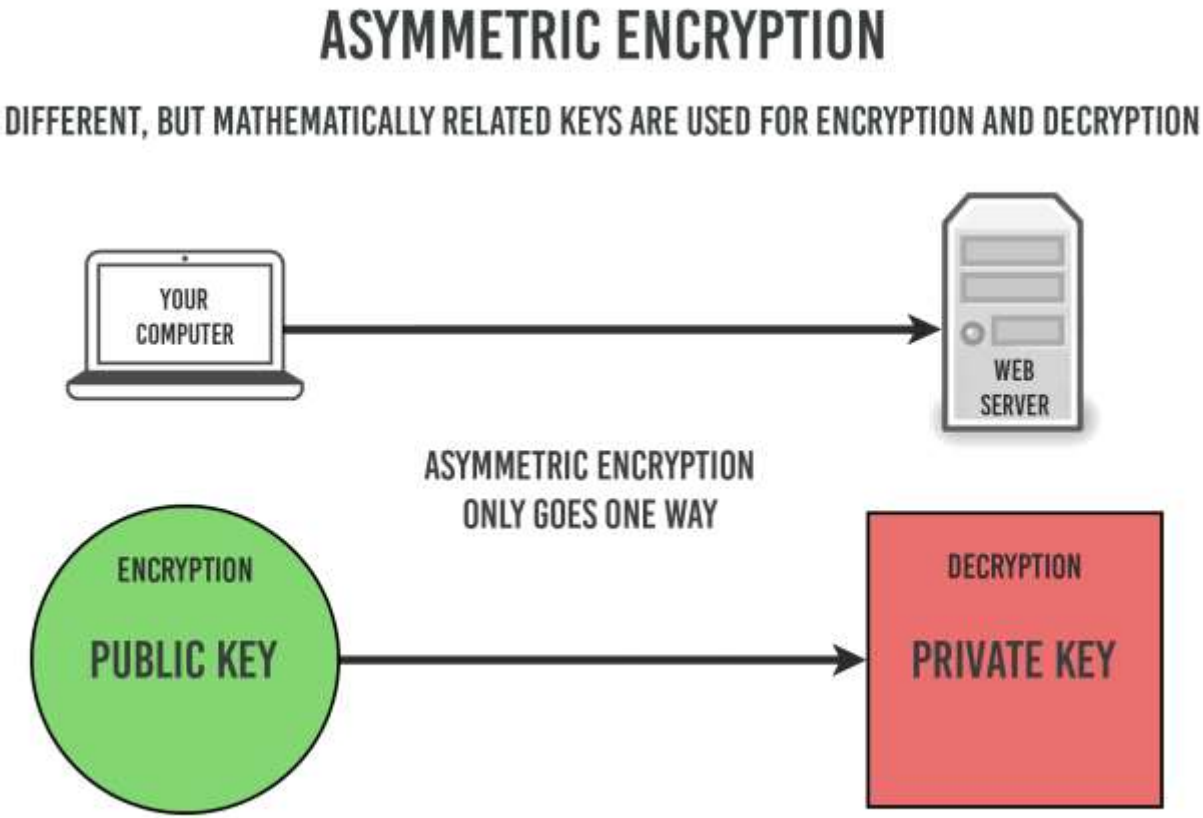
HTTPS


HTTP
110101 Username: Pete 011010 10111 Password: Sp@rkie
001010110 Credit Card #: 887989078975 1110001 000100
Everything sent across this connection is plain text
WEB SERVER
THE SAME DATA OVER HTTPS
HTTPS
EnCt2a9853f7b50cf776d12c9a56f40327c4055ab27c7a9853f7
bwIMZ51cbCjyUTLN+GSwJZwPsv0j09e3QXhXnfxVMF3LSRZ82O+J
o3bSxUisWLnWEc9i5/W8dVtfcTcwy4O7ZN4u8971mrP1ShH4eim9
WEB SERVER

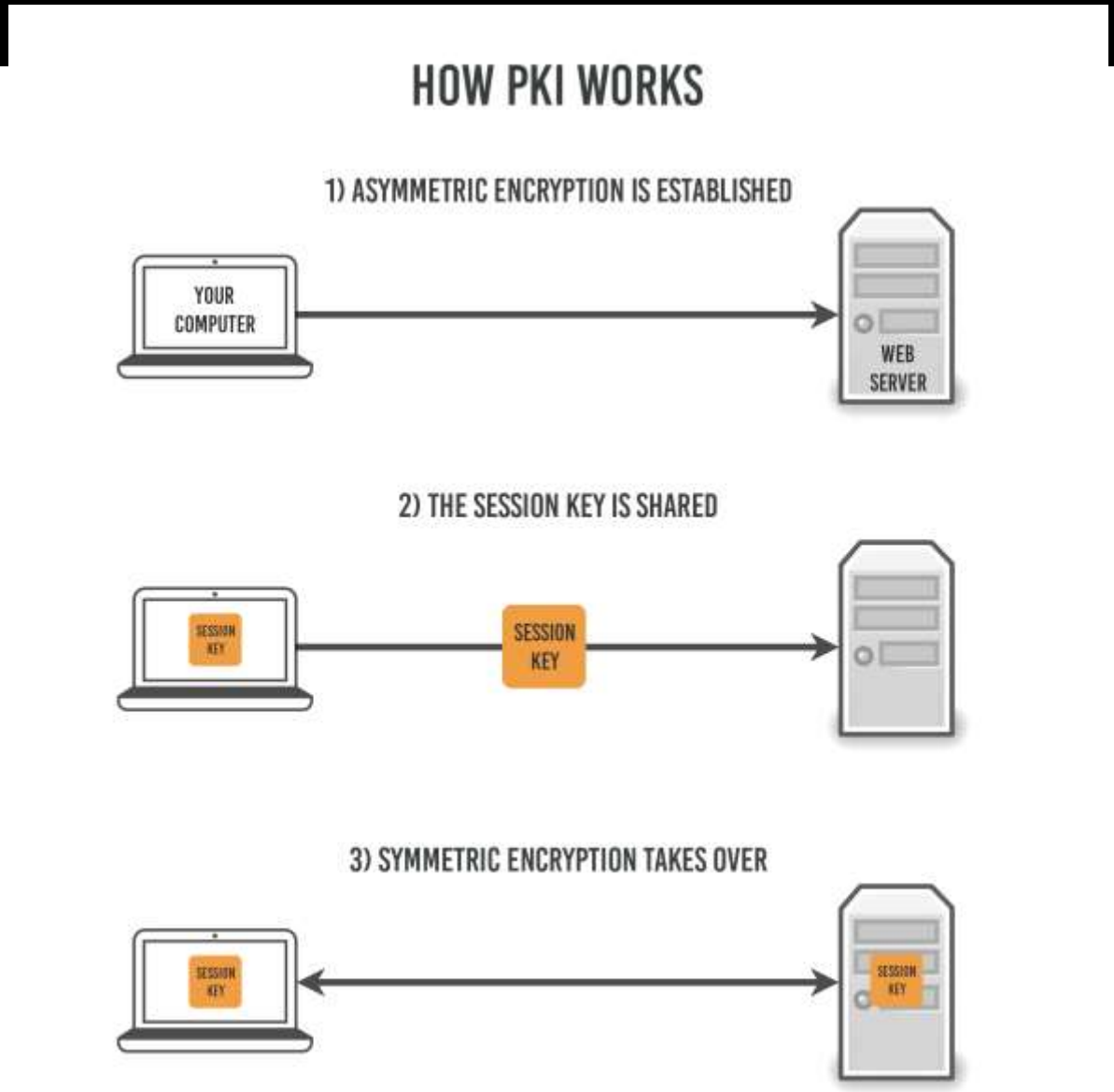
HTTPS


SYMMETRIC ENCRYPTION
THE SAME KEY IS USED FOR ENCRYPTION AND DECRYPTION
YOUR COMPUTER
WIRELESS ROUTER
ENCRYPTION
SYMMETRIC KEY
DECRYPTION
SYMMETRIC ENCRYPTION GOES BOTH WAYS
DECRYPTION
SYMMETRIC KEY
ENCRYPTION

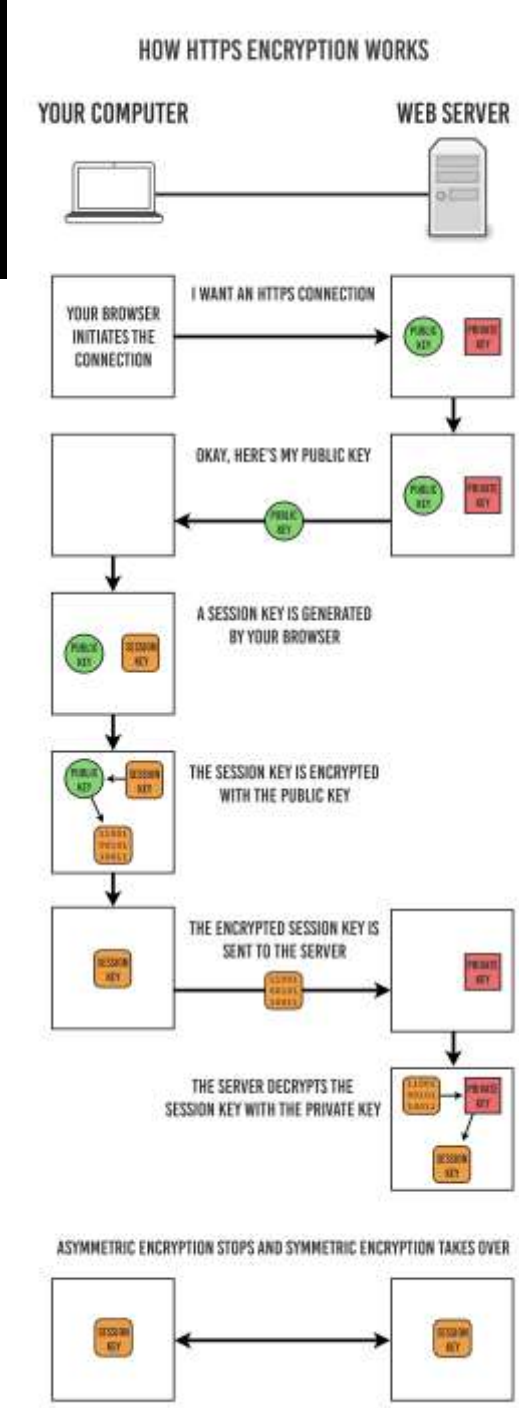
HTTPS


ASYMMETRIC ENCRYPTION
DIFFERENT, BUT MATHEMATICALLY RELATED KEYS ARE USED FOR ENCRYPTION AND DECRYPTION
YOUR COMPUTER
WEB SERVER
ASYMMETRIC ENCRYPTION ONLY GOES ONE WAY
ENCRYPTION
PUBLIC KEY
DECRYPTION
PRIVATE KEY

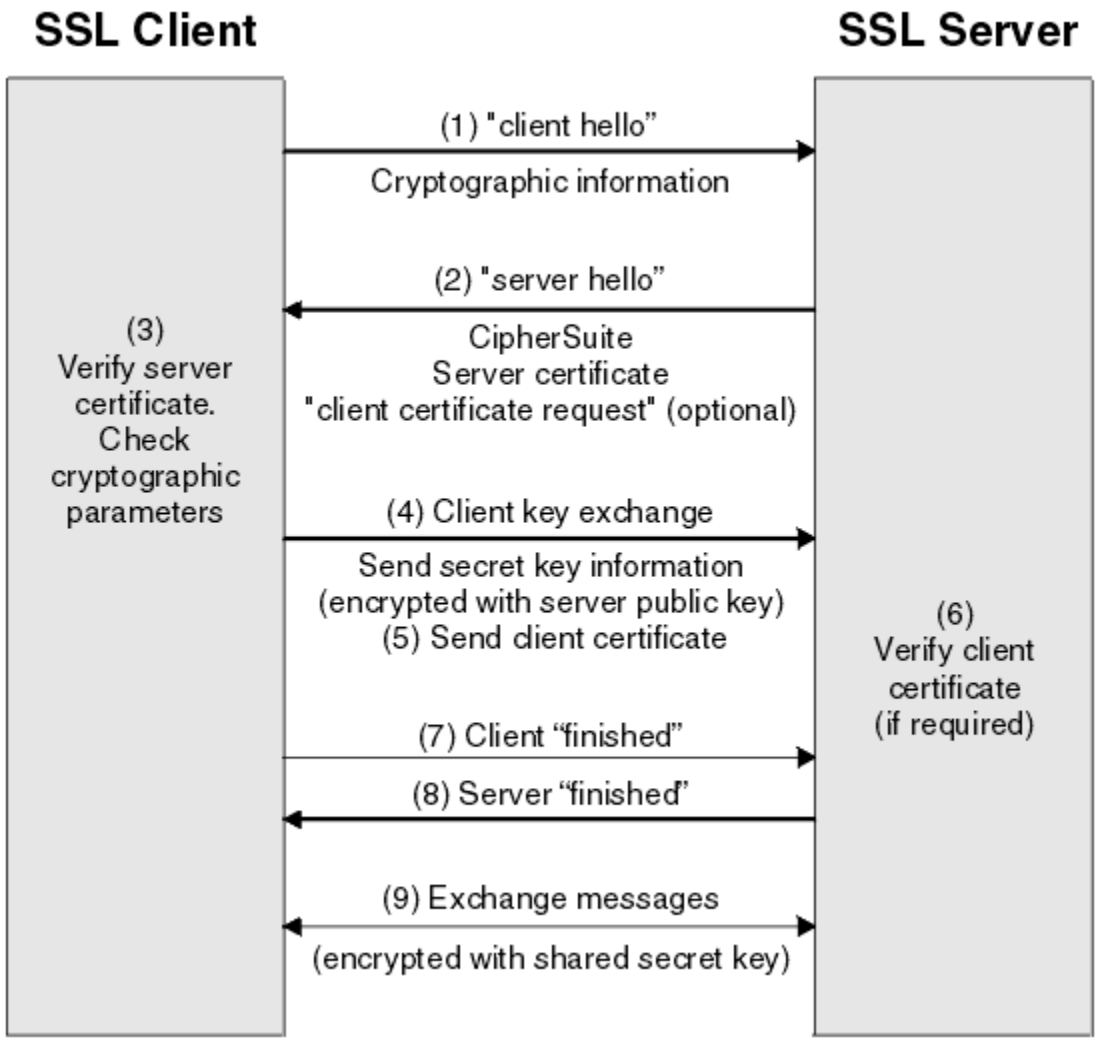
HTTPS


HOW PKI WORKS
1) ASYMMETRIC ENCRYPTION IS ESTABLISHED
YOUR COMPUTER
WEB SERVER
2) THE SESSION KEY IS SHARED
SESSION KEY
SESSION KEY
3) SYMMETRIC ENCRYPTION TAKES OVER
SESSION KEY
SESSION KEY

HTTPS


HOW HTTPS ENCRYPTION WORKS
YOUR COMPUTER
WEB SERVER
YOUR BROWSER INITIATES THE CONNECTION
I WANT AN HTTPS CONNECTION
OKAY, HERE'S MY PUBLIC KEY
A SESSION KEY IS GENERATED BY YOUR BROWSER
THE SESSION KEY IS ENCRYPTED WITH THE PUBLIC KEY
THE ENCRYPTED SESSION KEY IS SENT TO THE SERVER
THE SERVER DECRYPTS THE SESSION KEY WITH THE PRIVATE KEY
ASYMMETRIC ENCRYPTION STOPS AND SYMMETRIC ENCRYPTION TAKES OVER

HTTPS


SSL Client
SSL Server
(1) "client hello"
Cryptographic information
(2) "server hello"
CipherSuite
Server certificate
"client certificate request" (optional)
(3)
Verify server certificate.
Check cryptographic parameters
(4) Client key exchange
Send secret key information
(encrypted with server public key)
(5) Send client certificate
(6)
Verify client certificate
(if required)
(7) Client "finished"
(8) Server "finished"
(9) Exchange messages
(encrypted with shared secret key)

Web Page

- Web pages are documents or information resources that are suitable for the World Wide Web
- Can be accessed through a web browser and displayed on a monitor or a mobile device
- This information is usually in HTML or XHTML format, and may provide navigation to other web pages via hypertext links
- Web pages frequently refer to other resources such as style sheets (CSS), scripts (JavaScript) and images into their final presentation

Web Sites

- Are collections of related web pages containing web resources (web pages, images, videos, CSS files, JS files or other digital assets)
- Have common navigation between web pages
- Are hosted on at least one web server
- Are accessible via a network (such as the Internet)

Web Application

A web application or web app is a client–server computer program which the client (including the user interface and client-side logic) runs in a web browser. Common web applications include webmail, online retail sales, online auctions, wikis, instant messaging services and many other functions.

Web Application

1. **User** triggers a request to the **web server** over the **Internet**, either through a web browser or the application's user interface
2. **Web server** forwards this request to the appropriate **web application server**
3. **Web application server** performs the requested task – such as querying the **database** or processing the data – then generates the results of the requested data
4. **Web application server** sends results to the **web server** with the requested information or processed data
5. **Web server** responds back to the client with the requested information that then appears on the user's display

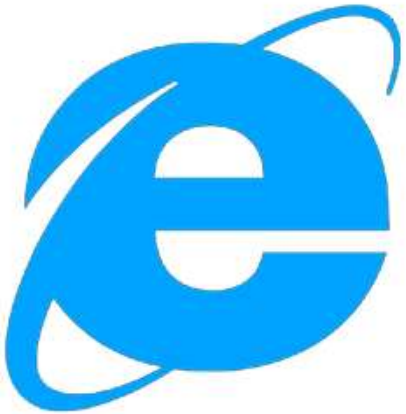
Web Browser

Opera

Google Chrome

Safari

Mozilla Firefox



Internet Explorer

Microsoft Edge

Web Browser

- A web browser (commonly referred to as a browser) is a software application for accessing information on the World Wide Web.
- Each individual web page, image, and video is identified by a distinct URL, enabling browsers to retrieve and display them on the user's device.

Web Browser

- In the case of https: the communication between the browser and the web server is encrypted for the purposes of security and privacy. Another URL prefix is file: which is used to display local files already stored on the user's device.
- Once a web page has been retrieved, the browser's rendering engine displays it on the user's device. This includes image and video formats supported by the browser.

Web Browser

- Web browser fetches information resources and display them on a user's device.
- This process begins when the user inputs a URL, such as https://example.com/ into the browser. Virtually all URLs on the Web start with either http: or https: which means the browser will retrieve them with the Hypertext Transfer Protocol.

Layout Engines

- Layout Engines are software components that displays the formatted content on the screen combining:
- Marked up content (such as HTML, XML, image files, etc.)
- Formatting information (such as CSS, XSL, etc.)
- It "paints" on the content area of a window, which is displayed on a monitor or a printer
- Typically embedded in web browsers, e-mail clients, on-line help systems or other applications that require the displaying (and editing) of web content
- The layout engine is the "heart of a browser"

Layout Engines and Browsers

Engine	Status	Steward	License	Embedded in
Blink	Active	Google	GNU LGPL, BSD-style	Google Chrome and Chromium, plus many other browsers including Opera and Vivaldi
EdgeHTML	Active	Microsoft	Proprietary	Microsoft Edge browser and Universal Windows Platform apps
Gecko	Active	Mozilla	Mozilla Public	Firefox browser and Thunderbird email client, plus forks like SeaMonkey and Waterfox
Goanna	Active	M.C. Straver[1]	Mozilla Public	Pale Moon and Basilisk browsers
Servo	Active	Mozilla	Mozilla Public	experimental browser
WebKit	Active	Apple	GNU LGPL, BSD-style	Safari browser, Adobe AIR apps, and other browsers like Maxthon
KHTML	Discontinued	KDE	GNU LGPL	Konqueror browser
Presto	Discontinued	Opera Software	Proprietary	formerly in the Opera browser
Tasman	Discontinued	Microsoft	Proprietary	Internet Explorer for Mac and Microsoft Entourage
Trident	Discontinued	Microsoft	Proprietary	Internet Explorer browser and Microsoft Outlook email client

https://en.wikipedia.org/wiki/Comparison_of_browser_engines

Layout Engines and Browsers 2019

Engine	Status	Steward	License	Embedded in
WebKit	Active	Apple	GNU LGPL, BSD-style	Safari browser, plus all browsers hosted on the iOS App Store
Blink	Active	Google	GNU LGPL, BSD-style	Google Chrome and all other Chromium-based browsers such as Microsoft Edge, Brave and Opera
Gecko	Active	Mozilla	Mozilla Public	Firefox browser and Thunderbird email client, plus forks such as SeaMonkey and Waterfox
Servo	Active	Mozilla	Mozilla Public	experimental browser
Goanna	Active	M. C. Straver[4]	Mozilla Public	Pale Moon and Basilisk browsers
NetSurf	Active	hobbyists[5]	GNU GPLv2	NetSurf browser[6]
KHTML	Discontinued	KDE	GNU LGPL	Konqueror browser
Trident	Discontinued	Microsoft	Proprietary	Internet Explorer browser and Microsoft Outlook email client
EdgeHTML	Discontinued	Microsoft	Proprietary	formerly in the Microsoft Edge browser
Presto	Discontinued	Opera Software	Proprietary	formerly in the Opera browser

https://en.wikipedia.org/wiki/Comparison_of_browser_engines

Layout Engines and Browsers 2019

Engine	Status	Embedded in
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Presto	Discontinued	formerly in the Opera browser
EdgeHTML	Discontinued	formerly in the Microsoft Edge browser
Trident	Discontinued	Internet Explorer browser and Microsoft Outlook email client

https://en.wikipedia.org/wiki/Comparison_of_browser_engines

User Agent

In computing, a user agent is software (a software agent) that is acting on behalf of a user. One common use of the term refers to a web browser telling a website information about the browser and operating system. This allows the website to customize content for the capabilities of a particular device, but also raises privacy issues.

User Agent


```
Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/69.0.3497.100 Safari/537.36
```

Copy/paste any user agent string in this field and click 'Analyze'

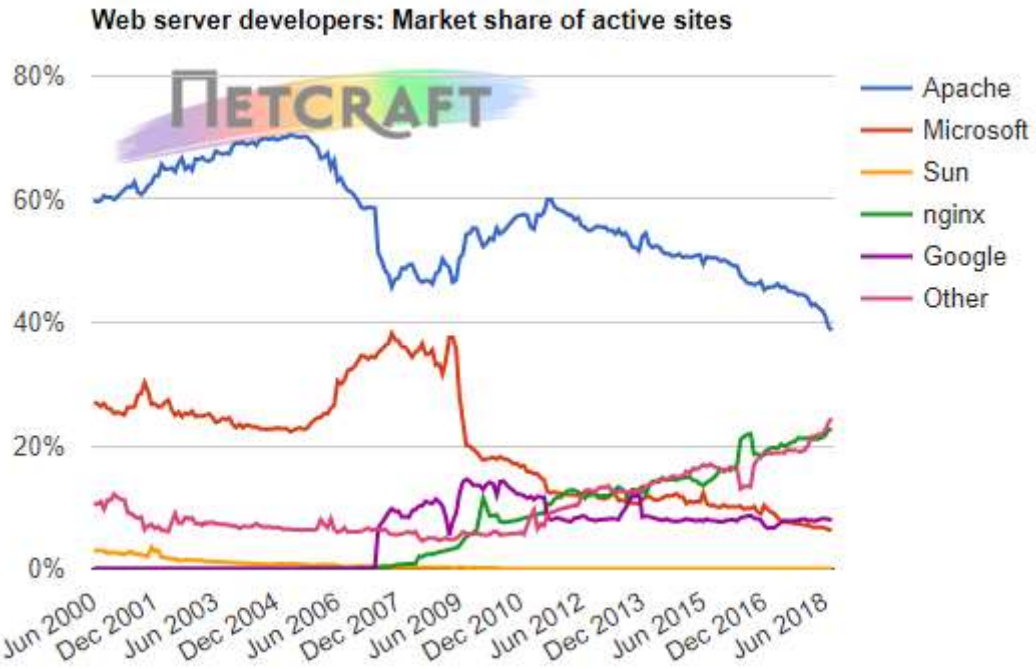
Analyze

Chrome 69.0.3497.100	
Mozilla	MozillaProductSlice. Claims to be a Mozilla based user agent, which is only true for Gecko browsers like Firefox and Netscape. For all other user agents it means 'Mozilla-compatible'. In modern browsers, this is only used for historical reasons. It has no real meaning anymore
5.0	Mozilla version
Windows NT 10.0	Operating System: Windows 10
Win64	(Win32 for 64-Bit-Windows) API implemented on 64-bit platforms of the Windows architecture - currently AMD64 and IA64
x64	64-bit windows version
AppleWebKit	The Web Kit provides a set of core classes to display web content in windows
537.36	Web Kit build
KHTML	Open Source HTML layout engine developed by the KDE project
like Gecko	like Gecko...
Chrome	Name : Chrome
69.0.3497.100	Chrome version
Safari	Based on Safari
537.36	Safari build
Description:	Free open-source web browser developed by Google. Chromium is the name of the open source project behind Google Chrome, released under the BSD license.

Web Servers

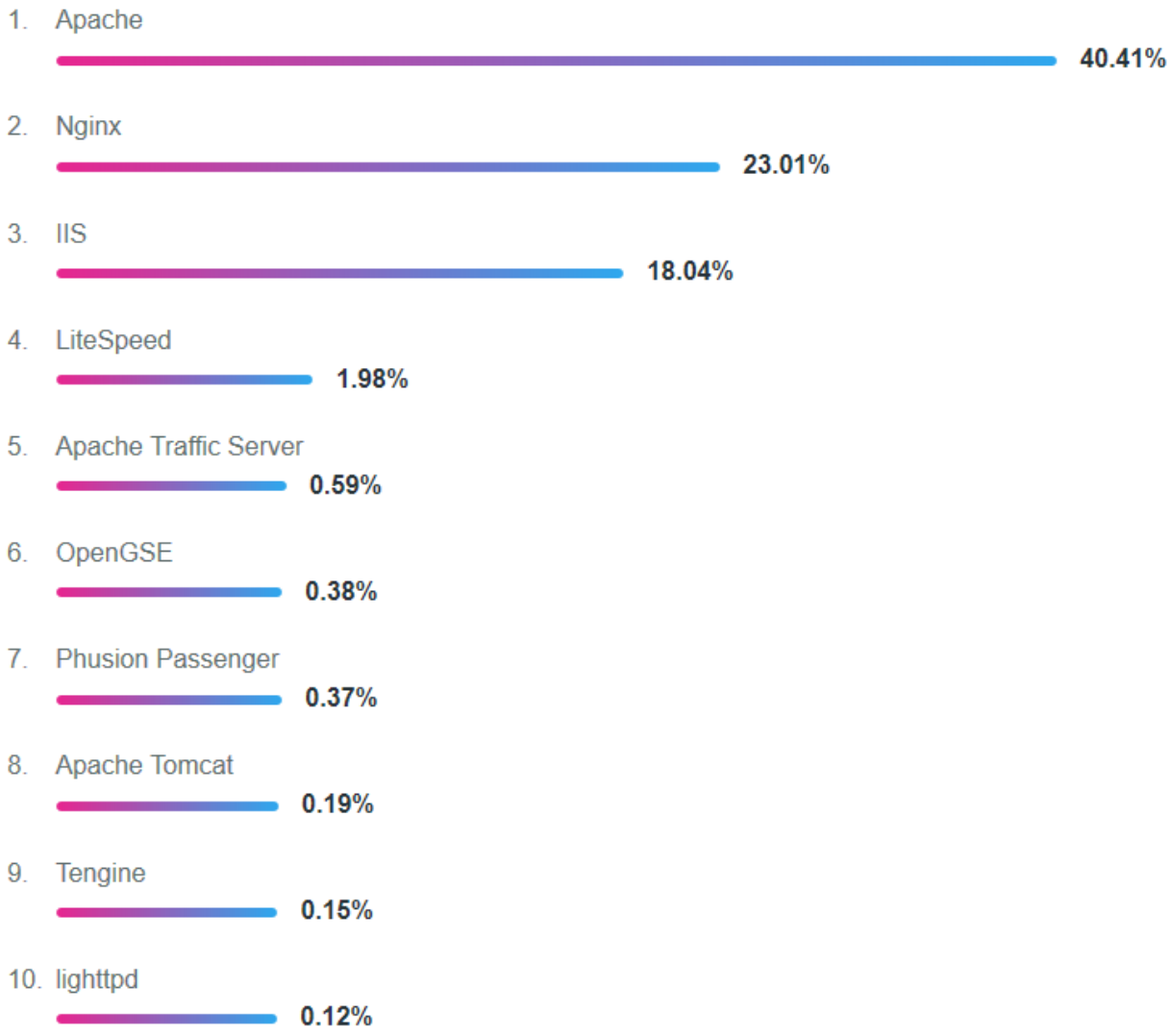
- All physical servers have hardware
- The hardware is controlled by the operating system
- Web servers are software products that use the operating system to handle web requests
- Web servers serve Web content
- These requests are redirected to other software products (ASP.NET, PHP, etc.), depending on the web server setting

Web Servers Market Share 2018



Developer	July 2018	Percent	August 2018	Percent	Change
Apache	72,209,166	39.30%	71,516,290	38.68%	-0.62
nginx	41,454,376	22.56%	41,922,177	22.67%	0.11
Google	14,745,102	8.02%	14,692,760	7.95%	-0.08
Microsoft	11,660,970	6.35%	11,566,589	6.26%	-0.09

Web Servers Market Share 2019



Client-Server Architecture

Client-Server Architecture

- The client-server model consists of:
- Server – a single machine or cluster of machines
- that provides web applications (or services) to
- multiple clients
- Examples:
- Web server running PHP scripts or ASP.NET pages
- IIS based Web server
- WCF based service
- Services in the cloud

Client-Server Architecture

- The client-server model consists of:
- Clients –software applications that provide UI
- (front-end) to access the services at the server

Examples:

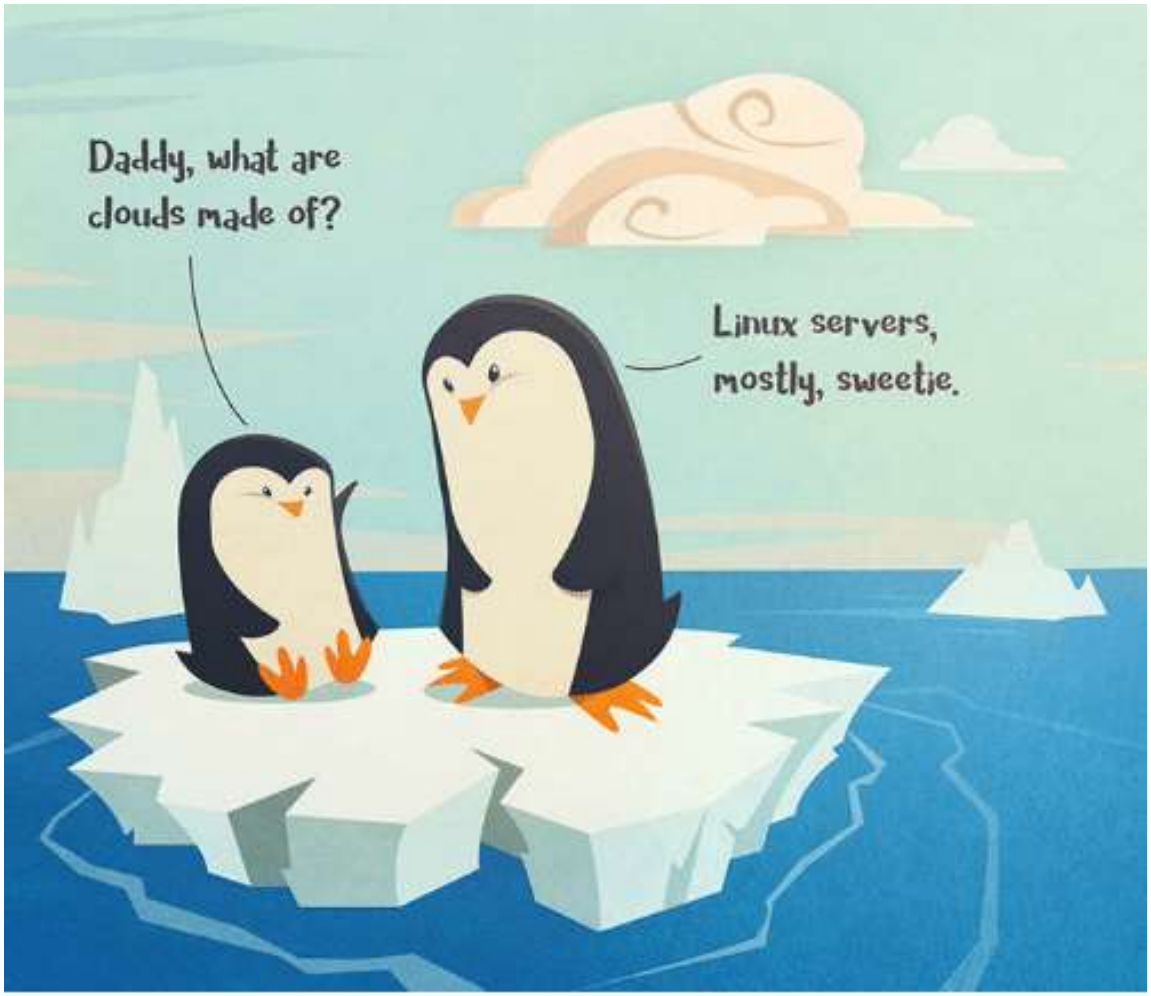
- Web browsers
- WPF applications
- HTML5 applications
- Silverlight applications
- ASP.NET consuming services

Client-Server Examples

- Web server (Apache, IIS) – Web browser
- FTP server (ftpd) – FTP client (FileZilla)
- EMail server (qmail) – email client (Outlook)
- SQL Server – SQL Server Management Studio
- BitTorrent Tracker – Torrent client (µTorrent)
- DNS server (bind) – DNS client (resolver)
- DHCP server (wireless router firmware) – DHCP
- client (mobile phone /Android DHCP client/)

The Cloud

The Cloud



Clouds and Linux servers

What is Cloud

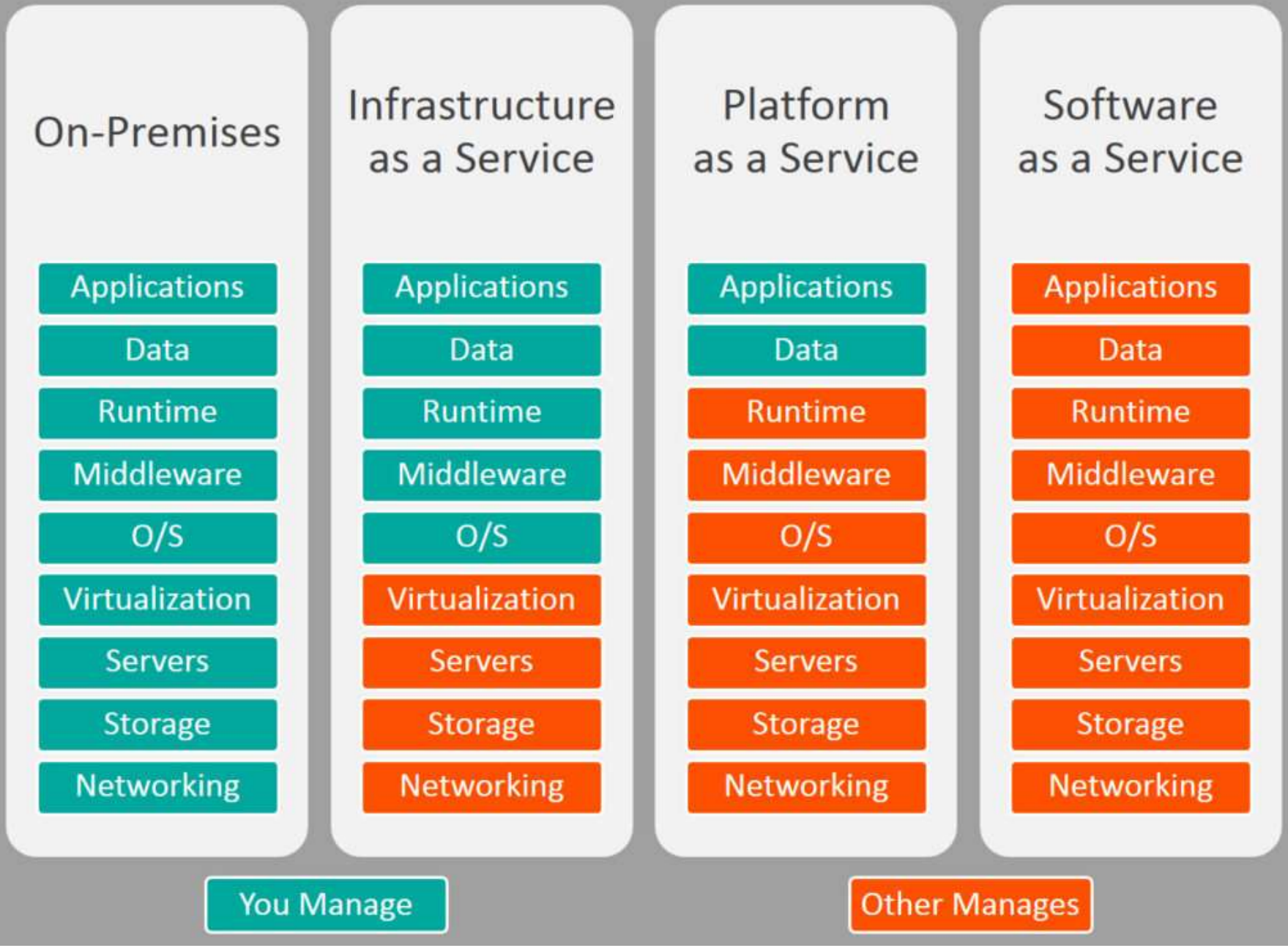
- Cloud computing is shared pools of configurable computer system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the Internet.
- While the term "cloud computing" was popularized with Amazon.com releasing its Elastic Compute Cloud product in 2006, references to the phrase "cloud computing" appeared as early as 1996, with the first known mention in a Compaq internal document.

What is Cloud

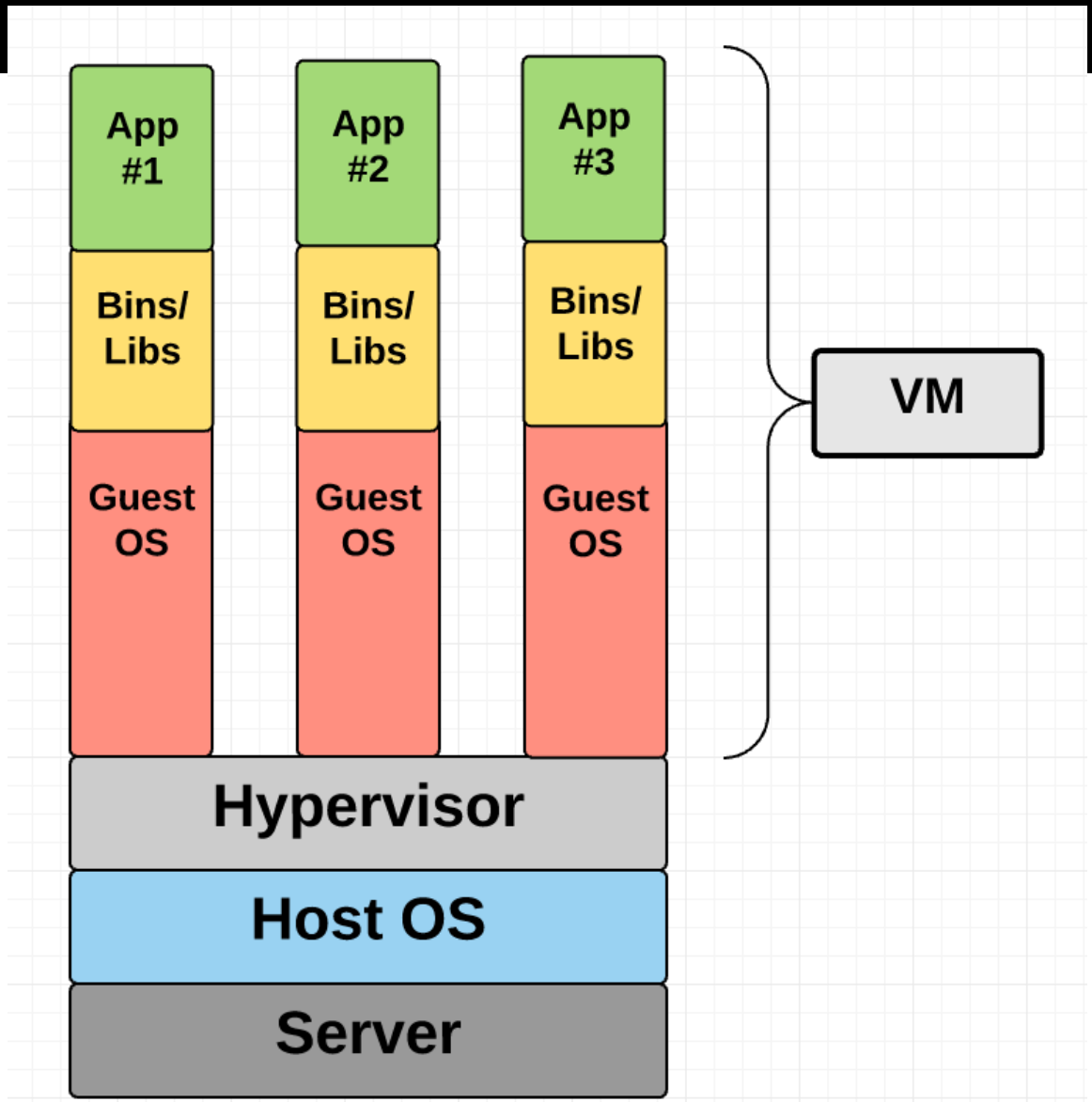
- Cloud => multiple hardware machines combine their computing power and resources
- Share them between multiple applications
- To save costs and use resources more efficiently
- Public clouds
- Provide computing resources on demand
  - Publicly in Internet
  - Paid or free of charge (to some limit)
- Amazon AWS, Google App Engine, Microsoft Azure, Rackspace, PHPFog, Heroku, AppHarbor

Cloud Computing Models

- Infrastructure as a Service (IaaS)
  - Virtual machines in the cloud on demand
  - Users install the OS and software they need
- Platform as a Service (PaaS)
  - Platform, services and APIs for developers
  - E.g. Java + JBoss + JSF + JPA + MongoDB or
  - JavaScript + Node.js + MongoDB + RabbitMQ
- Software as a Service (SaaS)
  - Hosted application on demand (e.g. Google Apps, Microsoft Office 365, WordPress)


On-Premises
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Infrastructure as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Platform as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Software as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
You Manage
Other Manages

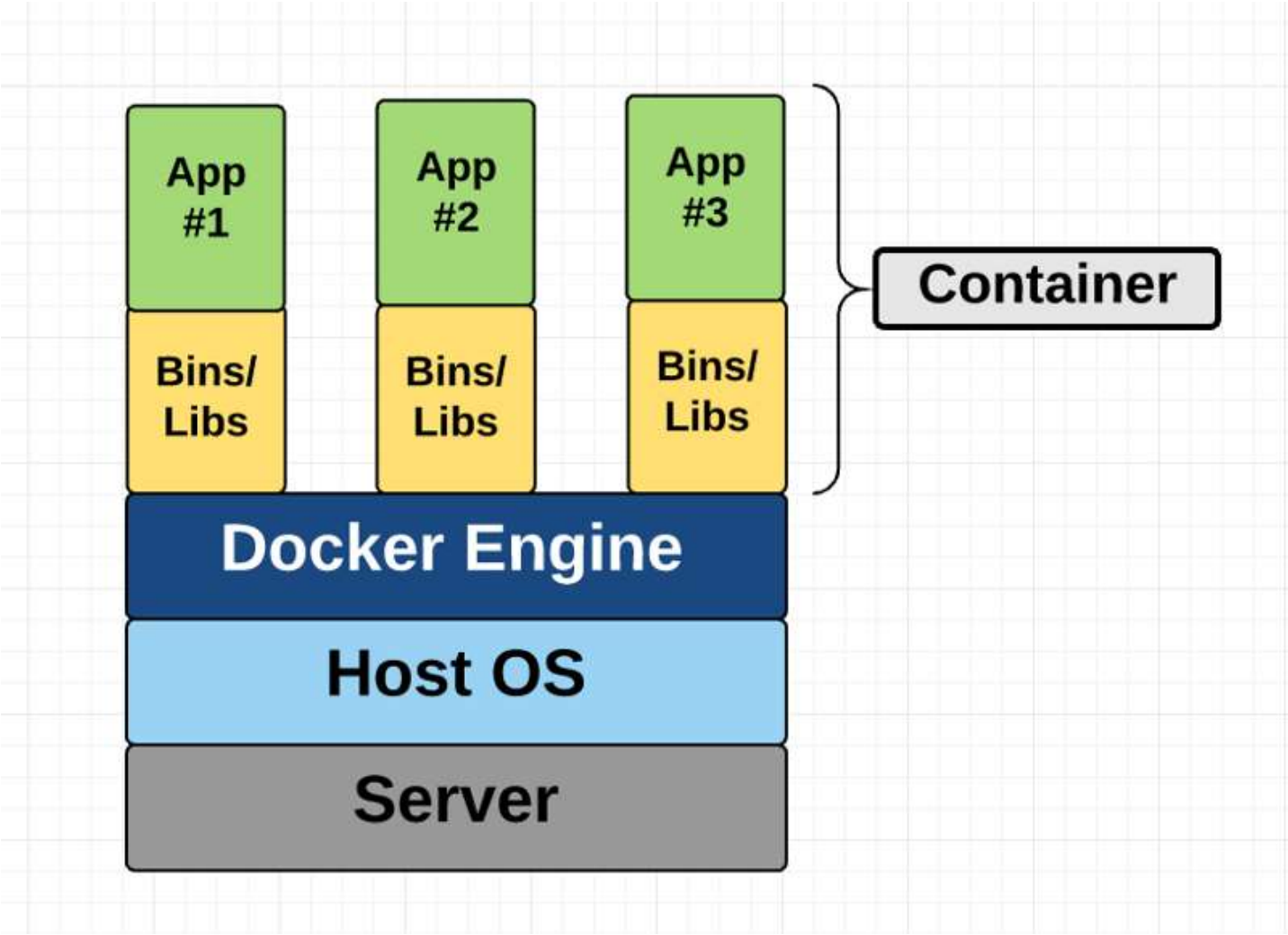
The Cloud VMs



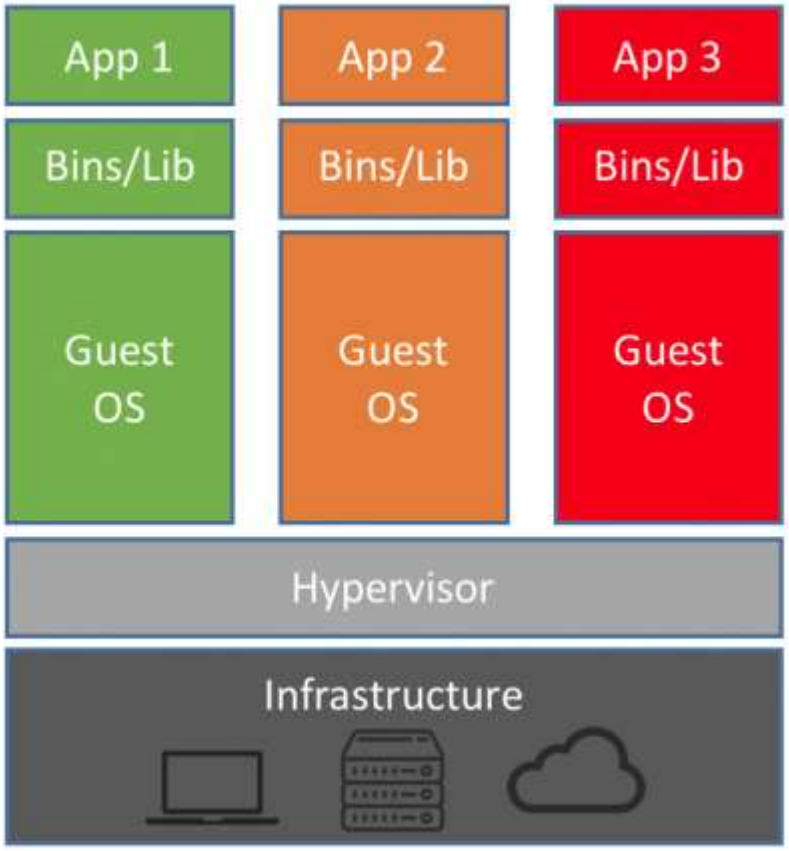
The Cloud - Containers

It works on my machine...

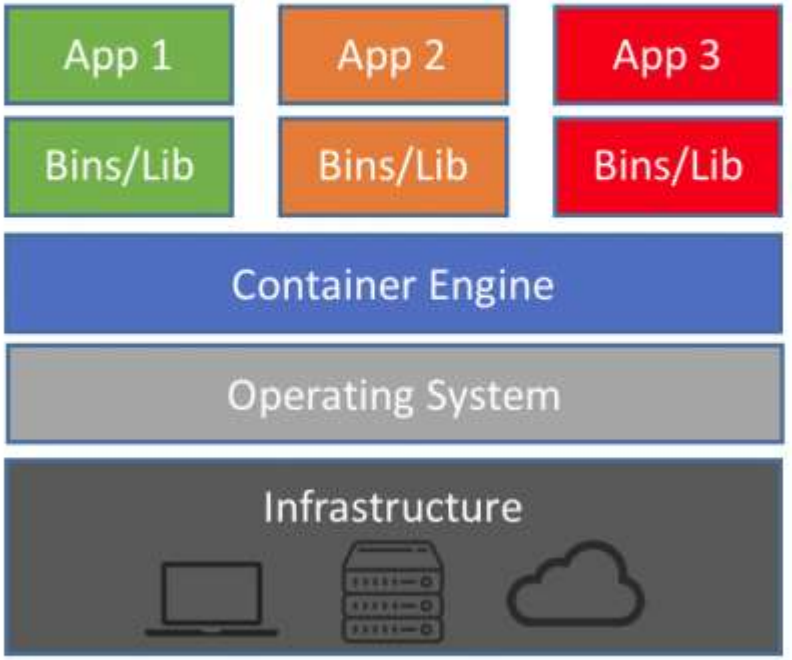
The Cloud - Containers



The Cloud



Machine Virtualization



Containers

Main characteristics

Web Application Testing

Web-based Applications

- Most software applications today are written as web-based applications
  - Being run in an Internet browser

Web Testing Issues

- Testing a web application is quite a bit more difficult than testing the same functionality in a Desktop application
- Various issues are present:
  - Timing difficulties
  - Differences between browsers
  - New technologies that make web browsing a rich, but difficult-to-test, experience

Web Testing Issues (2)

- Web browsers don't provide clear visibility to what's happening on the page
  - The tester has no straight-forward way of consistently identifying an element on a web page and detecting changes in the element's state

Web Testing Issues (3)

- New technologies introduce new testing issues
  - The same features that make web browsing a richer experience also present obstacles to testing
    - Asynchronous processes
    - Client side code running directly in the browser
    - Animation
    - Etc.

Web Testing Tools Categories

Web Testing Tools

- Web testing tools are a common type of test tool, used for:
  - Functional/Regression Testing
  - Load and Performance Testing
  - Web Site Security Testing
  - Web Site Management Testing
  - Mobile Web/App Testing

Web Testing Tools

- Web testing tools are a common type of test tool, used for:
  - Scanning websites for broken or missing hyperlinks (Link checkers)
  - Static analysis on HTML, checking for conformance to standards

Main Web Testing Methods

Web Page Functionality Test

- Functionality Testing
  - Check all the links
    - the outgoing links from all the pages from specific domain under test
    - all internal links
    - links jumping on the same pages
    - links used to send the email
    - check if there are any orphan pages
    - check for broken links

Web Page Functionality Test

- Functionality Testing
  - Test forms in all pages
    - Check all the validations on each field
    - Check for the default values of fields
    - Wrong inputs to the fields in the forms
    - Options to create forms if any,
      form delete, view
      or modify the forms

Web Page Functionality Test

- Functionality Testing
  - Cookies testing
    - Test the application by enabling or disabling the cookies in your browser options
    - Test if the cookies are encrypted before they are written to user machine
    - Check application security by deleting the cookies

HTTP Cookies

- An HTTP cookie (also called web cookie, Internet cookie, browser cookie, or simply cookie) is a small piece of data sent from a website and stored on the user's computer by the user's web browser while the user is browsing.
- Cookies were designed to be a reliable mechanism for websites to remember stateful information (such as items added in the shopping cart in an online store) or to record the user's browsing activity.

HTTP Cookies (2)

- Other kinds of cookies perform essential functions in the modern web. Perhaps most importantly, **authentication cookies** are the most common method used by web servers to know whether the user is logged in or not, and which account they are logged in with.
- Without such a mechanism, the site would not know whether to send a page containing sensitive information, or require the user to authenticate themselves by logging in.

HTTP Cookies (3)

- Good use of cookies:
- Cookies store your login state. Without them, you wouldn’t be able to log into websites. Websites use cookies to remember and identify you.
- Cookies store preferences on websites. You couldn’t change settings and have them persist between page loads without cookies.
- Cookies allow websites to provide personalized content. For example, if you’re shopping on Amazon, Amazon can remember the products you’ve browsed and recommend similar products – even if you’re not logged in.

HTTP Cookies (4)

- Not so good use of cookies:
- Advertising and tracking networks use tracking cookies to track you across the web. When you visit website that uses scripts from an advertising network, that network can set a cookie in your browser. When you visit another website that uses tracking scripts from the same network, the advertising network can check the value of your cookie – it knows the same person visited both websites.
- This information is used to target ads to you – for example, if you search for smart phone and later visit a news website, you may see advertisements for smart phone on the news website

HTTP Cookies (5)

- Session cookie
- A session cookie, also known as an in-memory cookie, transient cookie or non-persistent cookie, exists only in temporary memory while the user navigates the website. Browsers normally delete session cookies when the user closes the browser. Unlike other cookies, session cookies do not have an expiration date assigned to them, which is how the browser knows to treat them as session cookies.

HTTP Cookies (6)

- Persistent cookie
- A persistent cookie expires at a specific date or after a specific length of time. This means that, for the cookie's entire lifespan, its information will be transmitted to the server every time the user visits the website that it belongs to, or every time the user views a resource belonging to that website from another website (such as an advertisement).
- For this reason, persistent cookies are sometimes referred to as tracking cookies because they can be used by advertisers to record information about a user's web browsing habits over an extended period of time.
- However, they are also used for "legitimate" reasons (such as keeping users logged into their accounts on websites, to avoid re-entering login credentials at every visit).

Web Page Functionality Test

- Functionality Testing
  - Test HTML and CSS
    - Checking for syntax errors
    - Readable color schemas
    - Standard compliance
      - E.g. standards such W3C and ISO is followed

Web Page Functionality Test

- Functionality Testing
  - Database testing
    - Testing the backend databases, like comparing the actual results with expected resu

Web Page Functionality Test

- Functionality Testing
  - Database testing basically include
    - Data validity testing
      - Test if any errors are shown while executing queries
    - Data Integrity testing
      - Maintained while creating, updating or deleting data in database
    - Check response time of queries
    - Test data retrieved from the database is shown accurately in the web application

Usability Testing (1)

- Usability testing is the ability of the software product to be easy and understandable to use by its users.
- Usability is relevant not only for software products
- The users are key element in usability testing, expert testers might guide and monitor it, but aren’t always the best source of feedback.

Usability Testing (2)

Usability. Is the product easy to use?

- **Affordance**: product invites to discover possibilities of the product.
- **Intuitiveness**: it is easy to understand and explain what the product can do.
- **Minimalism**: there is nothing redundant about the product's content or appearance.
- **Learnability**: it is fast and easy to learn how to use the product.
- **Memorability**: once you have learnt how to do something you don't forget it.
- **Discoverability**: the product's information and capabilities can be discovered by exploration of the user interface.
- **Operability**: an experienced user can perform common actions very fast.
- **Interactivity**: the product has easy-to-understand states and possibilities of interacting with the application (via GUI or API).

Usability Testing (3)

Usability. Is the product easy to use?

- **Control**: the user should feel in control over the proceedings of the software.
- **Clarity**: is everything stated explicitly and in detail, with a language that can be understood, leaving no room for doubt?
- **Errors**: there are informative error messages, difficult to make mistakes and easy to repair after making them.
- **Consistency**: behavior is the same throughout the product, and there is one look & feel.
- **Tailorability**: default settings and behavior can be specified for flexibility.
- **Accessibility**: the product is possible to use for as many people as possible, and meets applicable accessibility standards.
- Documentation: there is a Help that helps, and matches the functionality.

Usability Testing (4)

Web Page Usability Test

- Web page usability test
  - A method of simulating the user's way of experience
    - E.g., checking help links, contents in the page, checking menu options and their links, think times between the pages and message dialogs in the pages

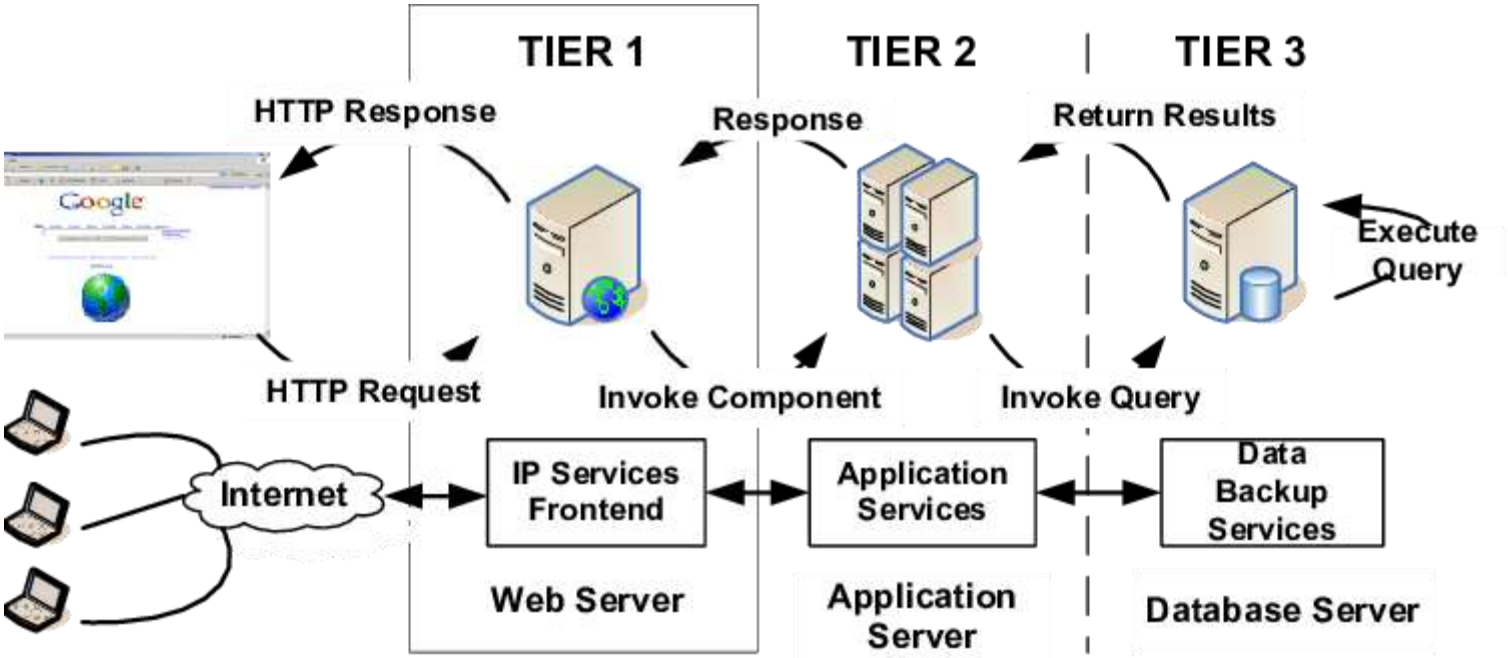
Web Page Usability Test

- Usability testing
  - Test for navigation
    - How the user surfs the web pages, different controls like buttons, boxes or how user using the links on the pages to surf different pages
    - Web site should be easy to use
    - Instructions should be provided clearly and correct (it means whether they satisfy purpose)

Web Page Usability Test

- Usability testing
  - Content checking
    - Content should be logical, easy to understand and meaningful
    - Check for spelling errors
    - All the anchor text links should be working properly
    - Images should be placed properly with proper sizes

Interface Testing



Interface Testing

- Interface Testing
  - The main layers are
    - Web server
    - Application server
    - Database server

  Check if all the interactions between these servers are executed properly

Compatibility Testing

- Compatibility Testing
  - Browser compatibility
  - Operating system compatibility
  - Mobile browsing
  - Printing options

Web Page Compatibility

- Testing web page compatibility
  - A method of testing multiple browsers based on user requirements
  - The web page presentation depends on how well the components are used

Web Page Compatibility Test

- Sample browser compatibility checklist

CSS validation
HTML or XHTML validation
Page validations with and without JavaScript enabled
Ajax and jQuery functionality
Font size validation
Page layout in different resolutions
All images and alignment
Header and footer sections
Page styles
Date formats
Special characters with HTML character encoding
Page zoom-in and zoom-out functionality

You can repeat these tests on different browsers and operating systems

Security Testing

Security Testing

- Security Testing basically include
  - Testing for vulnerabilities of the web application
    - Test unauthorized access to secure pages should not be permitted
    - Restricted files should not be downloadable without appropriate access
    - Check sessions are automatically killed after prolonged user inactivity
    - Check error handling - do not leak abstractions

Performance Testing

- Performance Testing
  - Verifies web page responses as per expectations based on the environment
  - Also includes stress testing and load testing of the application

Testing With Different Networks

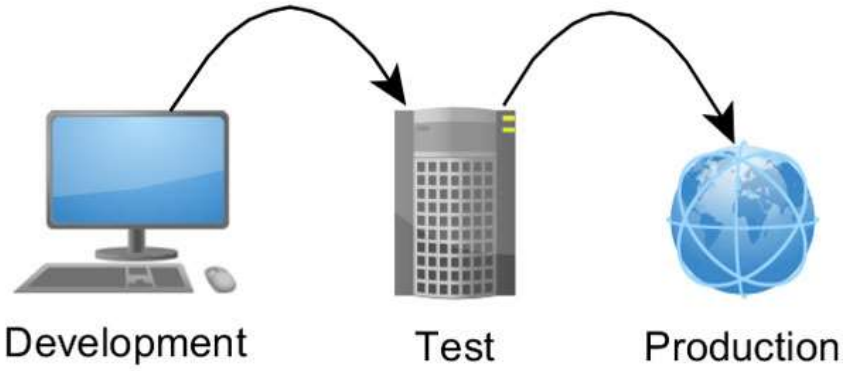
- Testing a web application using different networks
  - Required due to different points a user may access the system from
    - E.g., a local intranet or an internet with a lower network speed
  - An application's performance and the accessibility are based directly on the network used
  - This is also part of performance testing

Other Web Testing Methods

- There are many other types of testing that can be performed as part of Web Performance Testing:
  - Using different operating systems
  - Using different databases
  - Installing different versions of an operating system

Test Environment

- Set up a test environment that is separate from your development and production environment
- This includes a separate web server, database server, and application server if applicable



The Web and more...

Homework and reading

- https://en.wikipedia.org/wiki/Internet_protocol_suite
- https://en.wikipedia.org/wiki/Transmission_Control_Protocol
- https://en.wikipedia.org/wiki/Domain_Name_System
- https://en.wikipedia.org/wiki/Name_server
- https://technet.microsoft.com/pt-pt/library/cc786128(v=ws.10).aspx
- https://www.w3schools.com/html/html_intro.asp
- https://en.wikipedia.org/wiki/HTML
- https://en.wikipedia.org/wiki/Client%E2%80%93server_model
- https://www.maxcdn.com/one/visual-glossary/web-application/
- https://en.wikipedia.org/wiki/Comparison_of_browser_engines
- http://www.useragentstring.com/
- https://www.whatismybrowser.com/detect/what-is-my-user-agent
- https://en.wikipedia.org/wiki/Uniform_Resource_Identifier
- https://danielmiessler.com/study/url-uri/
- https://howhttps.works/
- https://www.freecodecamp.org/news/http-and-everything-you-need-to-know-about-it/
- https://www.visualcapitalist.com/what-happens-in-an-internet-minute-in-2019/
- https://gs.statcounter.com/
- https://hostadvice.com/marketshare/server/

Homework and reading

- http://www.pushtotest.com/guide-to-web-applications-testing
- https://www.softwaretestinghelp.com/web-application-testing/
- https://www.testing-web-sites.co.uk/testing-basics/what-is-web-testing/
- http://www.softwareqatest.com/qatweb1.html
- https://www.acunetix.com/websitesecurity/cross-site-scripting/
- https://www.w3schools.com/sql/sql_injection.asp
- https://wonderproxy.com/blog/9-tips-on-localization-testing/