

# Homeschooling Technology Class Series, by TTC

## Intro to Computer & Internet Theory

(12hr class, compressed into 2 hrs)

By: Thomas Weeks, Tweeks Technical Consulting, ©2013  
[tweeks-ttc@theweeks.org](mailto:tweeks-ttc@theweeks.org)

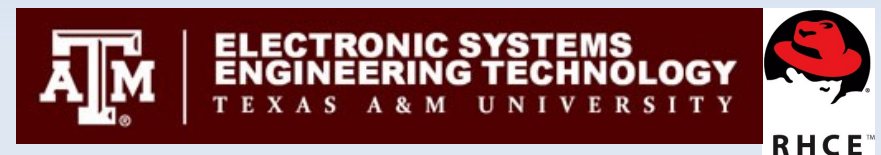
Prepared For: Let's Code Blacksburg!, 2015

# TTC: Intro To Computers About Me

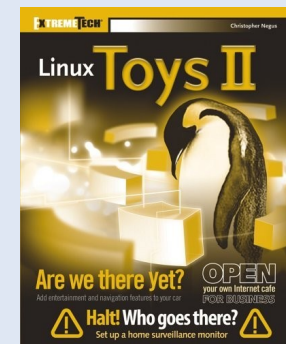
Thomas Weeks, Systems Engineer  
+ Community Liaison



BS-EET / Telecom TAMU, RHCE



Co-Authored:  
“The Linux Troubleshooting Bible”  
Contributing author on:  
“Linux Toys II”



President of XCSSA.ORG 14 yrs  
Founder of NRV Rocketry Club  
Organizer/Instructor for Let's Code



# Intro To Computer and Internet Theory

## Intro to Computer Theory

- How Were Computers Created?
- How Do Computers Work?
- How Data and File Storage Works
- Computer System's Files vs People's Files

## Intro to Internet Theory

- Client Computers and Server Computers
- How Computer Networks Work
- Computer Names vs IP Addresses
- Computer Networking Tool Labs



# Intro To Computers: How Were Computers Created?

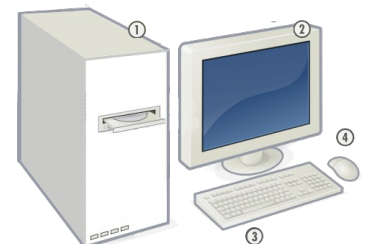
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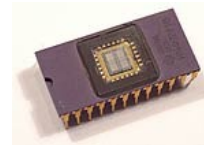
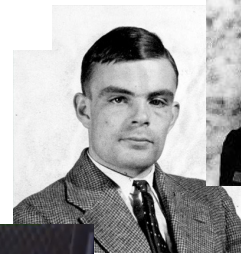
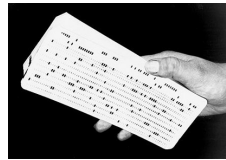
IBM



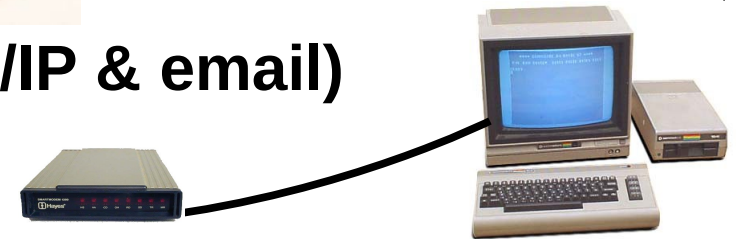
# Intro To Computers: How Were Computers Created?

## Computer & Internet History

IBM



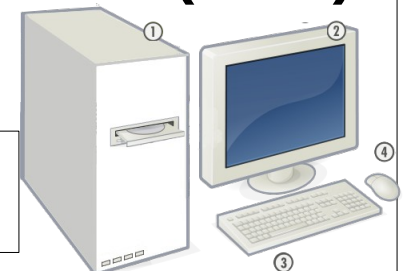
- 1800s: Punch Cards
- 1940s: Military Computers
- 1960s: ARPAnet & UNIX
- 1970s: The First CPU Is Invented
- 1980s: ARPA/Internet Standards (TCP/IP & email)
- 1980s: PC + MoDems + BBS' = Online
- 1990s: On-Line Services → Internet Service Providers (ISPs)
- 1995: Internet Opens Up To Public
- 1995-1999: Internet ".com" Explosion



AMERICA  
Online

Internet

Google



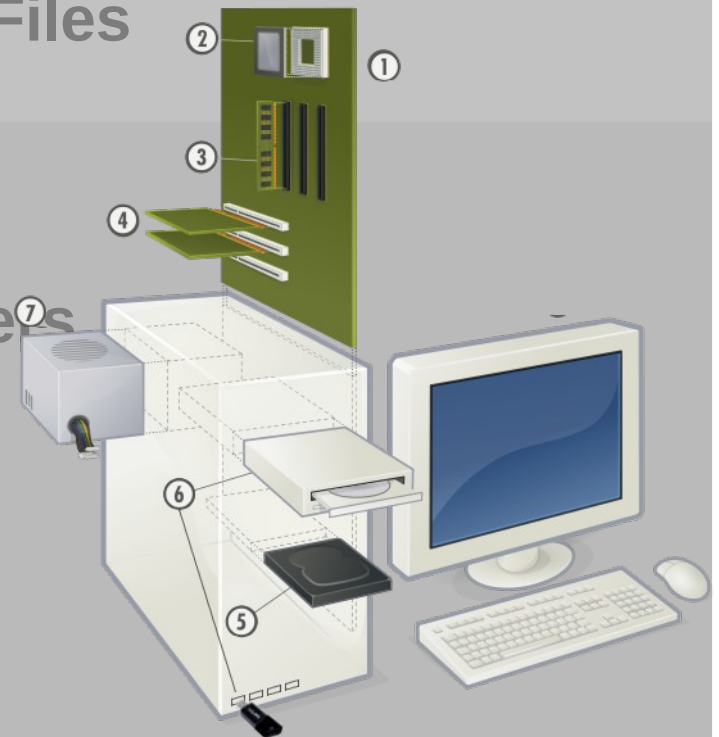
# Intro To Computers: How Do Computers Work?

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- **How Do Computers Work?**
- How Data and File Storage Works
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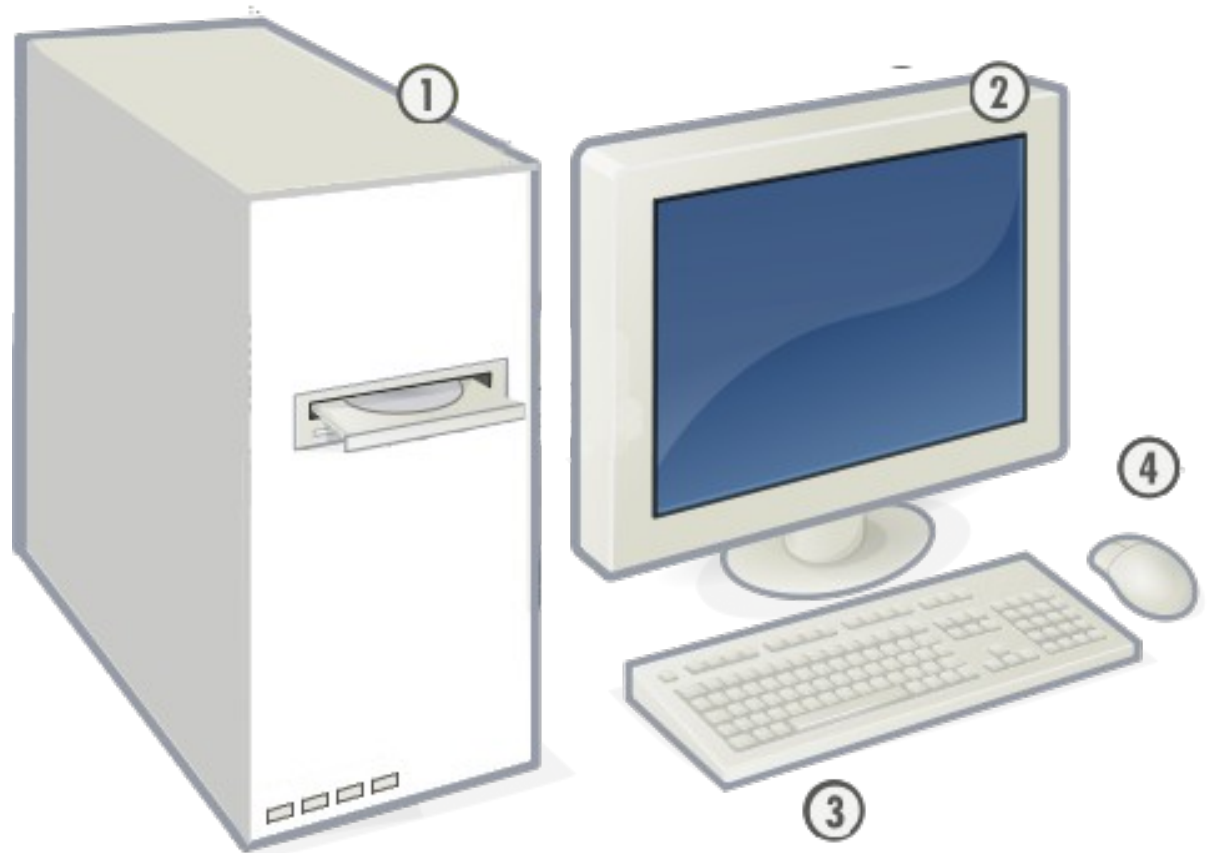
- Client Computers and Server Computers
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# Intro To Computers: How Do Computers Work?

## The Outside Parts

- 1) The Computer Case
- 2) The Monitor
- 3) The Keyboard
- 4) The Mouse

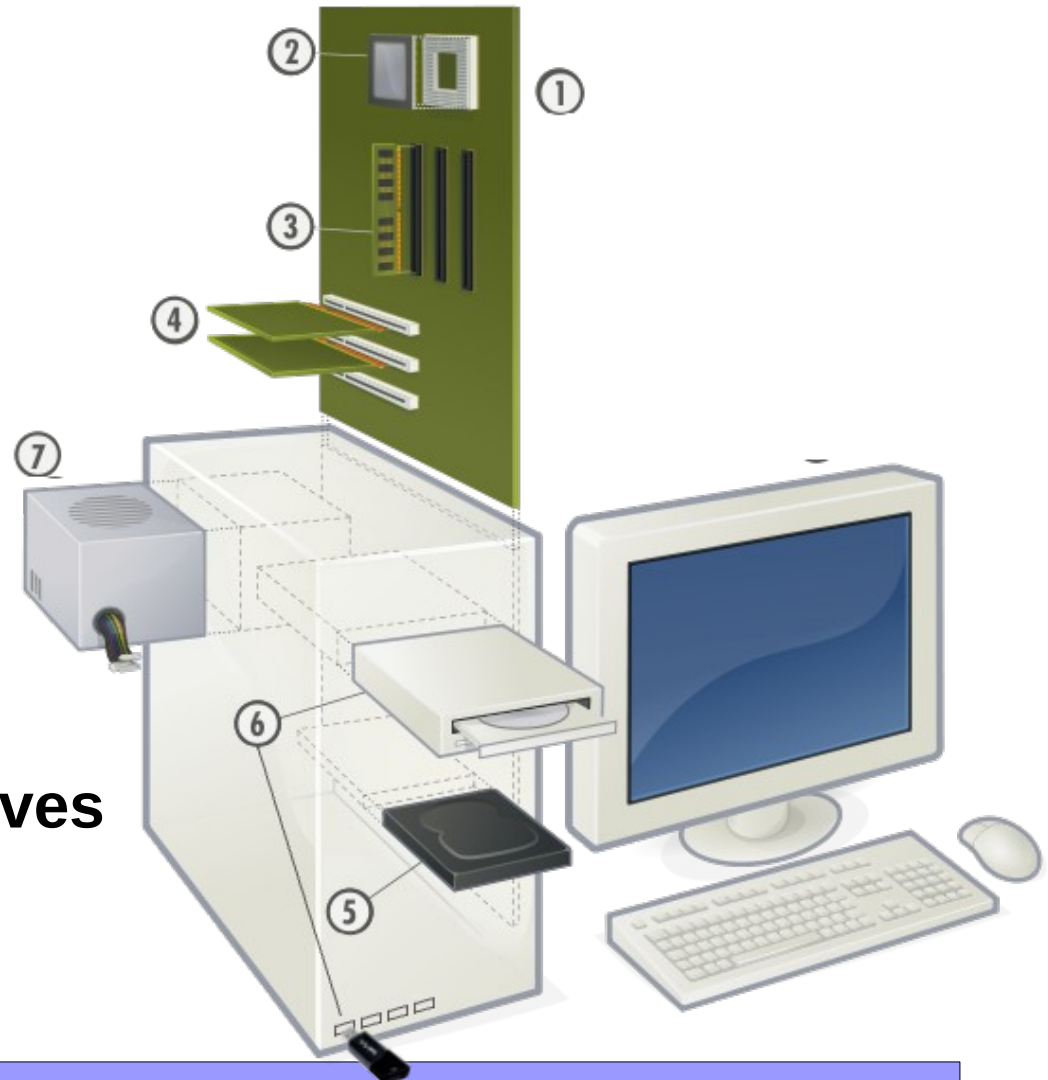


[1] - [https://en.wikipedia.org/wiki/Personal\\_computer\\_hardware](https://en.wikipedia.org/wiki/Personal_computer_hardware)

# Intro To Computers: How Do Computers Work?

## The Inside Parts

- 1) The Mother Board
- 2) The CPU
- 3) The Memory (RAM)
- 4) The Video & Network Cards
- 5) The Hard Drive
- 6) Optical & USB Flash Drives
- 7) Power Supply



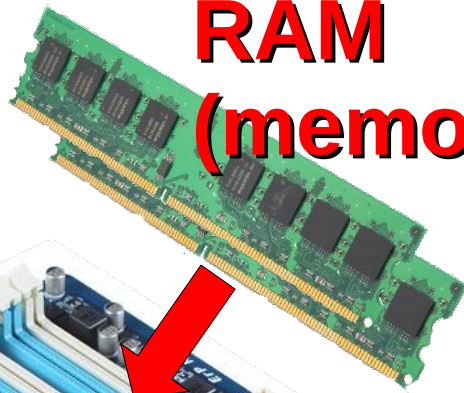


# Intro To Computers: How Do Computers Work?

**CPU Fan**



**RAM  
(memory)**



**PCI Network Card  
(ethernet)**



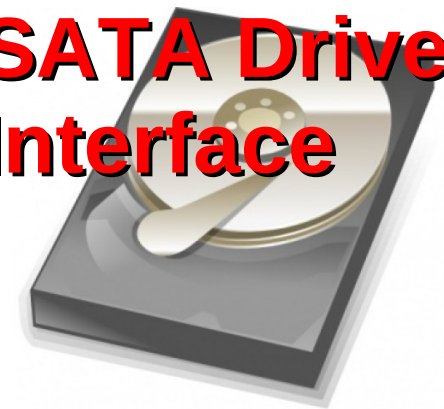
**CPU**



**Motherboard**


**PCI Slots**

**SATA Drive Interface**



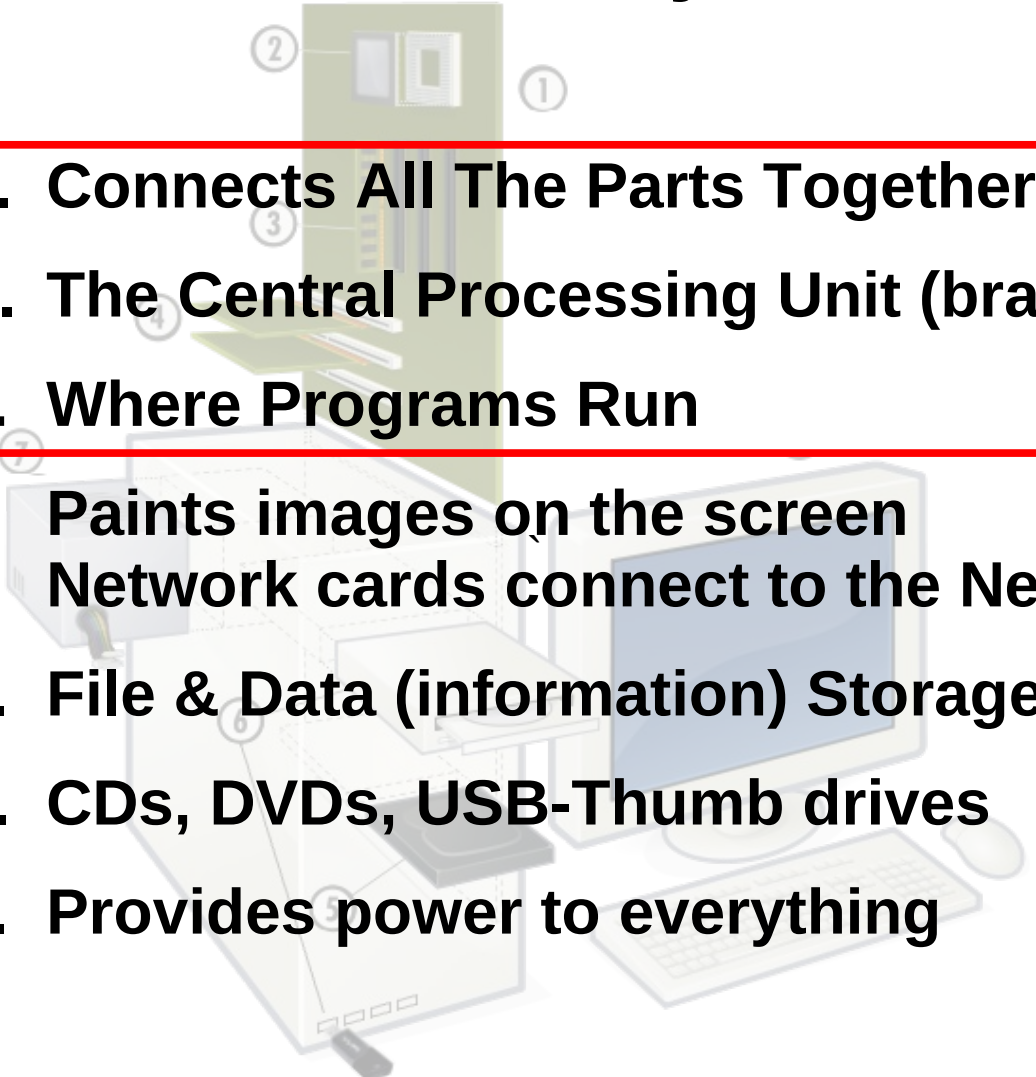
# Intro To Computers: How Do Computers Work?

## The Inside Parts & What They Do

- 
- 1) The Mother Board.....** Connects All The Parts Together
  - 2) The CPU.....** The Central Processing Unit (brain)
  - 3) The Memory (RAM).....** Where Programs Run
  - 4) The Video ..... & Network Cards** Paints images on the screen  
Network cards connect to the Net
  - 5) The Hard Drive.....** File & Data (information) Storage
  - 6) Optical & USB Drives.....** CDs, DVDs, USB-Thumb drives
  - 7) Power Supply .....** Provides power to everything

# Intro To Computers: How Do Computers Work?

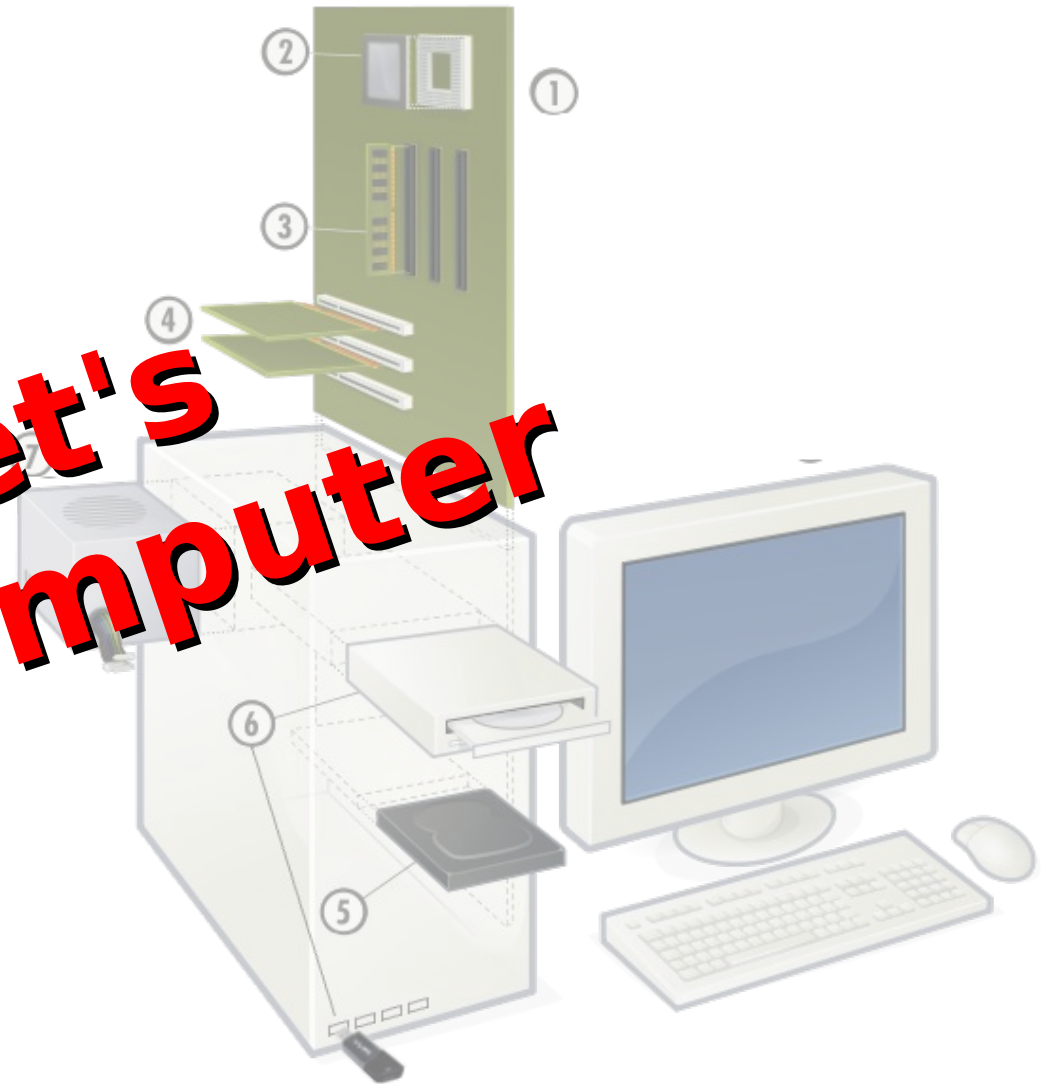
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# Intro To Computers: How Do Computers Work?

## The Inside Parts

**LAB: Let's  
Build A Computer**



# Intro To Computers: How File Storage Works

## Intro to Computer Theory

- How Were Computers Created?
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- **How Data and File Storage Works**
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# Intro To Computers: How File Storage Works

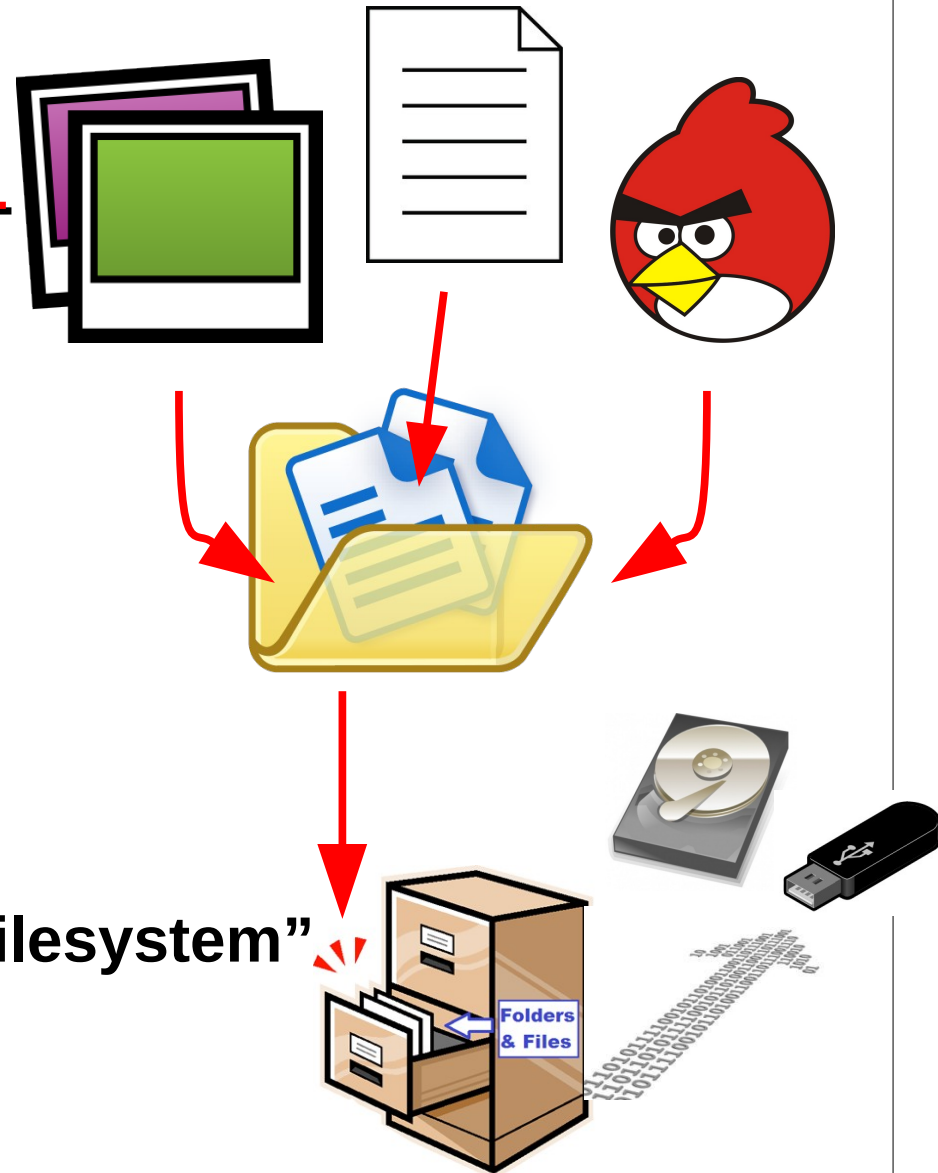
**Q: What IS a “file”  
and how is it  
stored on a  
computer?**



# Intro To Computers: How File Storage Works

## What Files Are:

- Files are just data, information or programs
- Files are stored in folders
- Folders and files are kept in a "filesystem"



# Intro To Computers: How File Storage Works

## What Filesystems Are:

- Filesystems organize and hold files and folders making them easy for humans to find.
- Some folders (directories) are for people and some are for computer operating systems.
- Filesystems are created on drives or disks when they are formatted.





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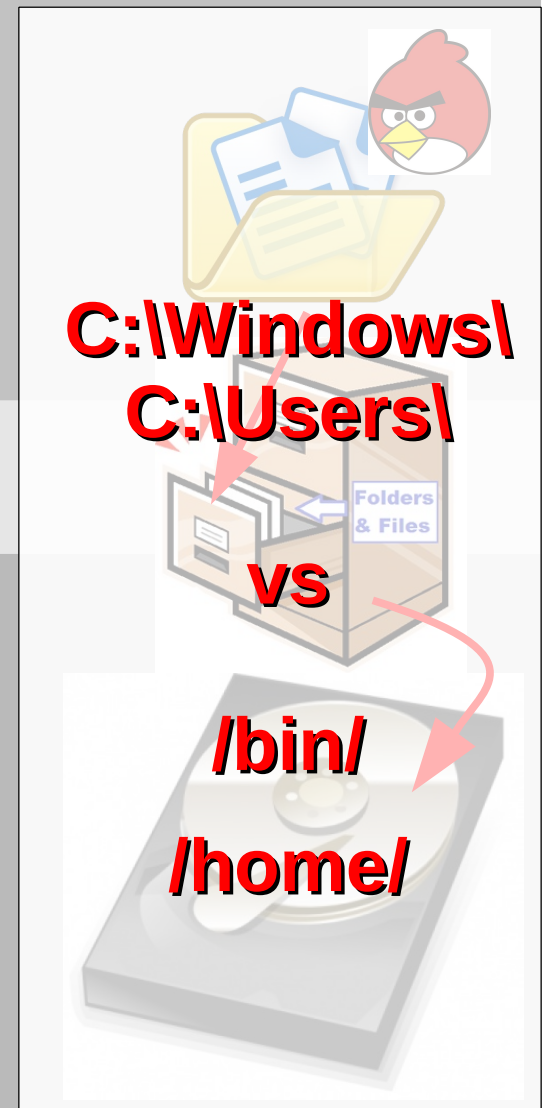
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# Intro To Computers: How File Storage Works

## Where Do System Files Go?

### Windows File Locations

C:\ .....root filesystem

C:\Windows\.....system & library files

C:\Program Files\..programs&packages

C:\Users\ .....user home folders

D:\ , E:\ , F:\ .....media drive letters

### Linux/UNIX File Locations

/.....root filesystem

/bin/ & sbin/....system files

/lib/.....system library files

/etc/.....system config files

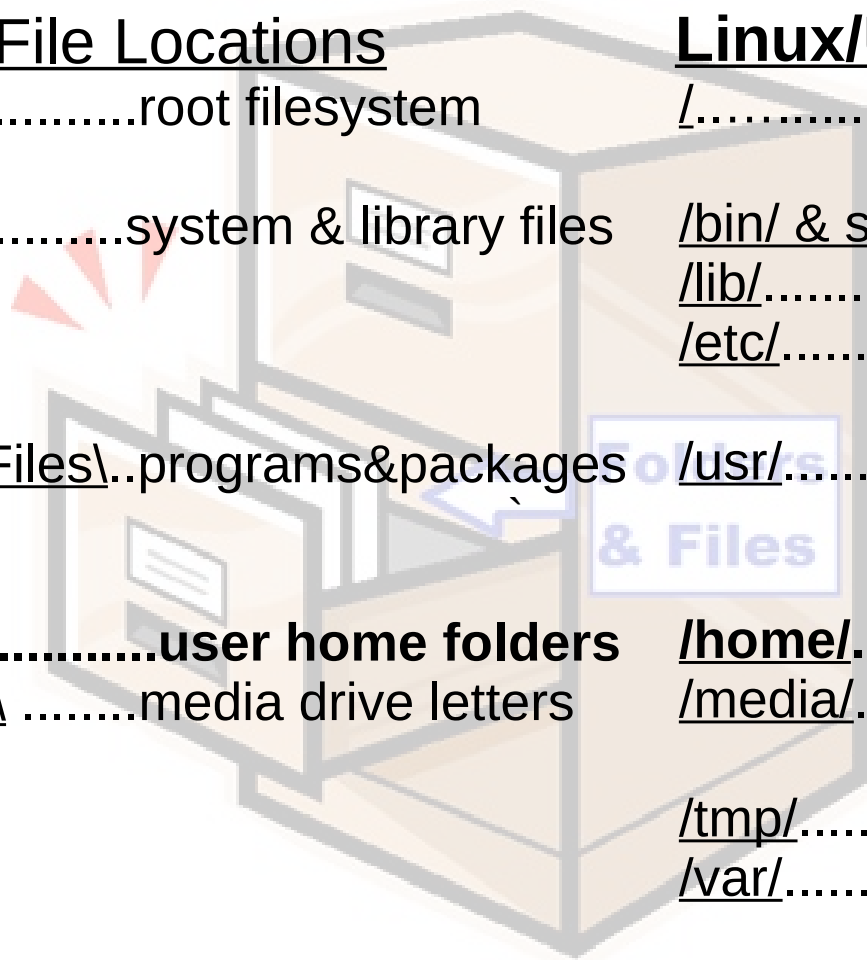
/usr/.....programs & packages

/home/.....user home folders

/media/.....media mounts

/tmp/.....temporary files

/var/.....system variables,  
program content, &  
run time file space.



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**Computer's (system) files**

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### Linux/UNIX File Locations

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**Human's (user) files**

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# TTC: Intro To Computers

## Computer Files vs People Files

### Remember These File Locations?

#### Windows File Locations

C:\ .....root filesystem

C:\Windows\.....system & library files

C:\Program Files\..programs&packages

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D:\ , E:\ , F:\ .....media drive letters

#### Linux/UNIX File Locations

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/var/.....system files, program content, & runtime file space.

**Lab Race!**

**Who can Find the files first?**

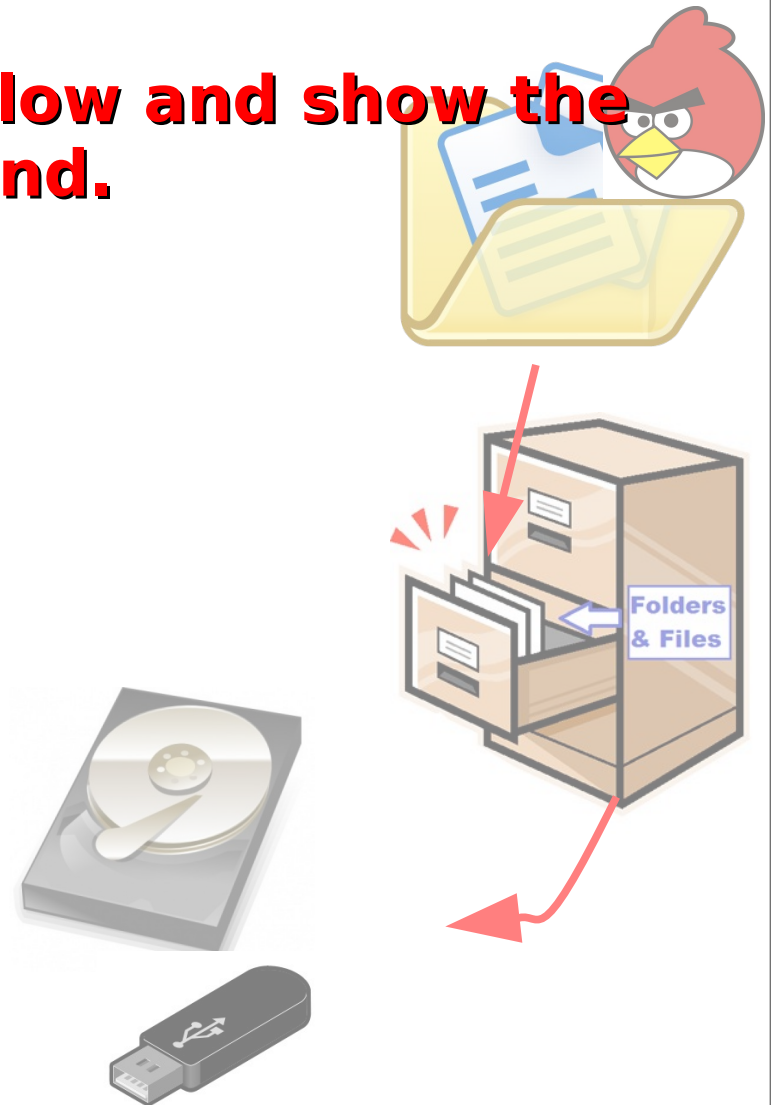


# Intro To Computers: How File Storage Works

## **Kids: Lab Race!**

**Accomplish each of the steps below and show the instructor or TA what you've found.**

**On Your Marks!**





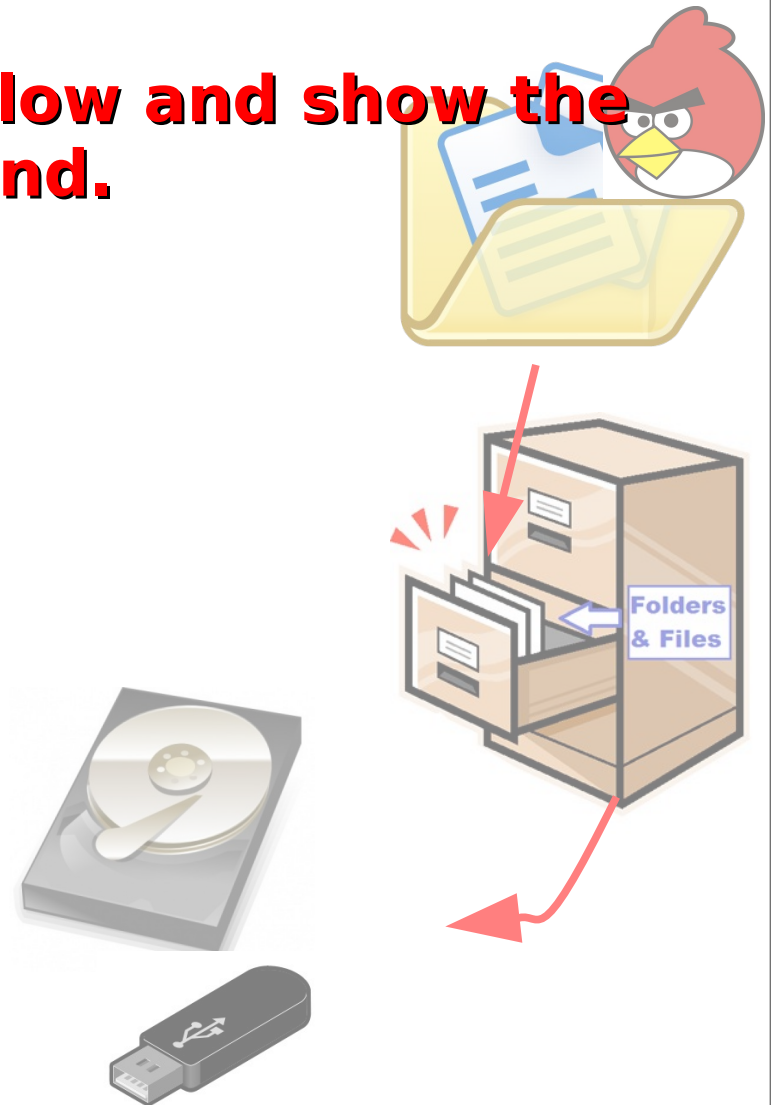
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**On Your Marks!**

**Get Set.....**



# Intro To Computers: How File Storage Works

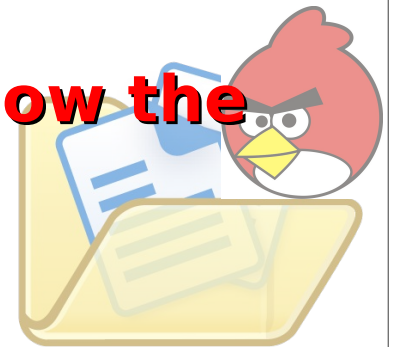
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**On Your Marks!**

**Get Set.....**

**GO!!!**



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## **Kids: Lab Race!**

**Accomplish each of the steps below and show the instructor or TA what you've found.**

**1) Windows students:**

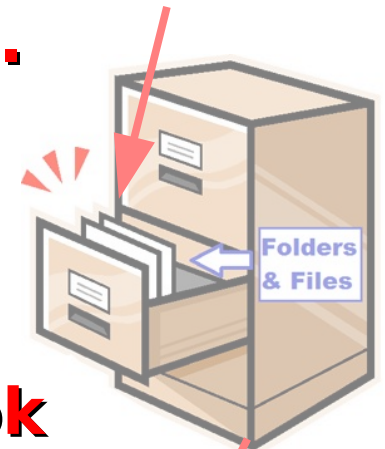
**Find the "CMD.EXE" system file & run it.**

**Mac/Linux students:**

**Find the "bash" system file & run it.**

**2) From the desktop, create a pretend book report text file in the correct file location.**

**3) Find a program that is installed on your system and show the instructor or TA.**



# Intro To Computers: How File Storage Works

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# Intro To Computers: How File Storage Works

## What Are Filesystems?

- Windows



- Mac OSX



- Linux

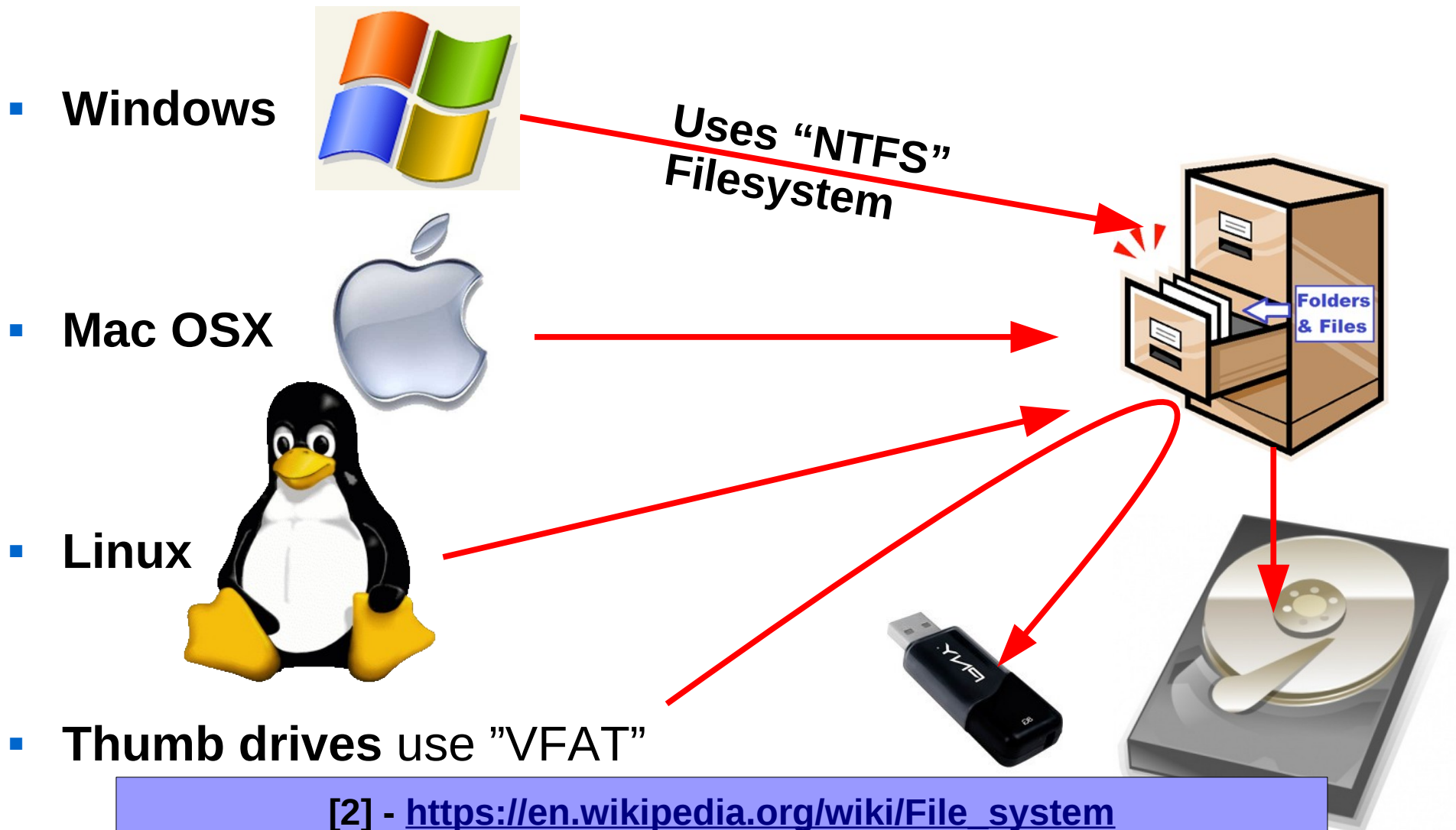


- Thumb drives use ..... ?



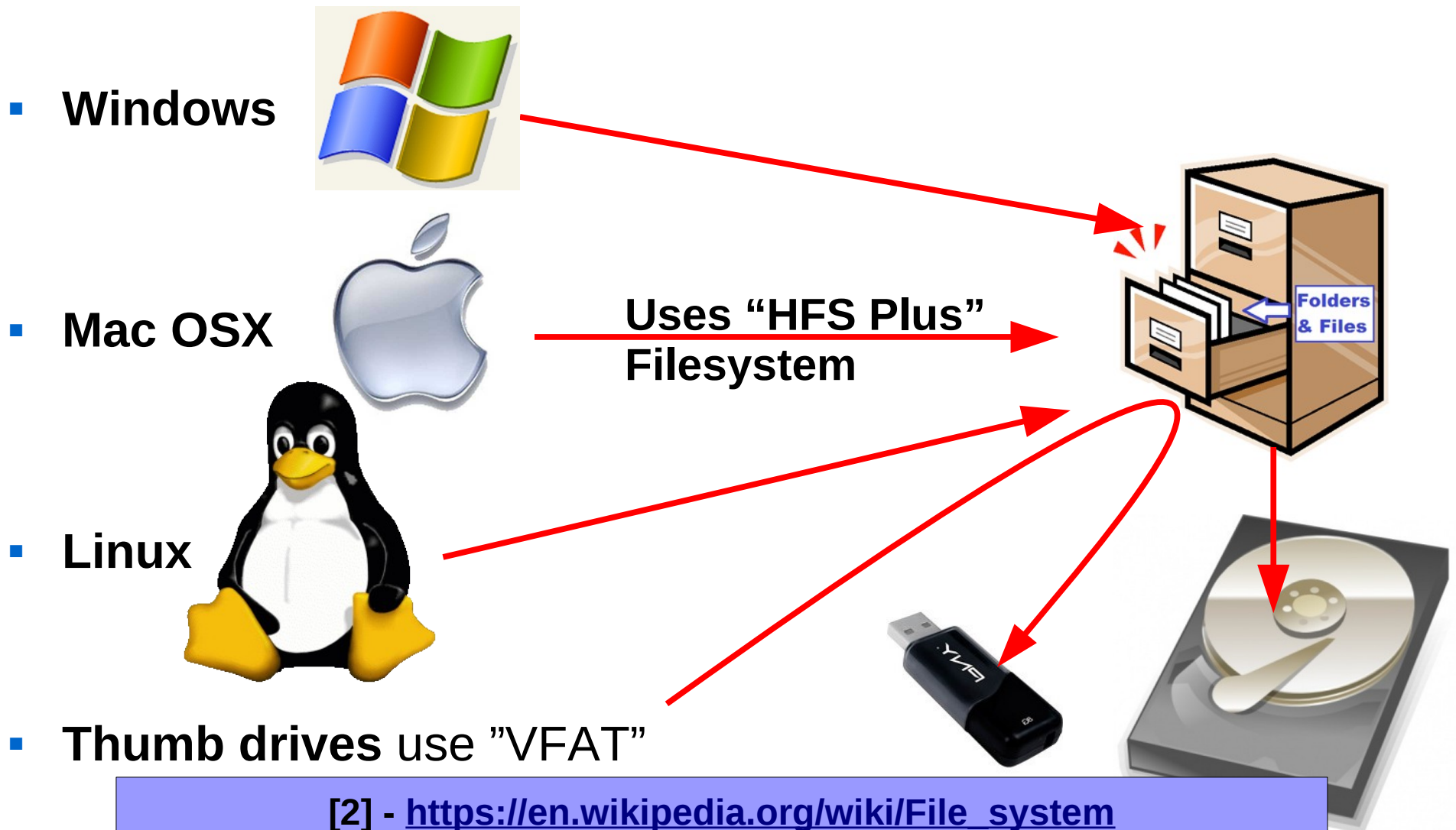
# Intro To Computers: How File Storage Works

## Different Operating Systems Use Different Filesystems [2]



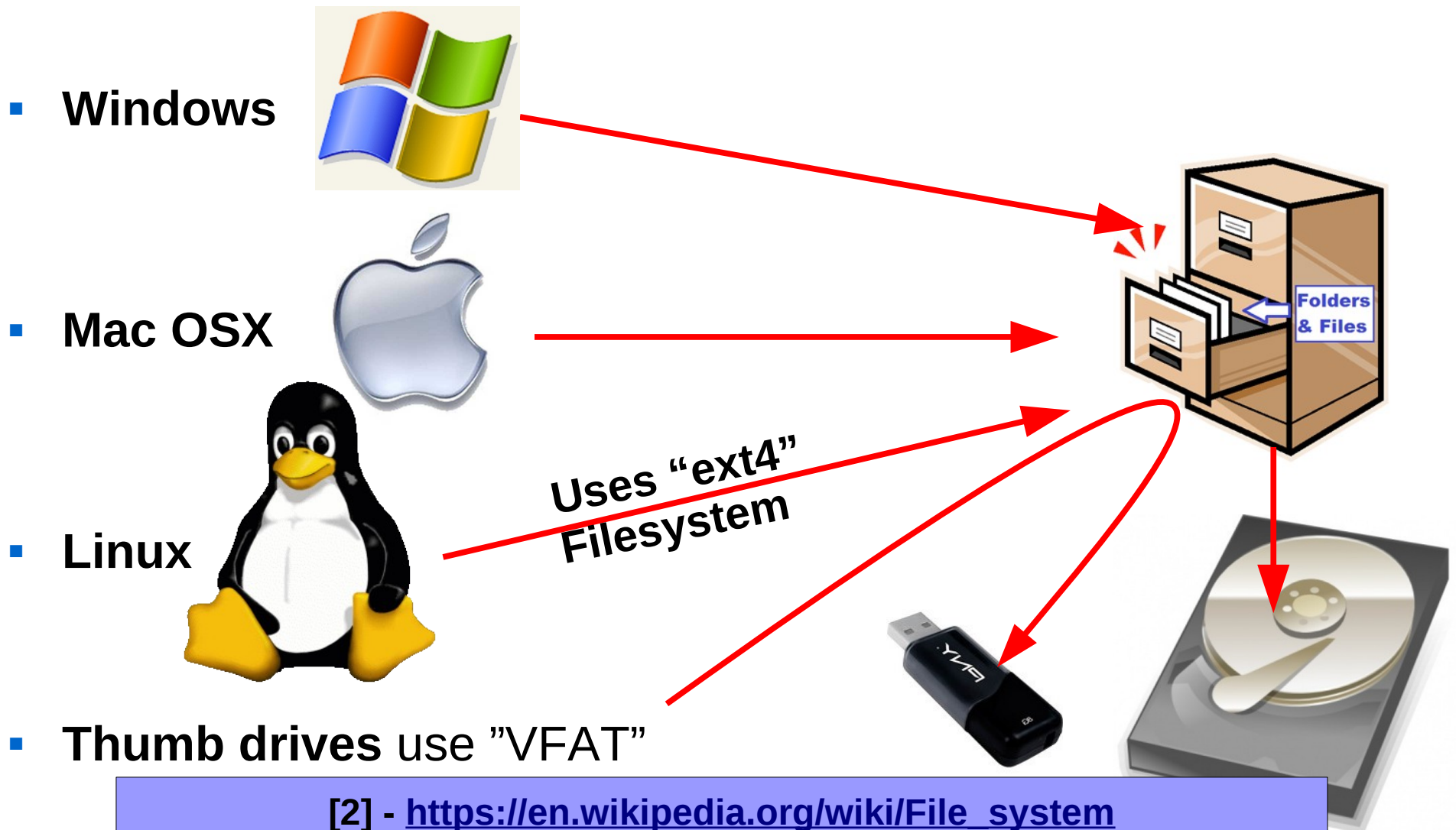
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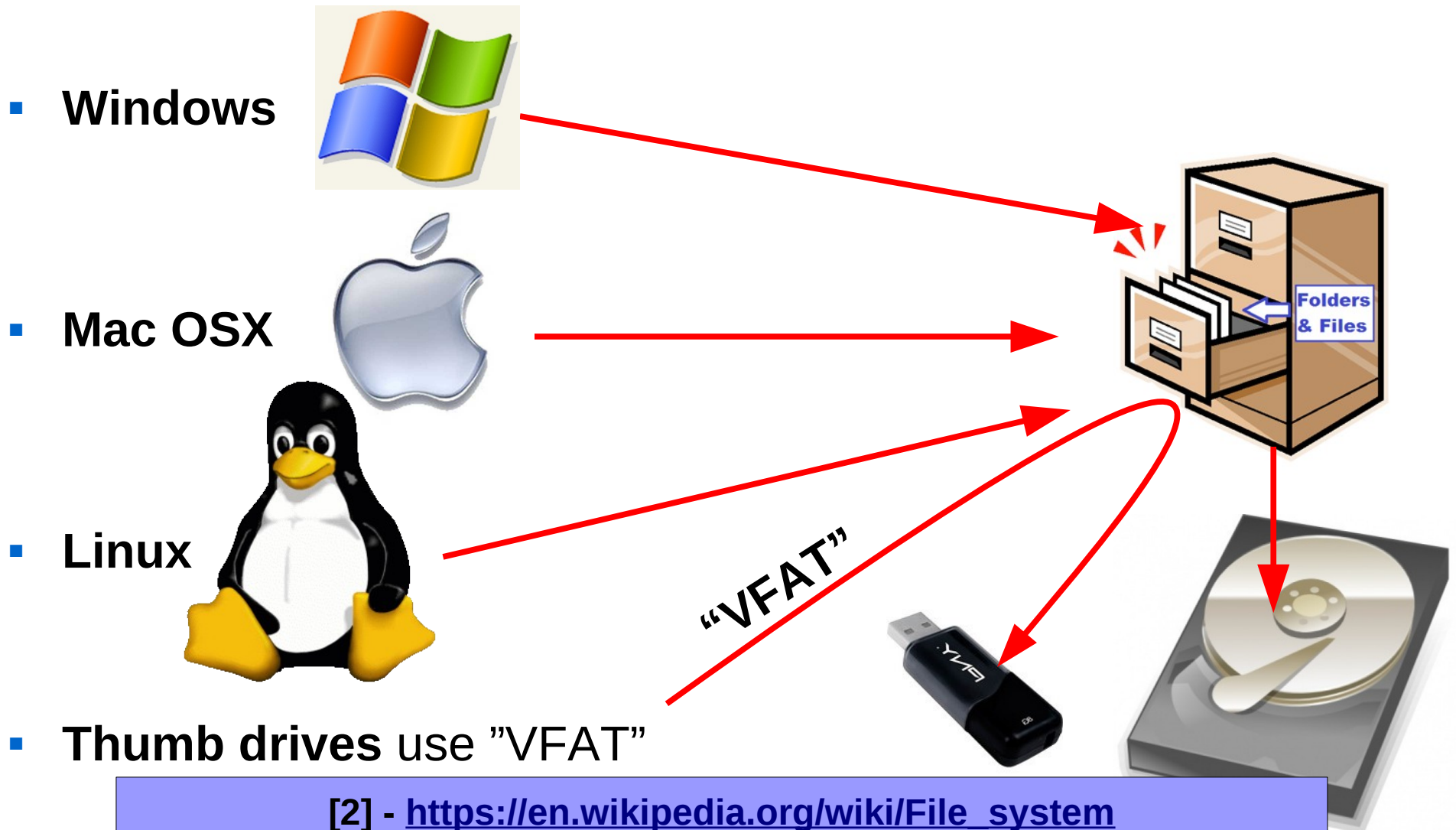


[2] - [https://en.wikipedia.org/wiki/File\\_system](https://en.wikipedia.org/wiki/File_system)



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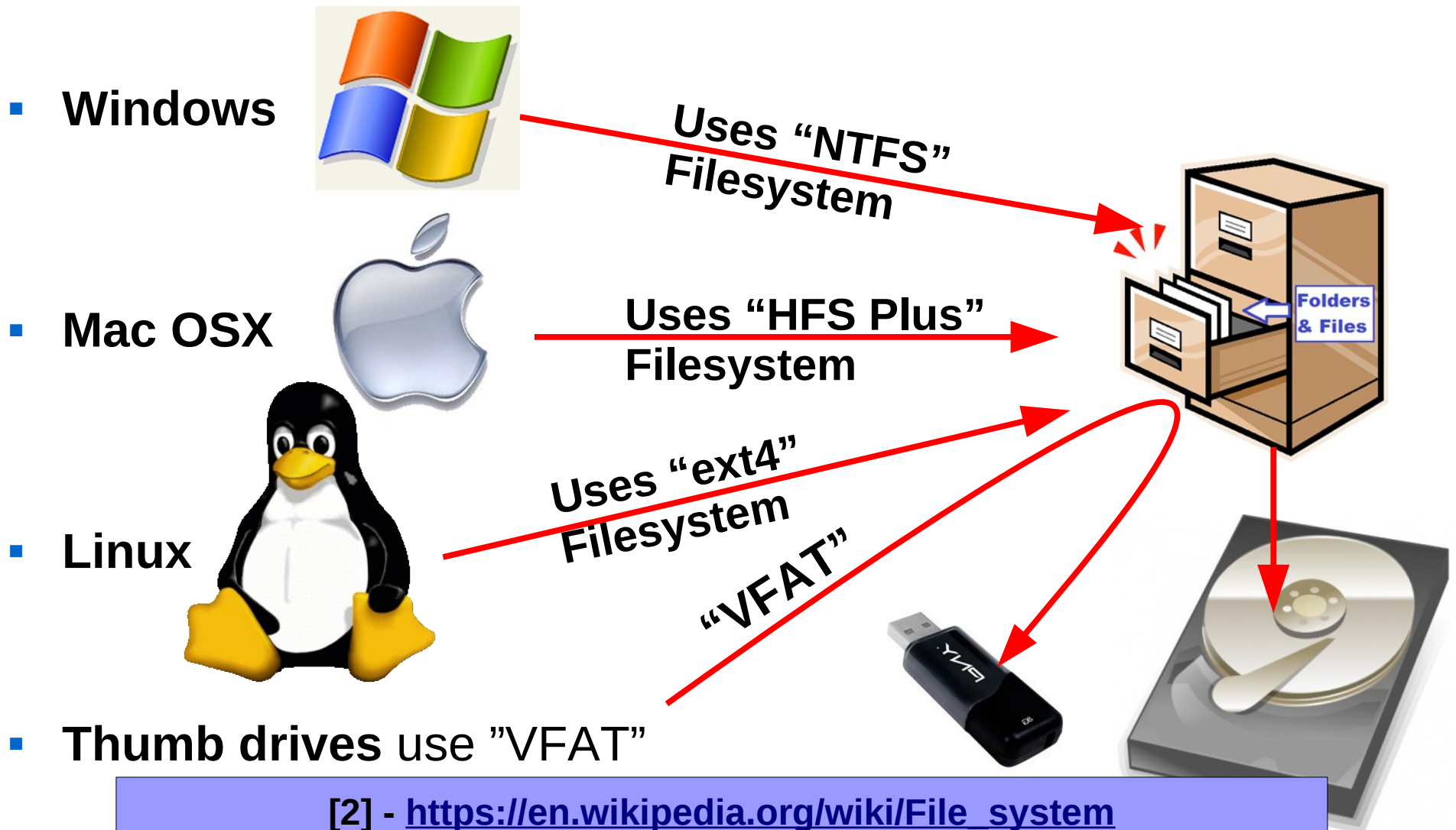
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# Intro To Computers: How File Storage Works

## Different Operating Systems Use Different Filesystems [2]



# Intro To Computers: How File Storage Works

## Kids: Lab Time!

What kind of filesystem does your hard drive or thumb drive use?



1) Open the computer icon on desktop

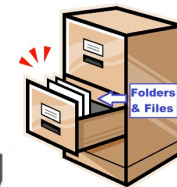
2) Right click on your hard drive or thumb drive.

3) Look at the “properties” of you drive

Q: What kind of filesystem is it?

---

---



Q: Why? \_\_\_\_\_

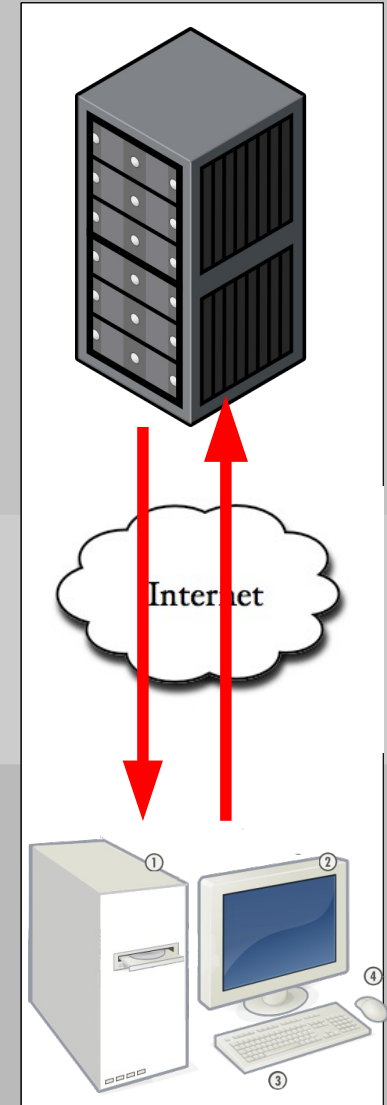
# TTC: Intro To Internet Client and Server Computers

## Intro to Computer Theory

- How Were Computers Created?
- How Do Computers Work?
- How Data and File Storage Works
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## Intro to Internet Theory

- **Client Computers and Server Computers**
- How Computer Networks Work
- Computer Names vs IP Addresses
- Computer Networking Tool Labs

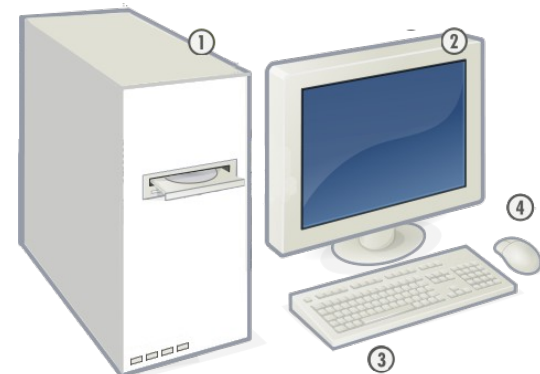


# TTC: Intro To Internet Client and Server Computers

Server

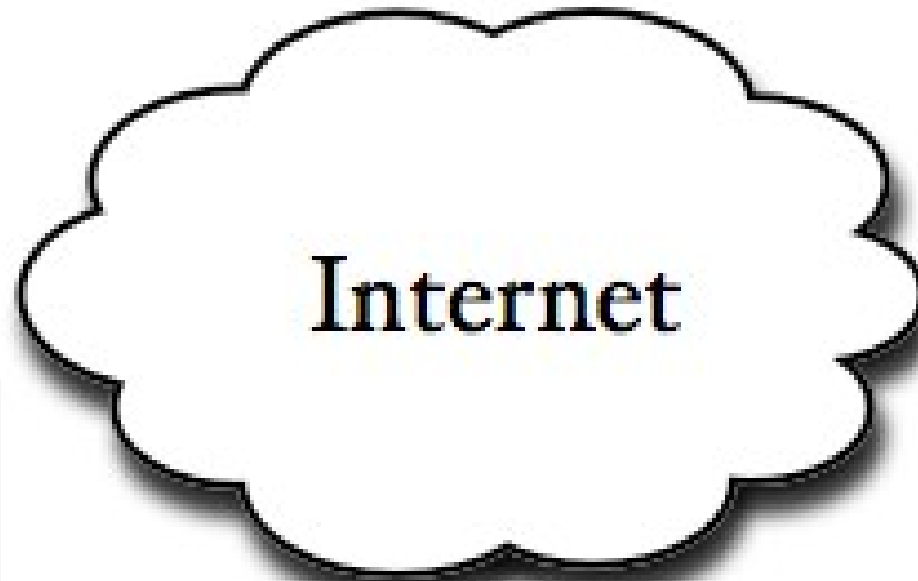
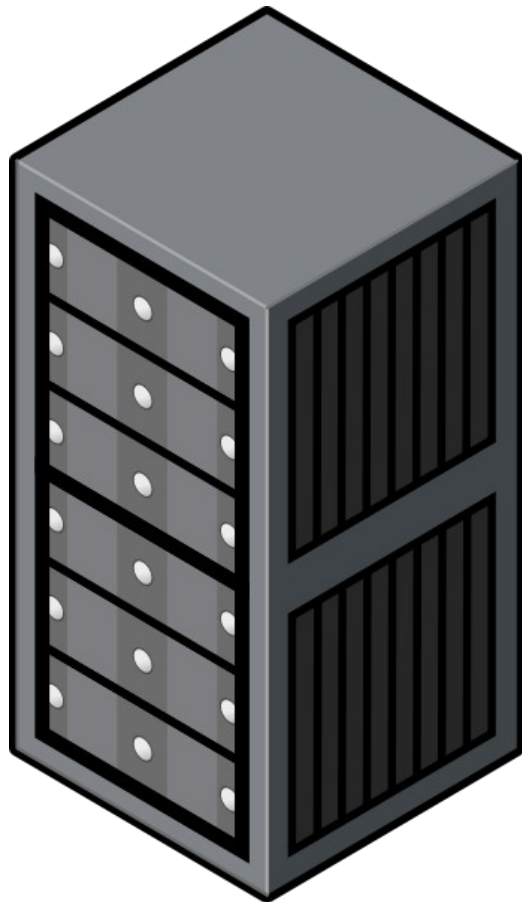
Client

**What's the difference  
between a client computer  
and server computer?**

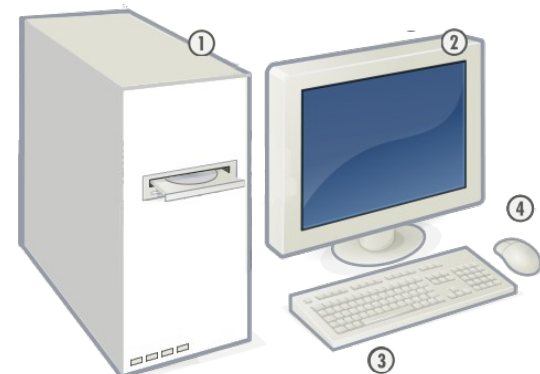


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Server

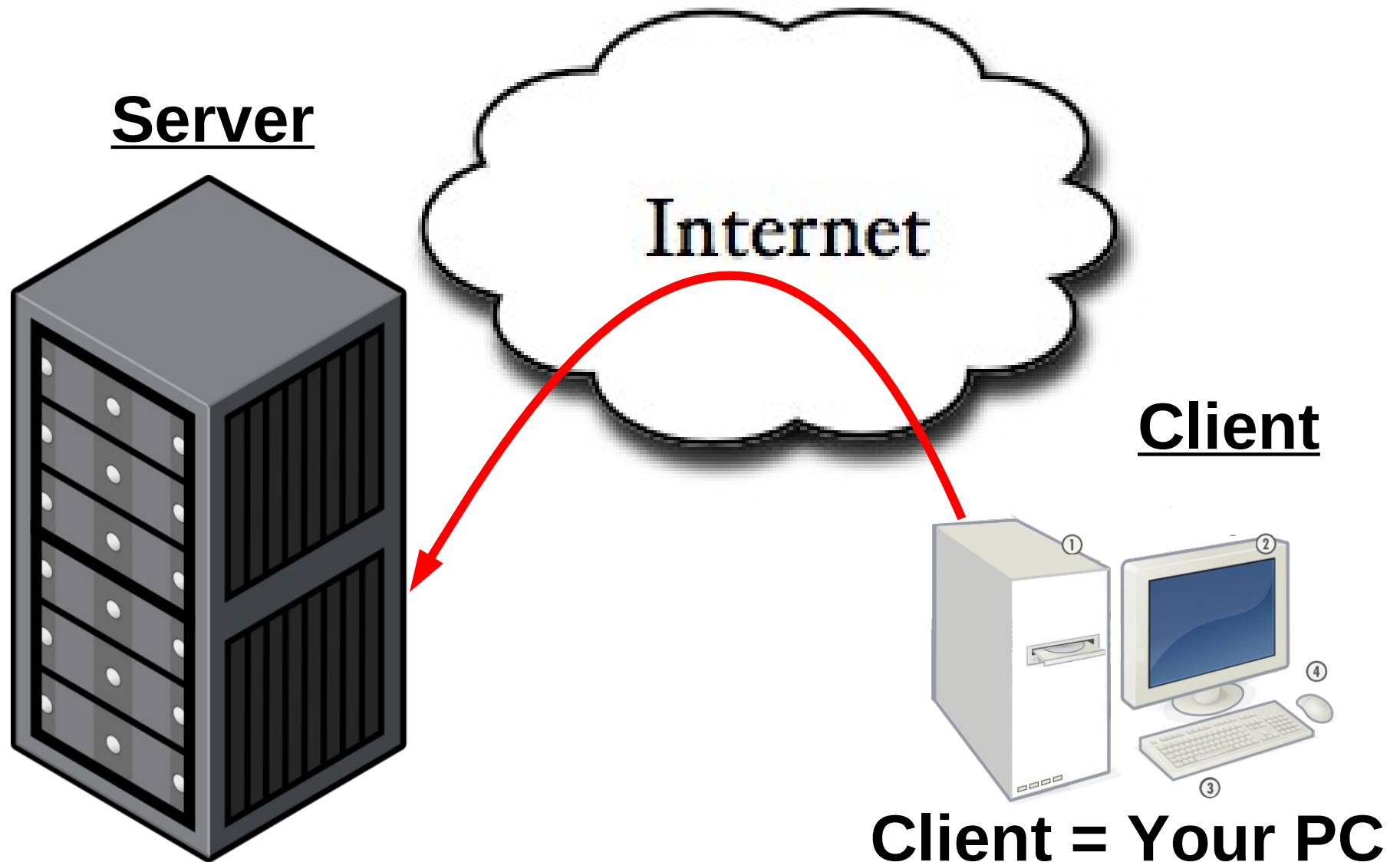


Client

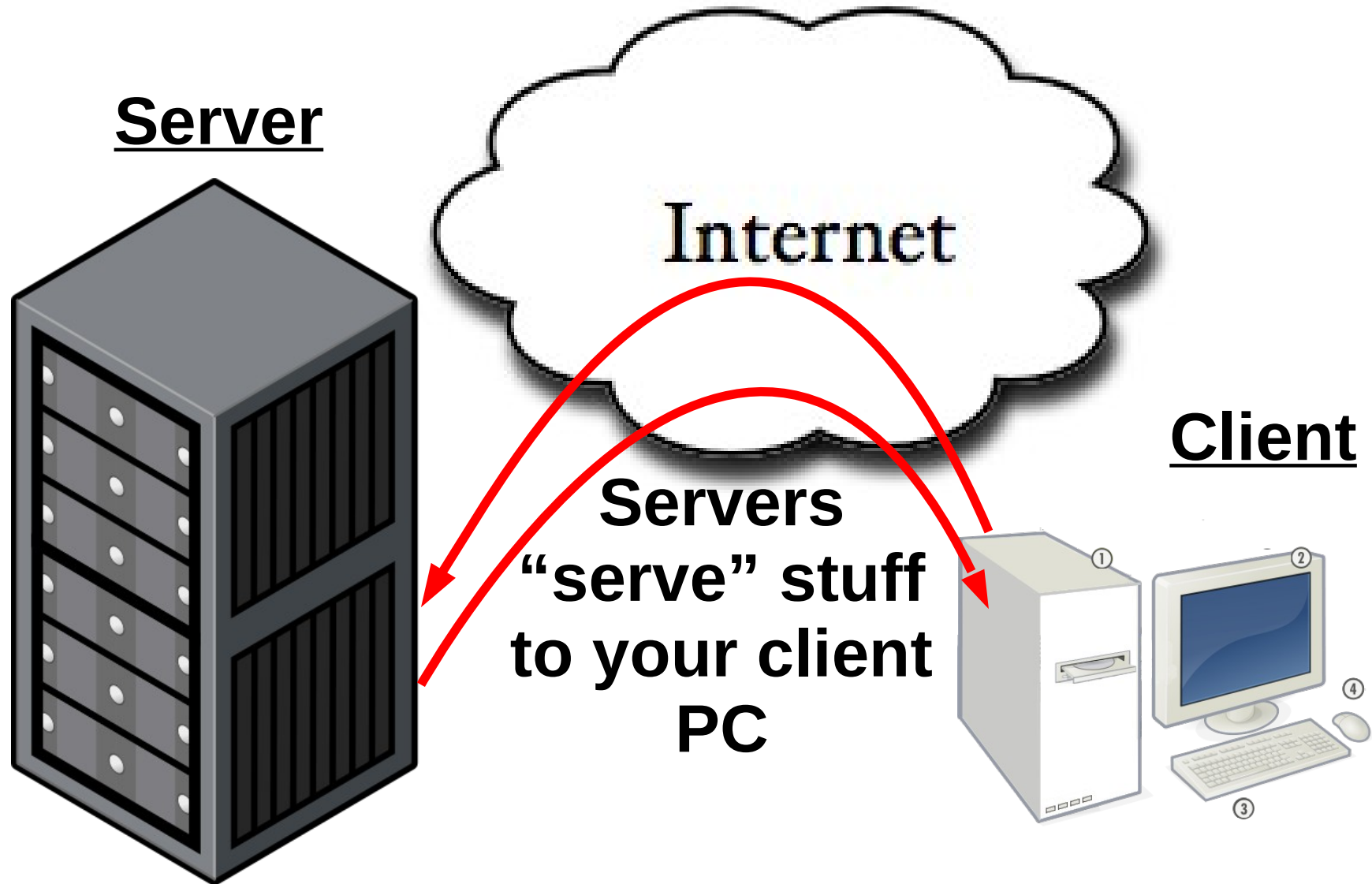


**Client = Your PC**

# TTC: Intro To Internet Client and Server Computers



# TTC: Intro To Internet Client and Server Computers





# TTC: Intro To Internet Client and Server Computers

Server Software

Service

Client Software

Web Services

Email Services

Streaming Music

File Transfer

Internet

Chat



# TTC: Intro To Internet

## Client and Server Computers

### Server Software

### Service

### Client Software

Web Services

Firefox / IE / Safari

Email Services

Thunderbird / Outlook

Streaming Music

WinAmp / iTunes

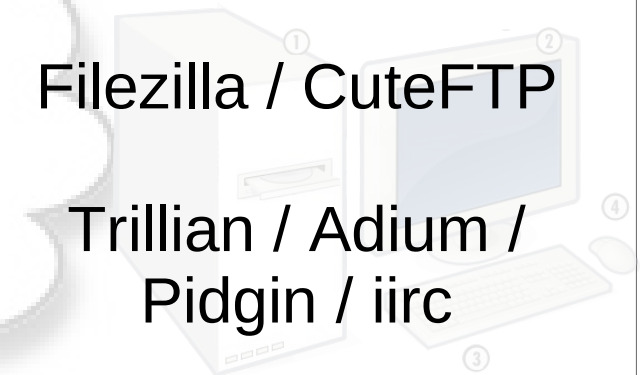
File Transfer

Filezilla / CuteFTP

Chat

Trillian / Adium /  
Pidgin / iirc

Internet



# TTC: Intro To Internet

## Client and Server Computers

### Server Software

### Service

### Client Software

Apache/MS-IIS/Youtube

Web Services

Firefox / IE / Safari

Postfix/Exchange/Gmail

Email Services

Thunderbird /Outlook

ShoutCast/SAM/iTunes

Streaming Music

WinAmp / iTunes

SFTP/vsftpd/Dropbox

File Transfer

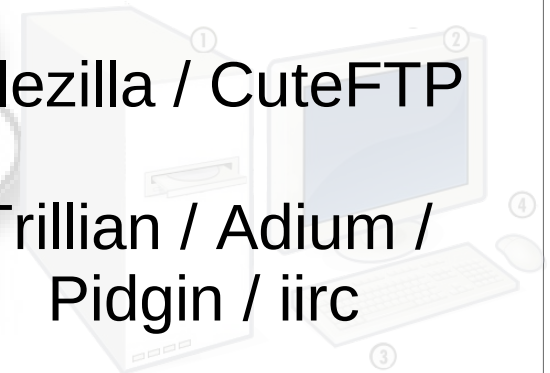
Filezilla / CuteFTP

WildfireXMPP/IRCd/GTalk

Chat

Trillian / Adium /  
Pidgin / iirc

Internet



# TTC: Intro To Internet

## Client and Server Computers

### Server Software

### Service

### Client Software

Apache/MS-IIS/Youtube

Web Services

Firefox / IE / Safari

Postfix/Exchange/Gmail

Email Services

Thunderbird /Outlook

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Streaming Music

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File Transfer

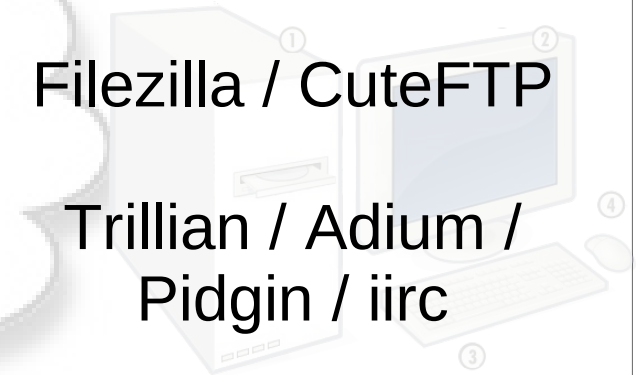
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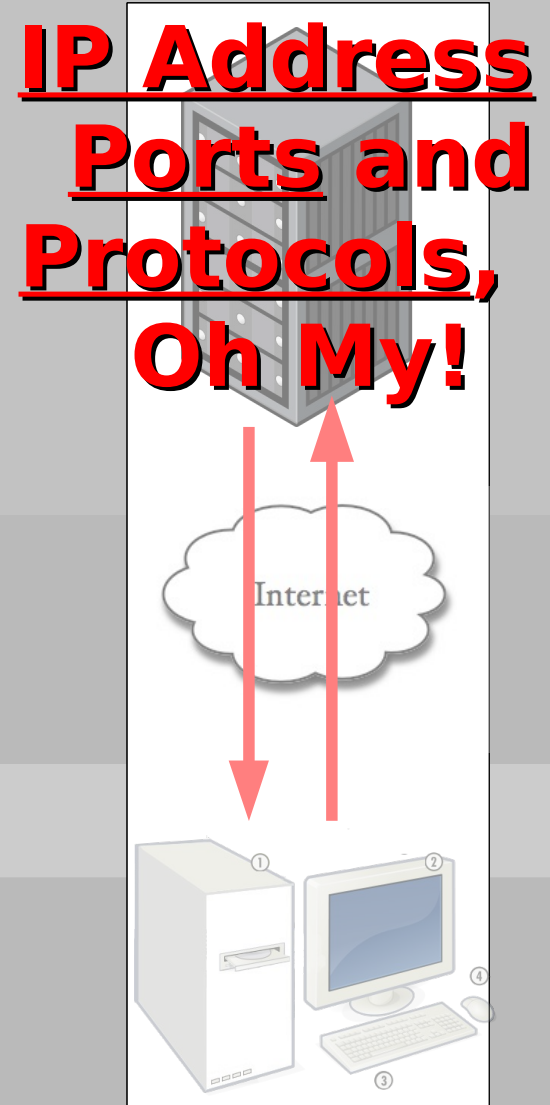
## How Computers Talk Over Networks

### Intro to Computer Theory

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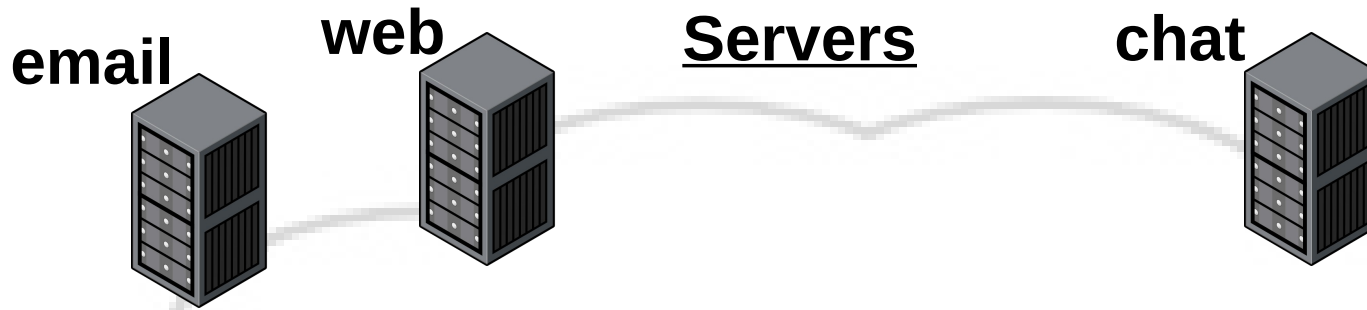
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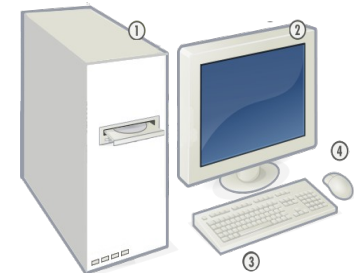
# TTC: Intro To Internet

## How Computers Talk Over Networks



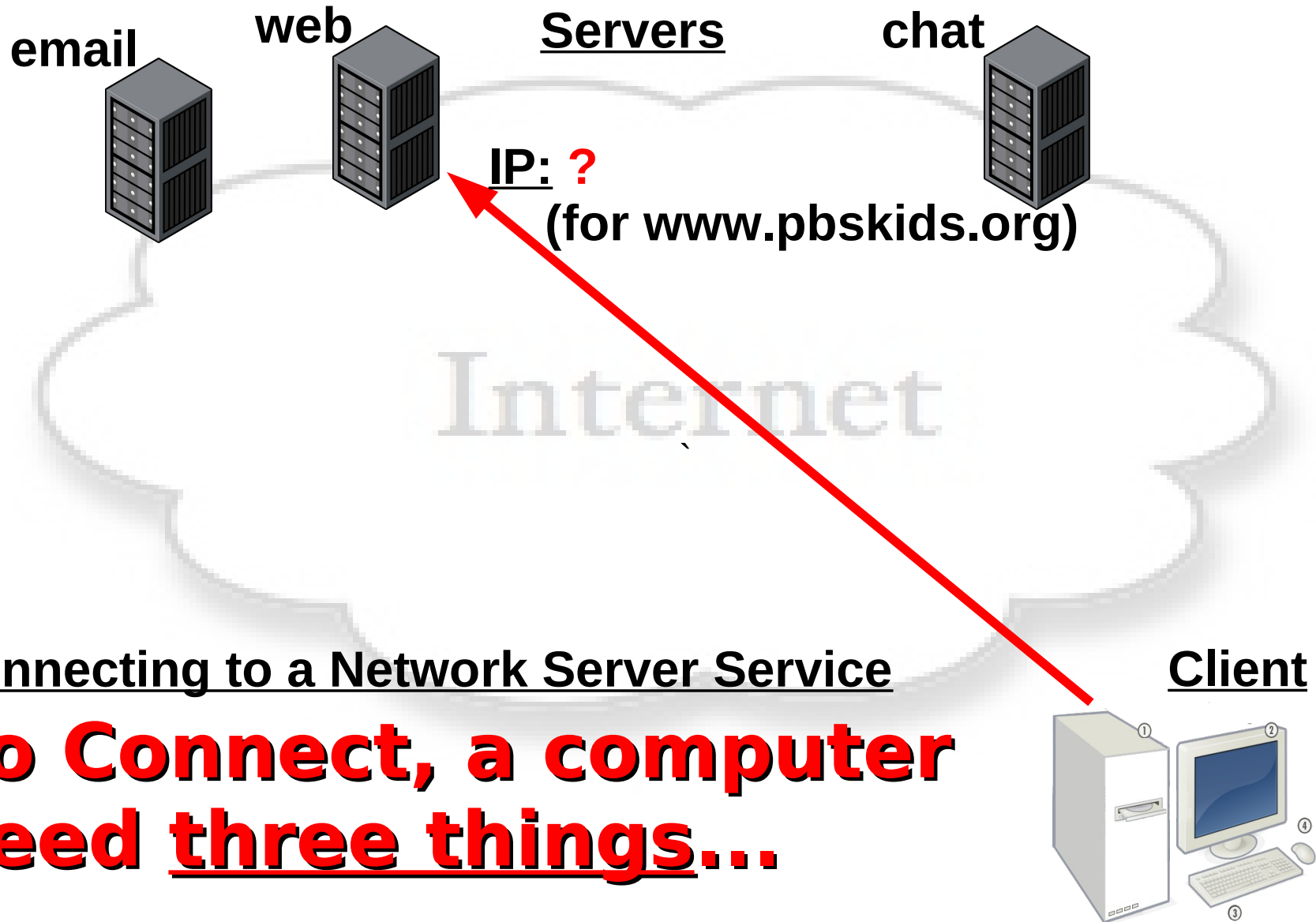
Connecting to a Network Server Service

Client



# TTC: Intro To Internet

## How Computers Talk Over Networks

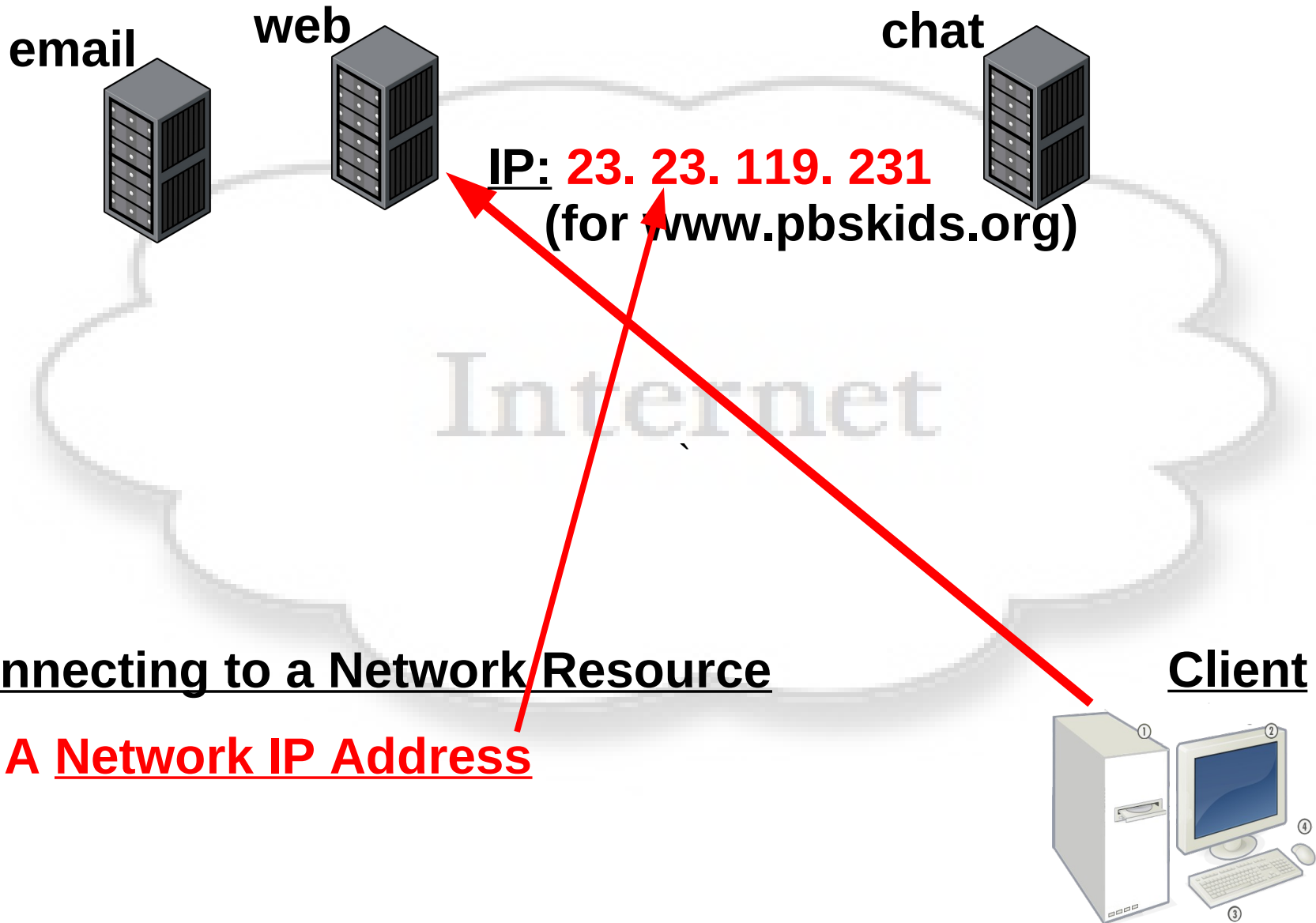


Connecting to a Network Server Service

**To Connect, a computer need three things...**

# TTC: Intro To Internet

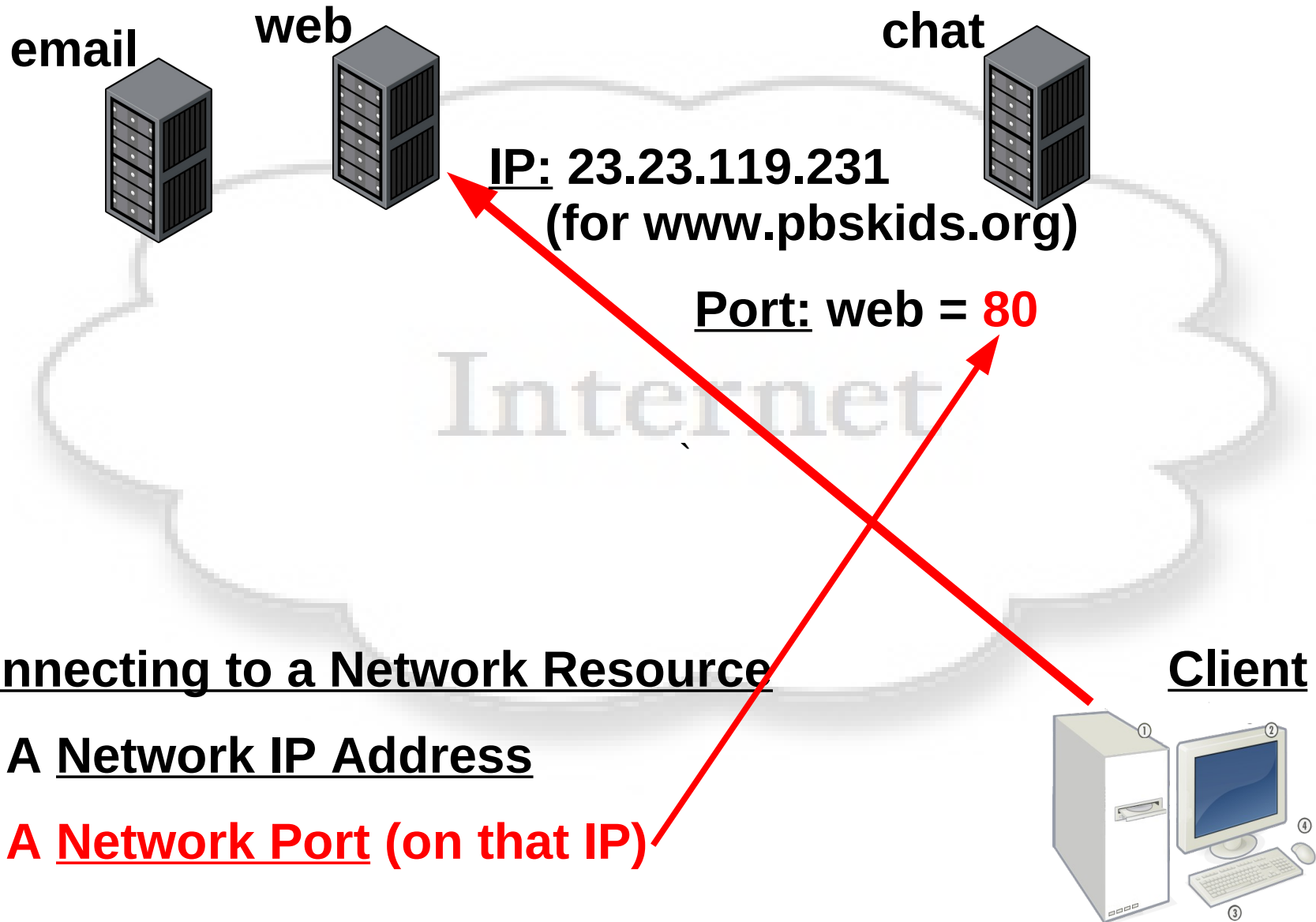
## How Computers Talk Over Networks





# TTC: Intro To Internet

## How Computers Talk Over Networks

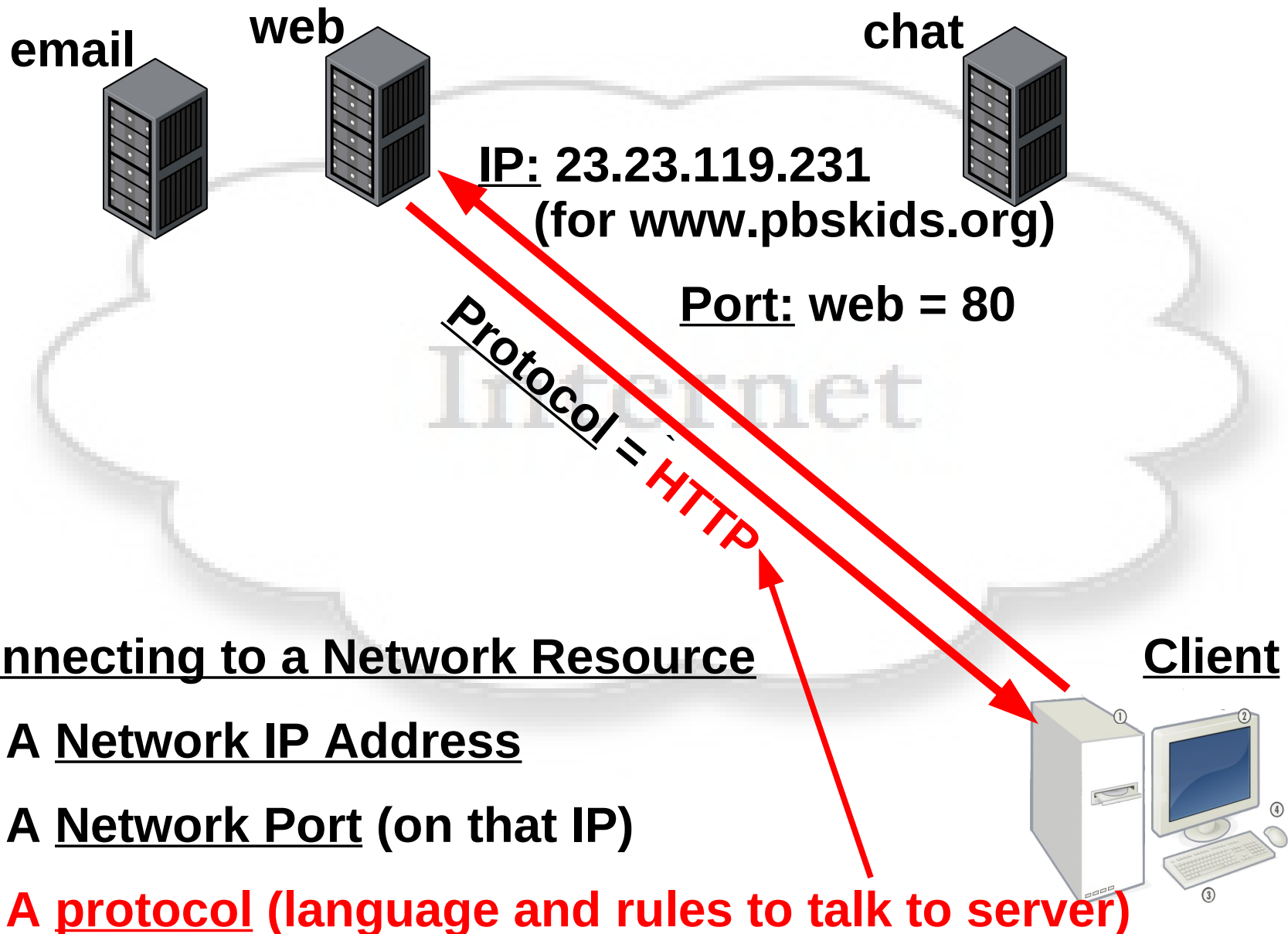


### Connecting to a Network Resource

- A Network IP Address
- A Network Port (on that IP)

# TTC: Intro To Networking

## How Computers Talk Over Networks



# TTC: Intro To Networking

## How Computers Talk Over Networks

**WAIT A SECOND!?!**

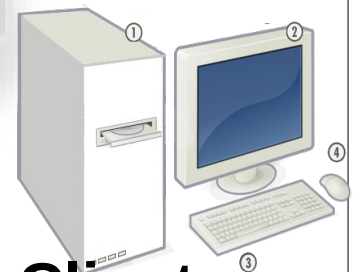
Web Server



**What the heck is an  
IP Address, a Port and  
a Protocol?**

...

**And who cares?!**



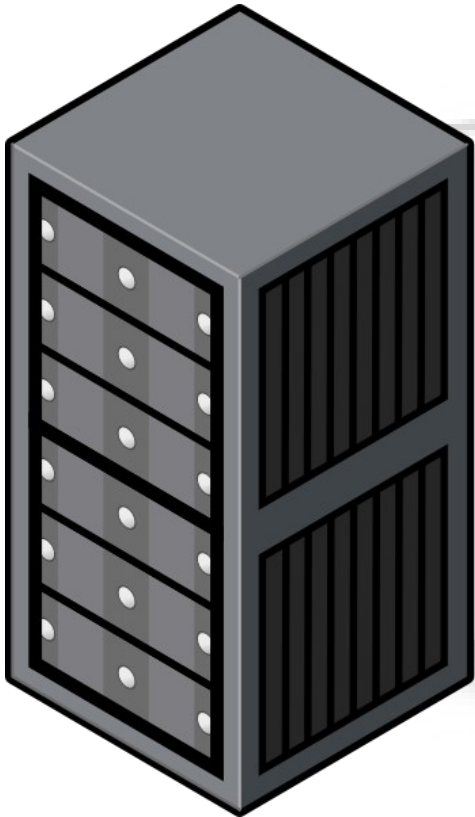
**Client**

# TTC: Intro To Networking

## How Computers Talk Over Networks

**WAIT A SECOND!?!**

Web Server

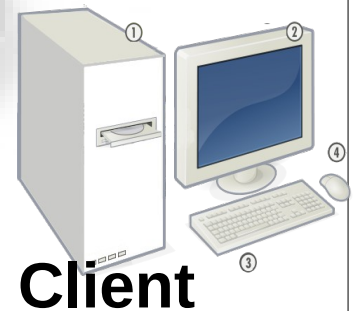


**What the heck is an  
IP Address, a Port and  
a Protocol?**

...

**And who cares?!**

**Computers Care!**

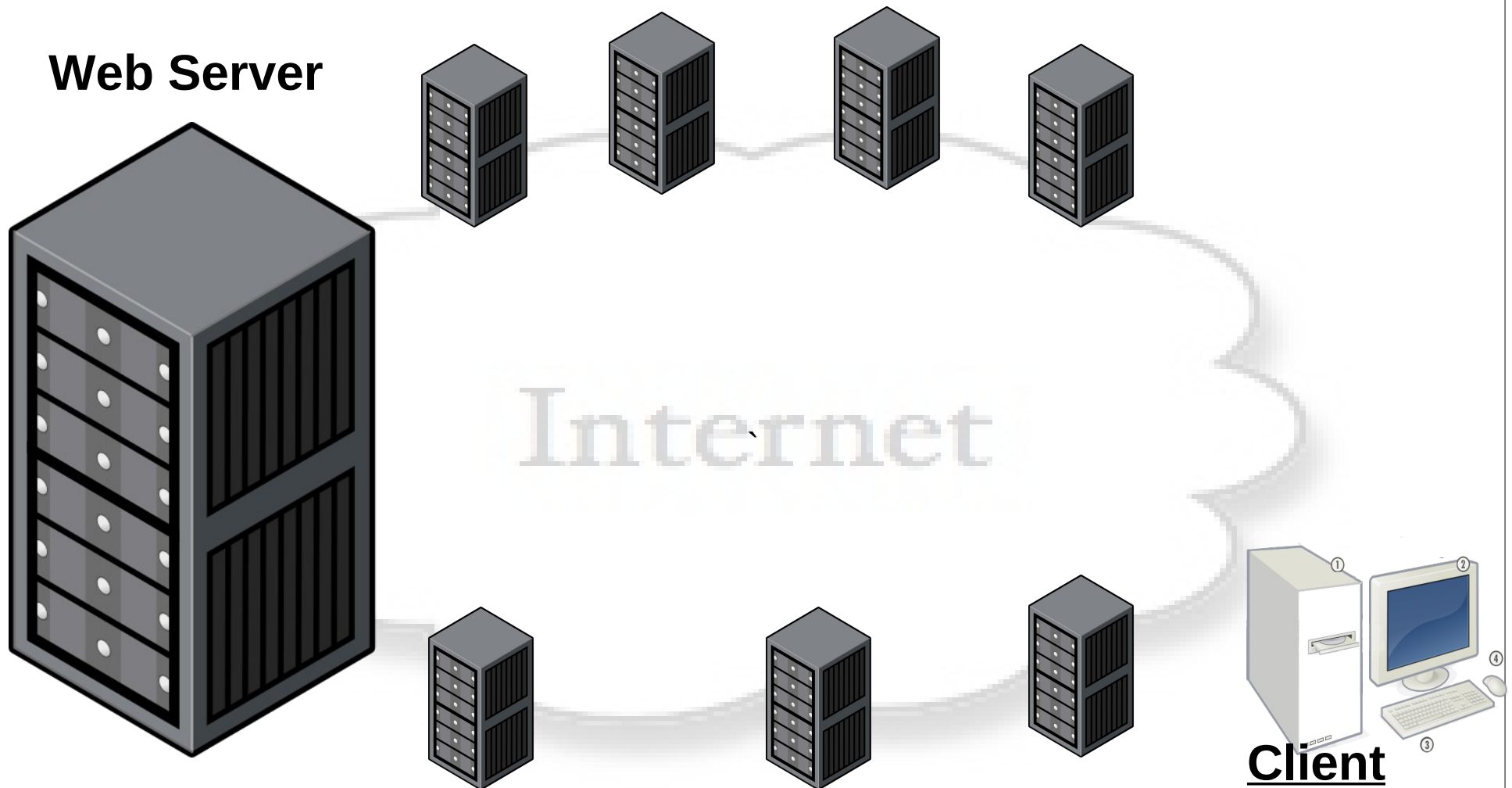


**Client**

# TTC: Intro To Networking

## How Computers Talk Over Networks

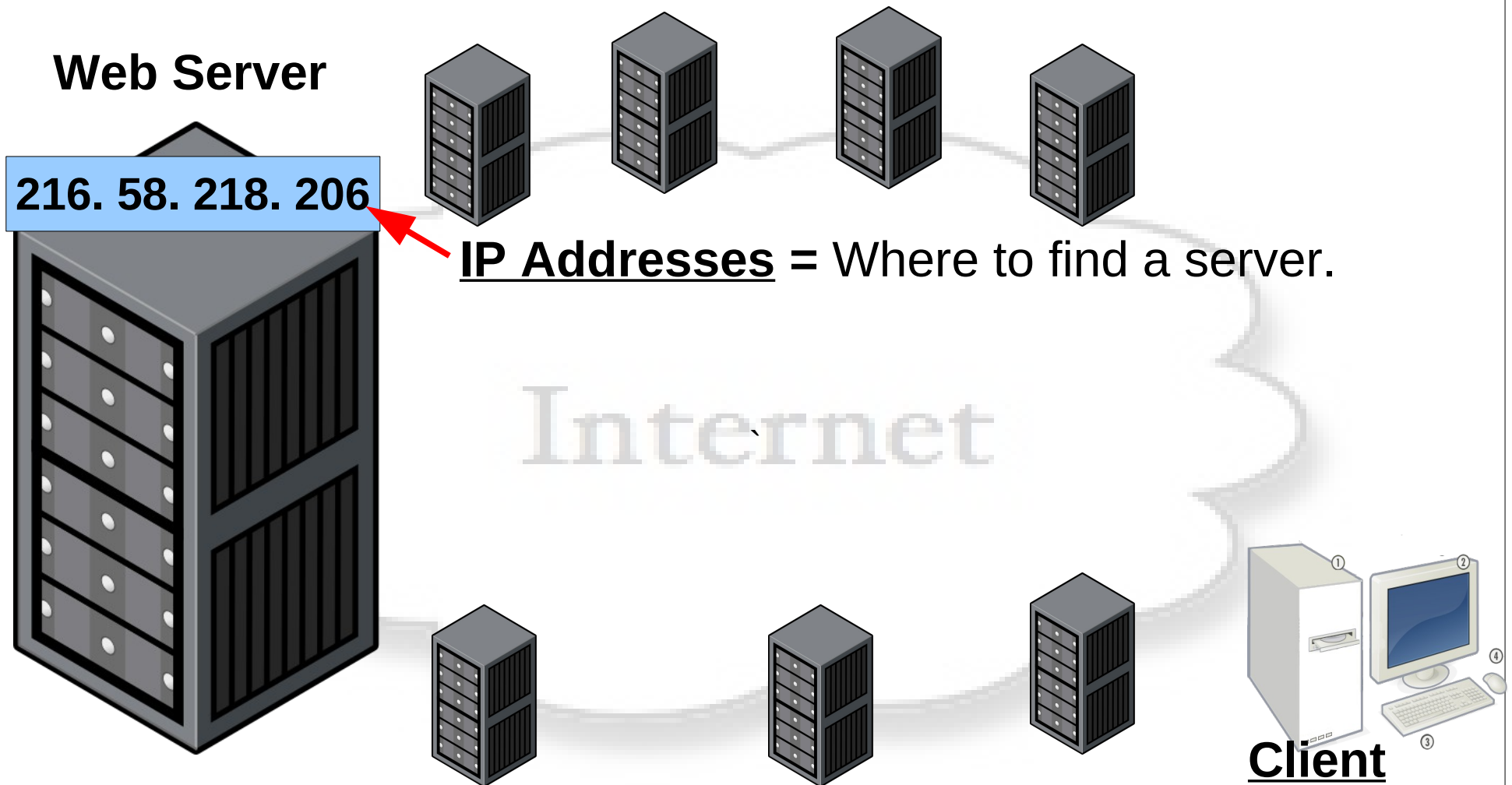
### Explaining IP Addresses, Ports and Protocols



# TTC: Intro To Networking

## How Computers Talk Over Networks

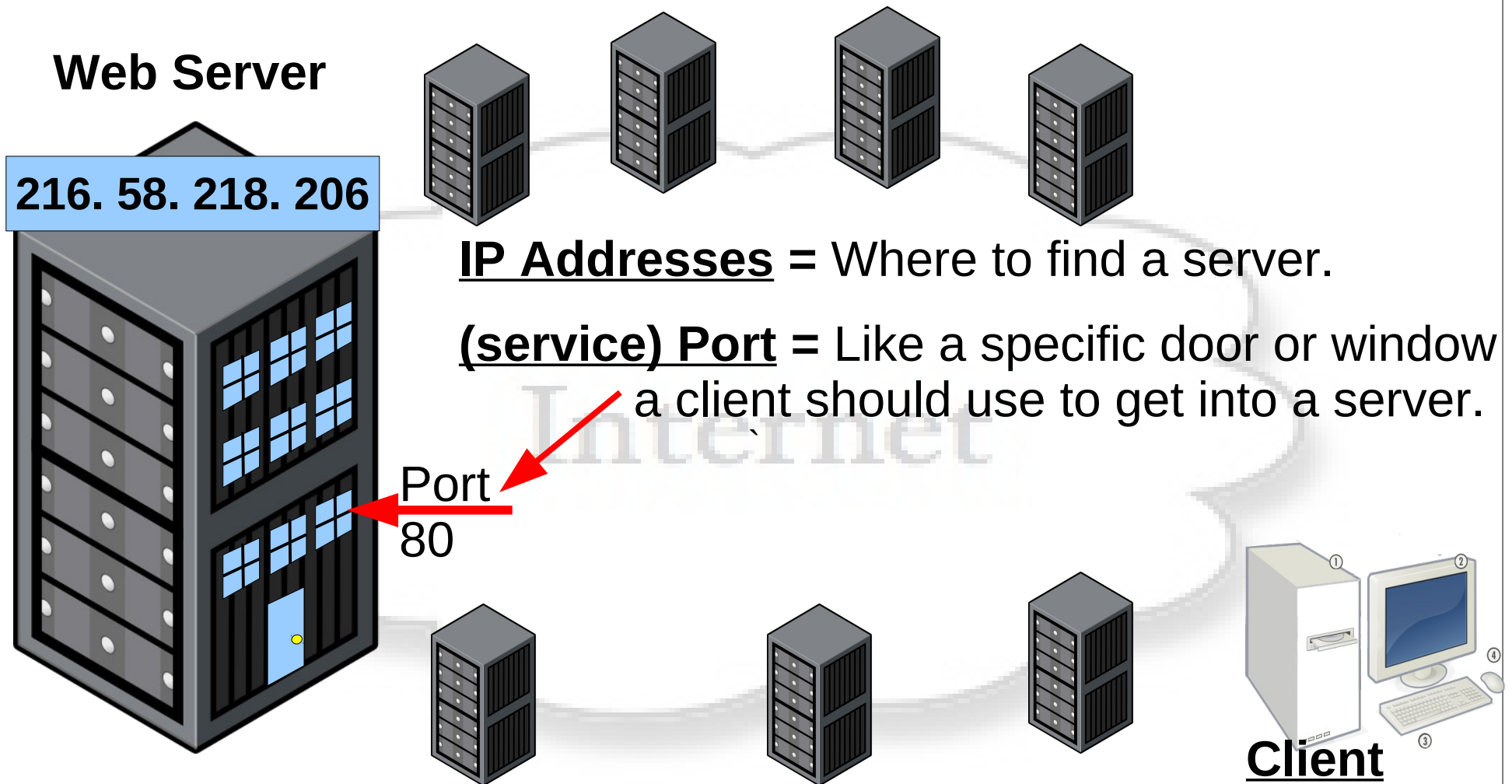
### Explaining IP Addresses, Ports and Protocols



# TTC: Intro To Networking

## How Computers Talk Over Networks

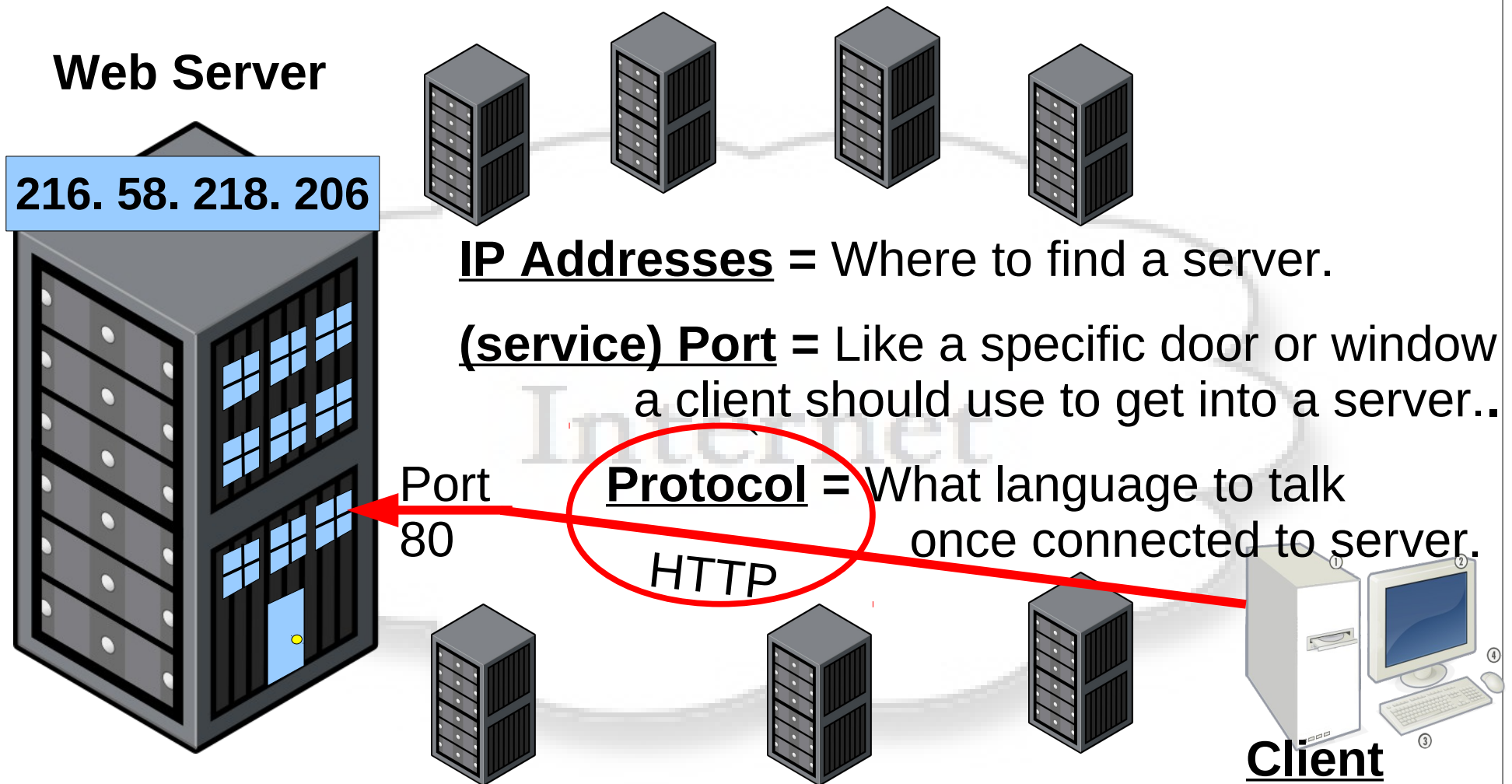
### Explaining IP Addresses, Ports and Protocols



# TTC: Intro To Networking

## How Computers Talk Over Networks

### Explaining IP Addresses, Ports and Protocols

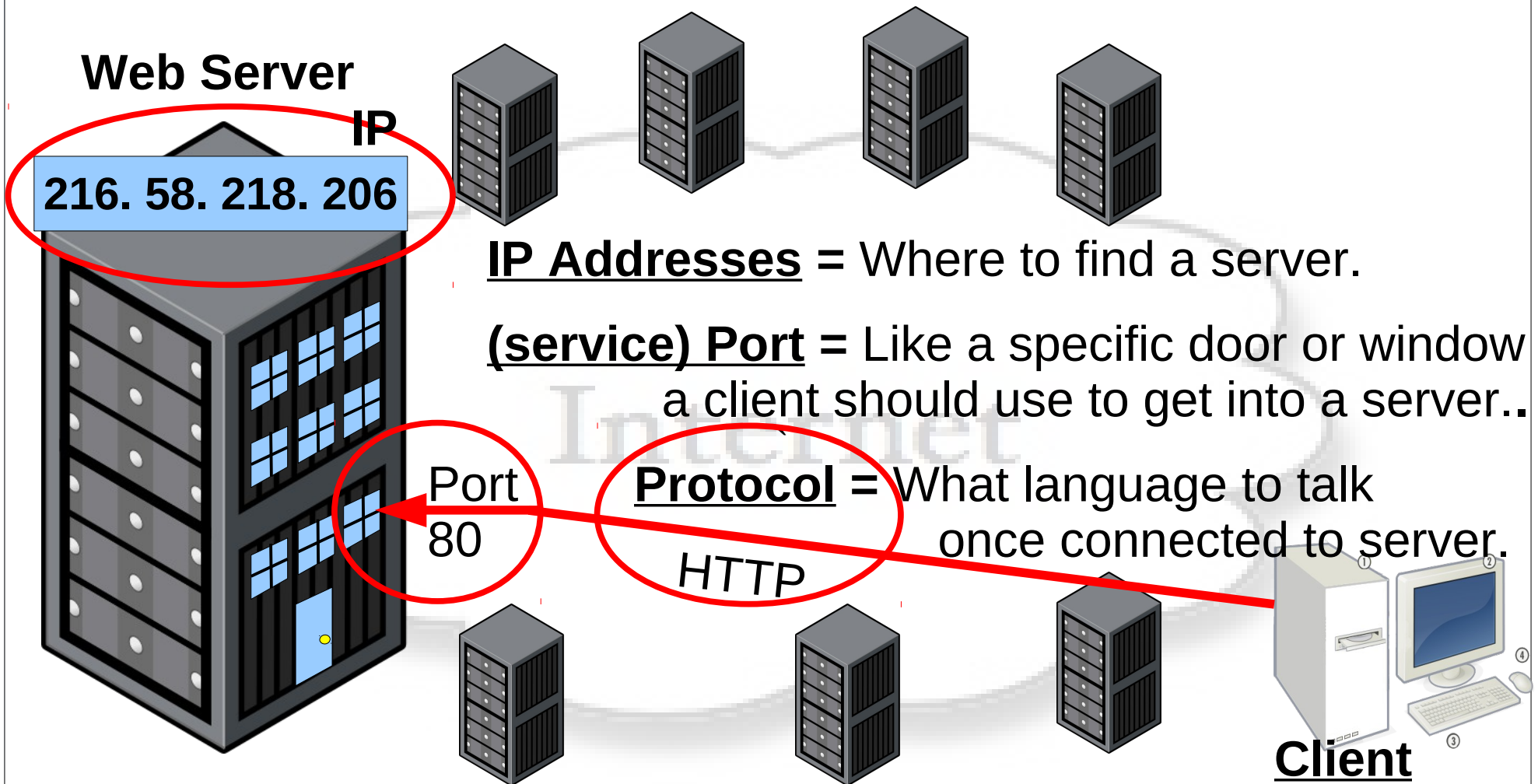




# TTC: Intro To Networking

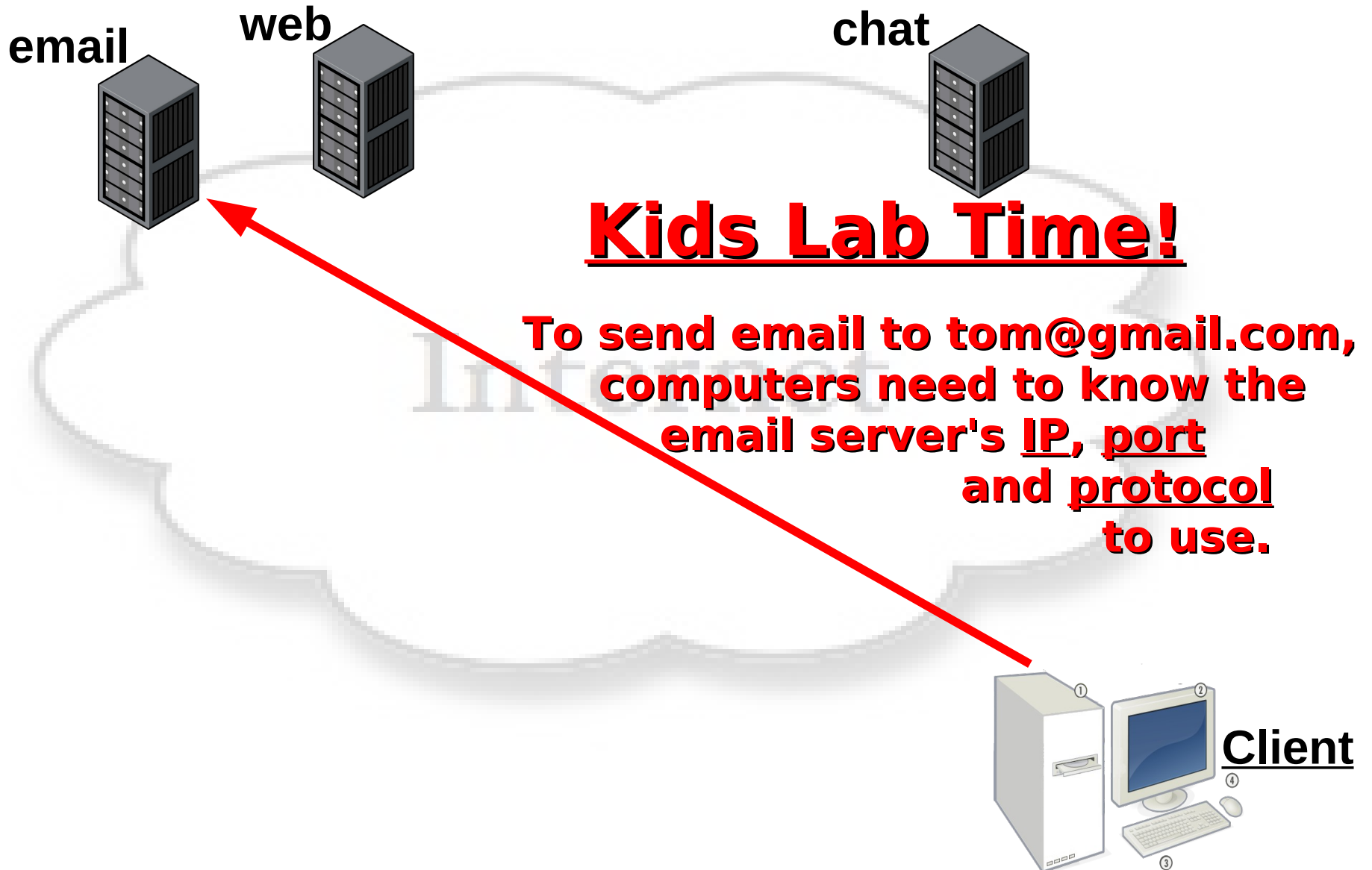
## How Computers Talk Over Networks

### Explaining IP Addresses, Ports and Protocols



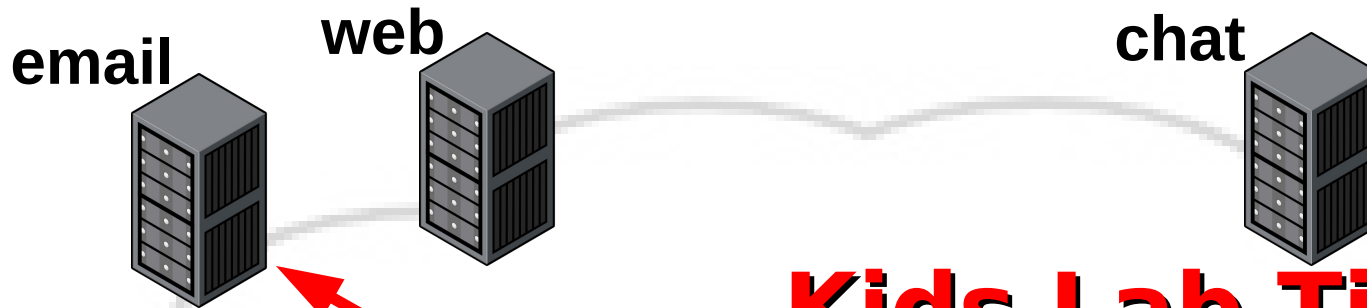
# TTC: Intro To Networking

## How Computers Talk Over Networks



# TTC: Intro To Networking

## How Computers Talk Over Networks



### Kids Lab Time!

To send email to **tom@gmail.com**, computers need to know the email server's IP, port and protocol to use.

To Send email to tom@gmail.com

IP Address: ???

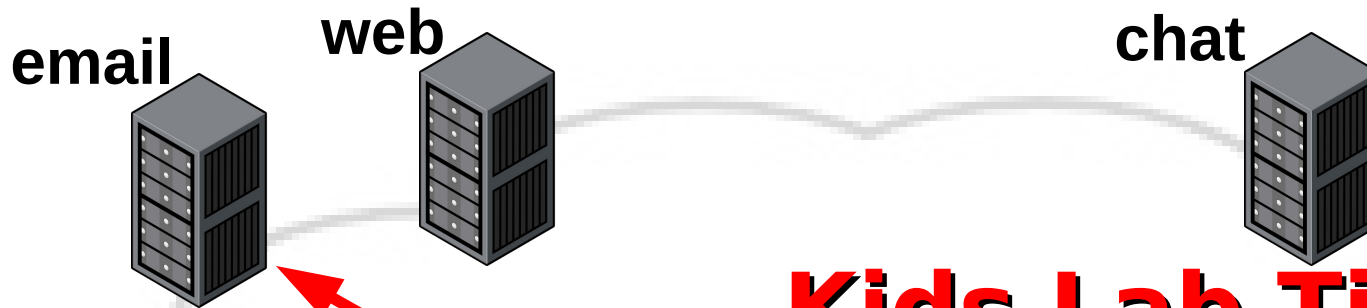
Port: ???

Protocol: ???



# TTC: Intro To Networking

## How Computers Talk Over Networks



### Kids Lab Time!

To send email to **tom@gmail.com**, computers need to know the email server's IP, port and protocol to use.

To Send email to tom@gmail.com

IP Address: gmail.com = (use "nslookup")

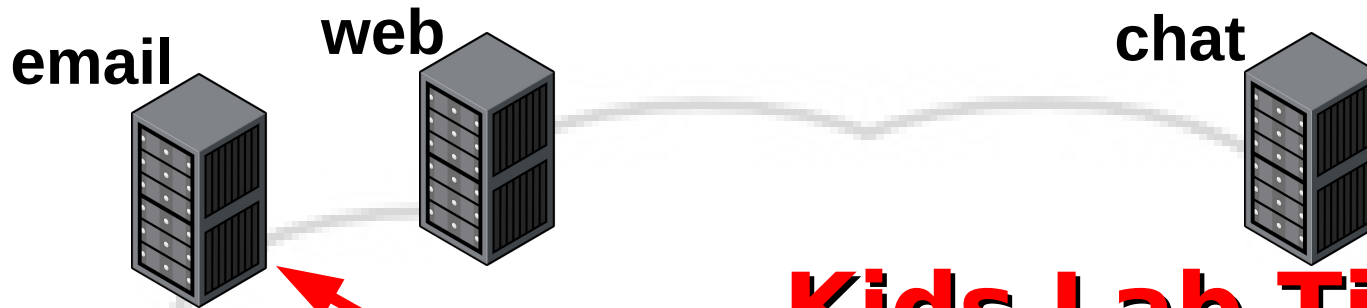
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Protocol: ???



# TTC: Intro To Networking

## How Computers Talk Over Networks



### Kids Lab Time!

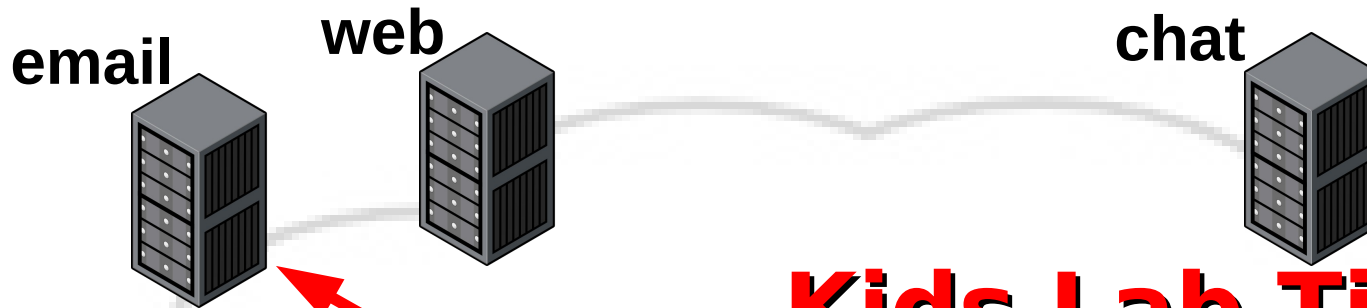
To send email to **tom@gmail.com**, computers need to know the email server's IP, port and protocol to use.

To Send email to tom@gmail.com  
IP Address: gmail.com = 173.194.46.117  
Port: ??? (see /etc/services)  
Protocol: ??? (see /etc/services)



# TTC: Intro To Networking

## How Computers Talk Over Networks



### Kids Lab Time!

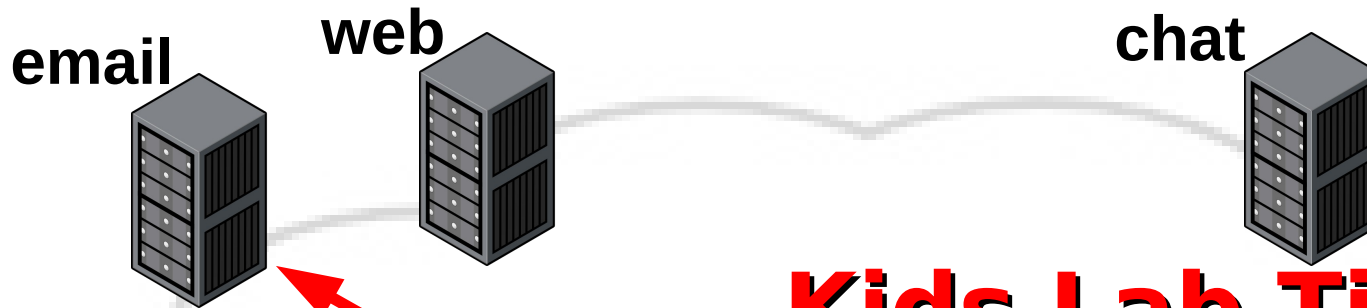
To send email to **tom@gmail.com**, computers need to know the email server's IP, port and protocol to use.

To Send email to tom@gmail.com  
IP Address: gmail.com = 173.194.46.117  
Port: 25  
Protocol: ???



# TTC: Intro To Networking

## How Computers Talk Over Networks



### Kids Lab Time!

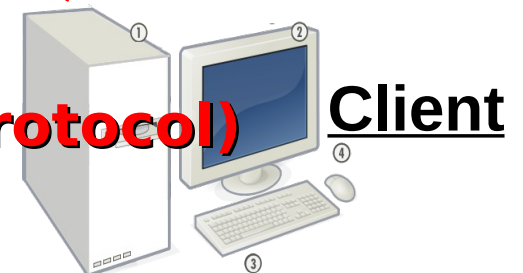
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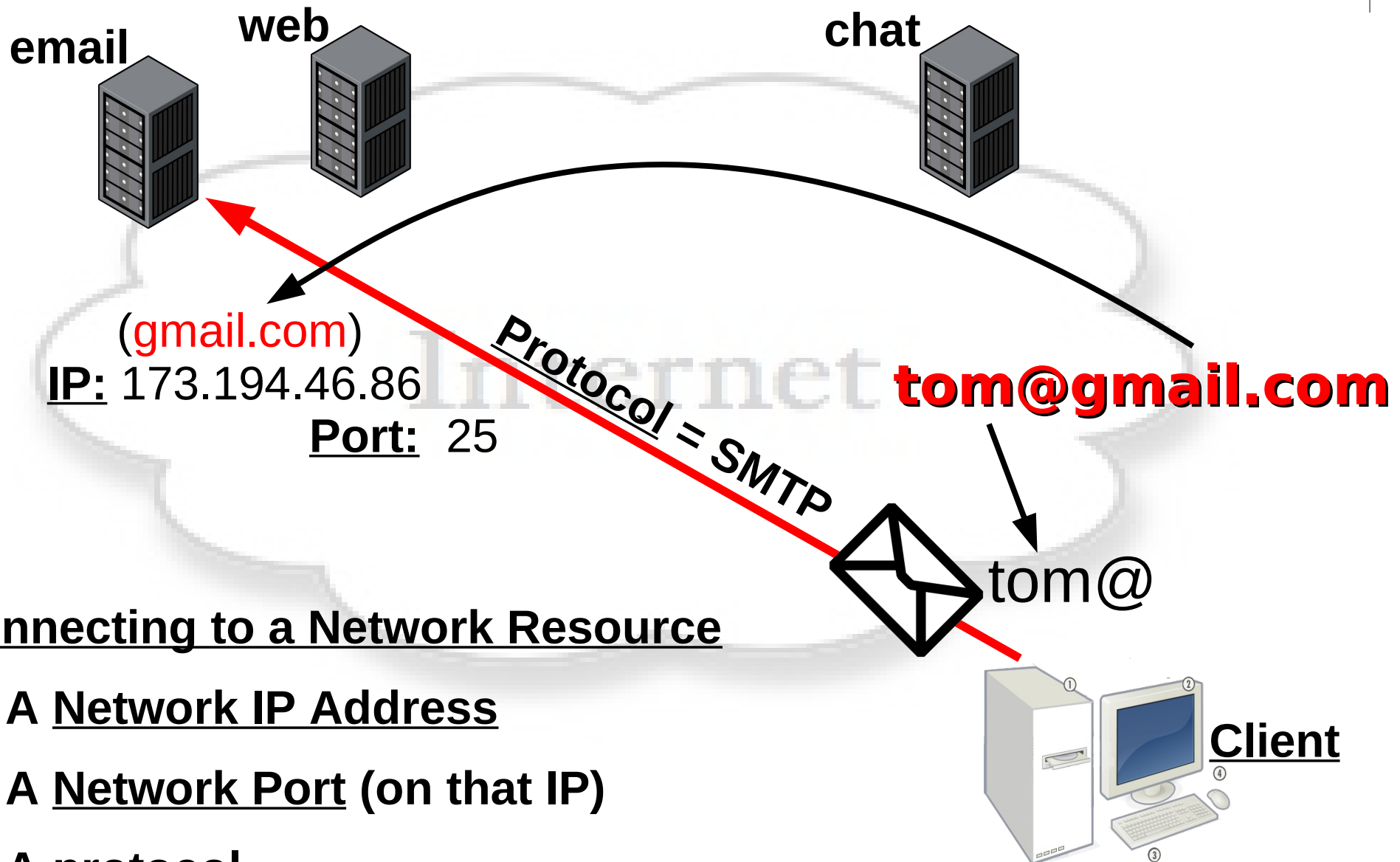
Port: 25

Protocol: SMTP (simple mail transfer protocol)



# TTC: Intro To Networking

## How Computers Talk Over Networks



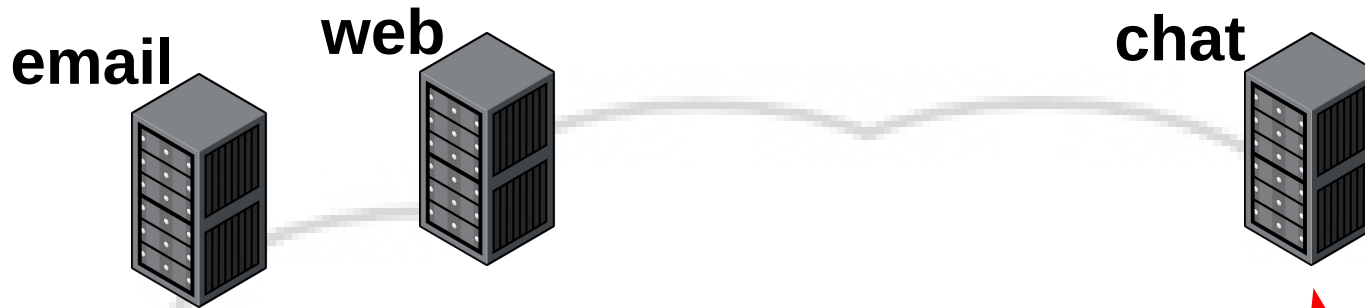
### Connecting to a Network Resource

- A Network IP Address
- A Network Port (on that IP)
- A protocol



# TTC: Intro To Networking

## How Computers Talk Over Networks

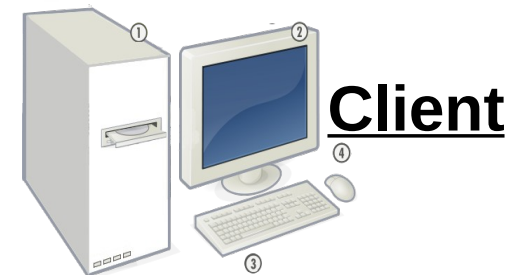


### Kids Lab Time!

To chat with a friend on the server chat.freenode.net, the computer needs that server's IP, port and protocol to use. Find them!

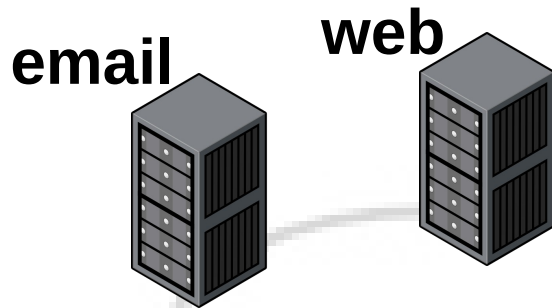
### To Chat on chat.freenode.net

IP Address:            ???  
Port:                    ???  
Protocol:                ???



# TTC: Intro To Networking

## How Computers Talk Over Networks



**Chat.freenode.net**  
**chat 130.239.18.172**



### Kids Lab Time!

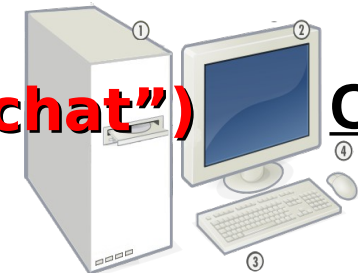
To chat with a friend on the server chat.freenode.net, the computer needs that server's IP, port and protocol to use. Find them!

### To Chat on chat.freenode.net

IP Address: 130.239.18.172

Port: ??? (look for "irc" or "chat")

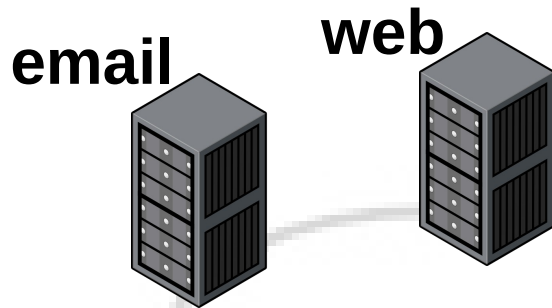
Protocol: ???



**Client**

# TTC: Intro To Networking

## How Computers Talk Over Networks



**Chat.freenode.net**  
chat **130.239.18.172**

**port = 6667**

### Kids Lab Time!

To chat with a friend on the server chat.freenode.net, the computer needs that server's IP, port and protocol to use. Find them!

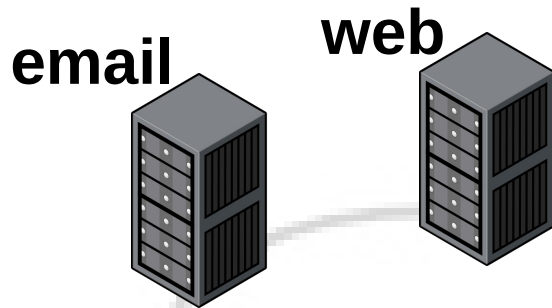
#### To Chat on chat.freenode.net

<u>IP Address:</u>	<b>130.239.18.172</b>
<u>Port:</u>	<b>6667</b>
<u>Protocol:</u>	<b>???</b>



# TTC: Intro To Networking

## How Computers Talk Over Networks



**Chat.freenode.net**  
chat **130.239.18.172**

**port = 6667**

### Kids Lab Time!

To chat with a friend on the server chat.freenode.net, the computer needs that irc server's IP, port and protocol to use. Find them!

### To Chat on chat.freenode.net

IP Address: 130.239.18.172

Port: 6667

Protocol: irc (Internet Relay Chat)

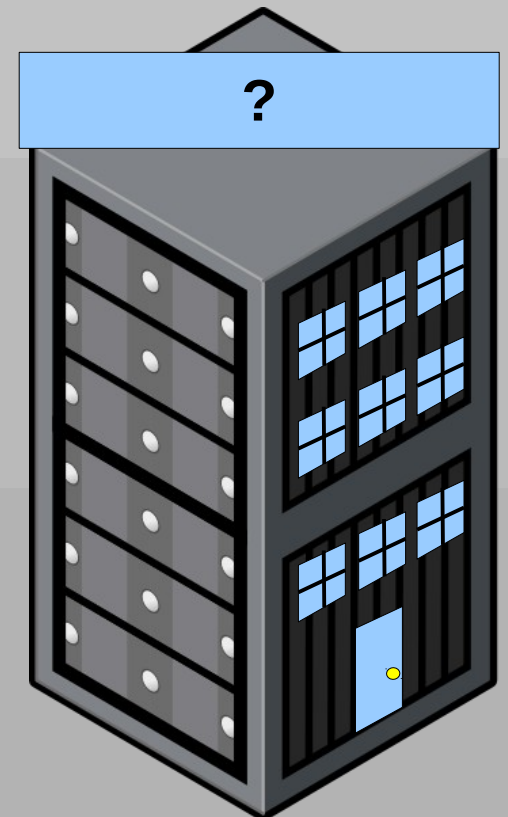


# TTC: Intro To Networking

## Computer Names vs IP Addresses

- How Were Computers Created?
- How Do Computers Work?
- How Data and File Storage Works
- Modern Computers Operating Systems
- Computer System's Files vs People's Files
- Exploring Computer Operating Systems
- Client Computers and Server Computers
- How Computer Networks Work
- **Computer Names vs IP Addresses**
- Computer Networking Tool Labs

[www.pbskids.org](http://www.pbskids.org)



# TTC: Intro To Networking

## Computer Names vs IP Addresses

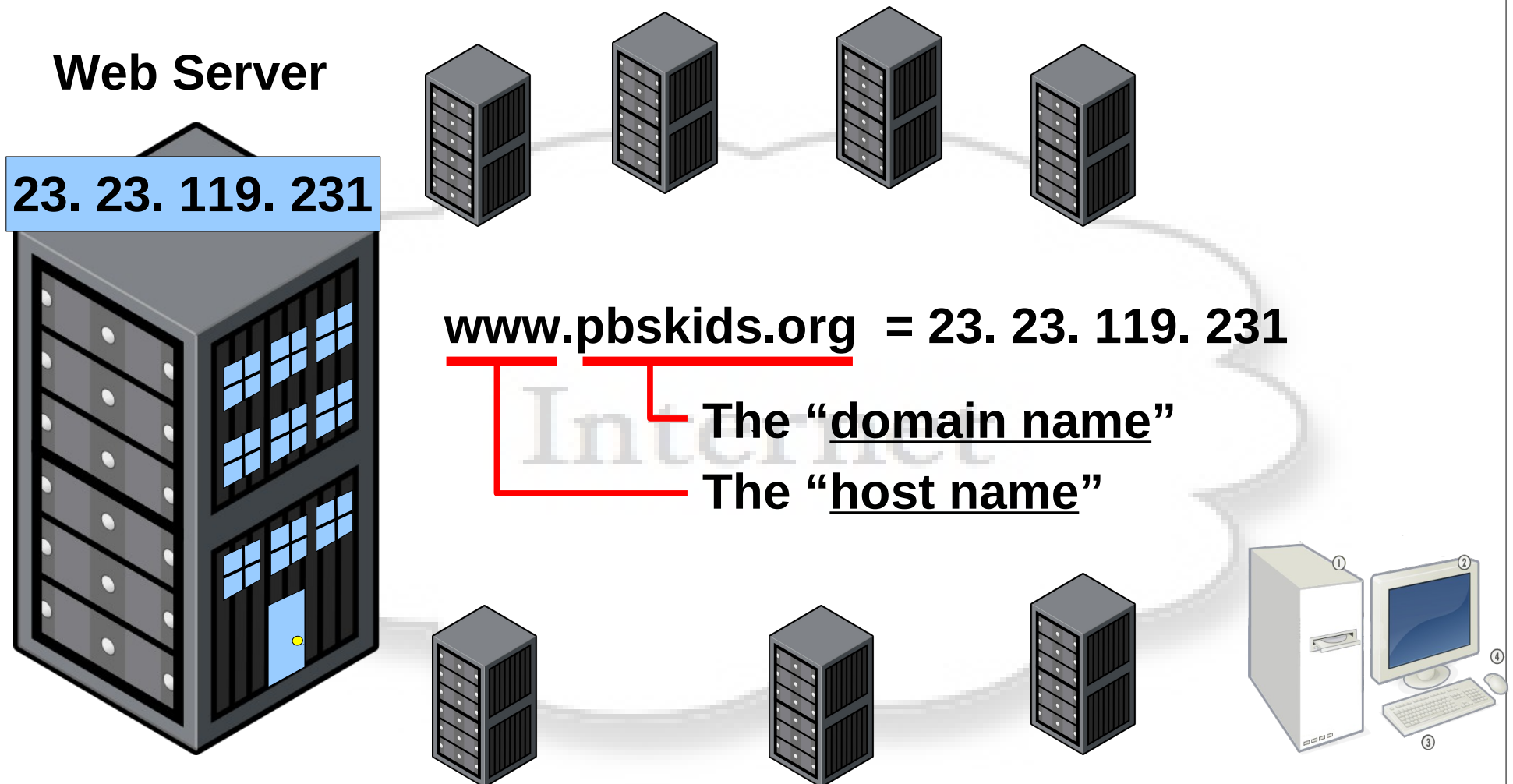
### What is a Computer Name?



# TTC: Intro To Networking

## Computer Names vs IP Addresses

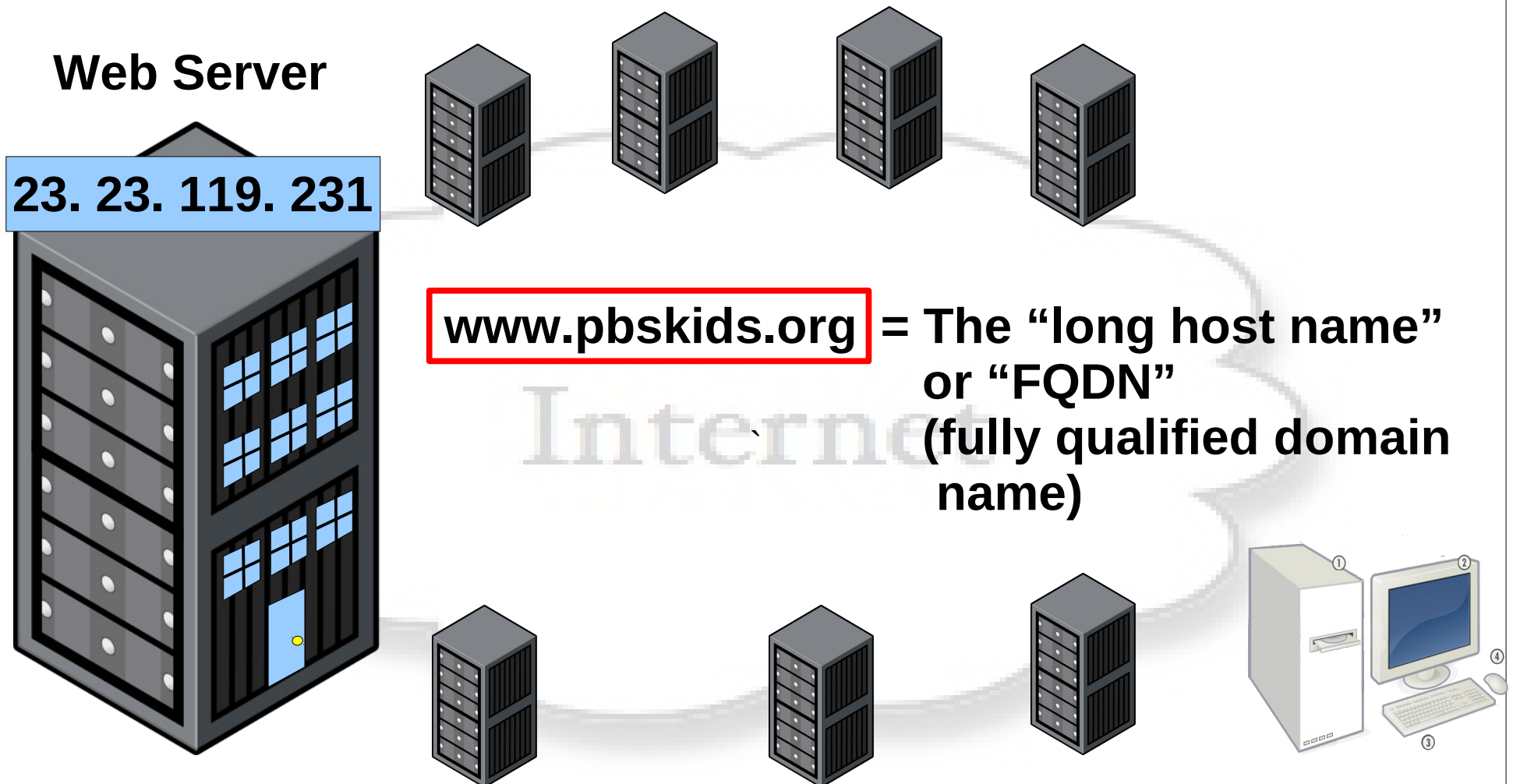
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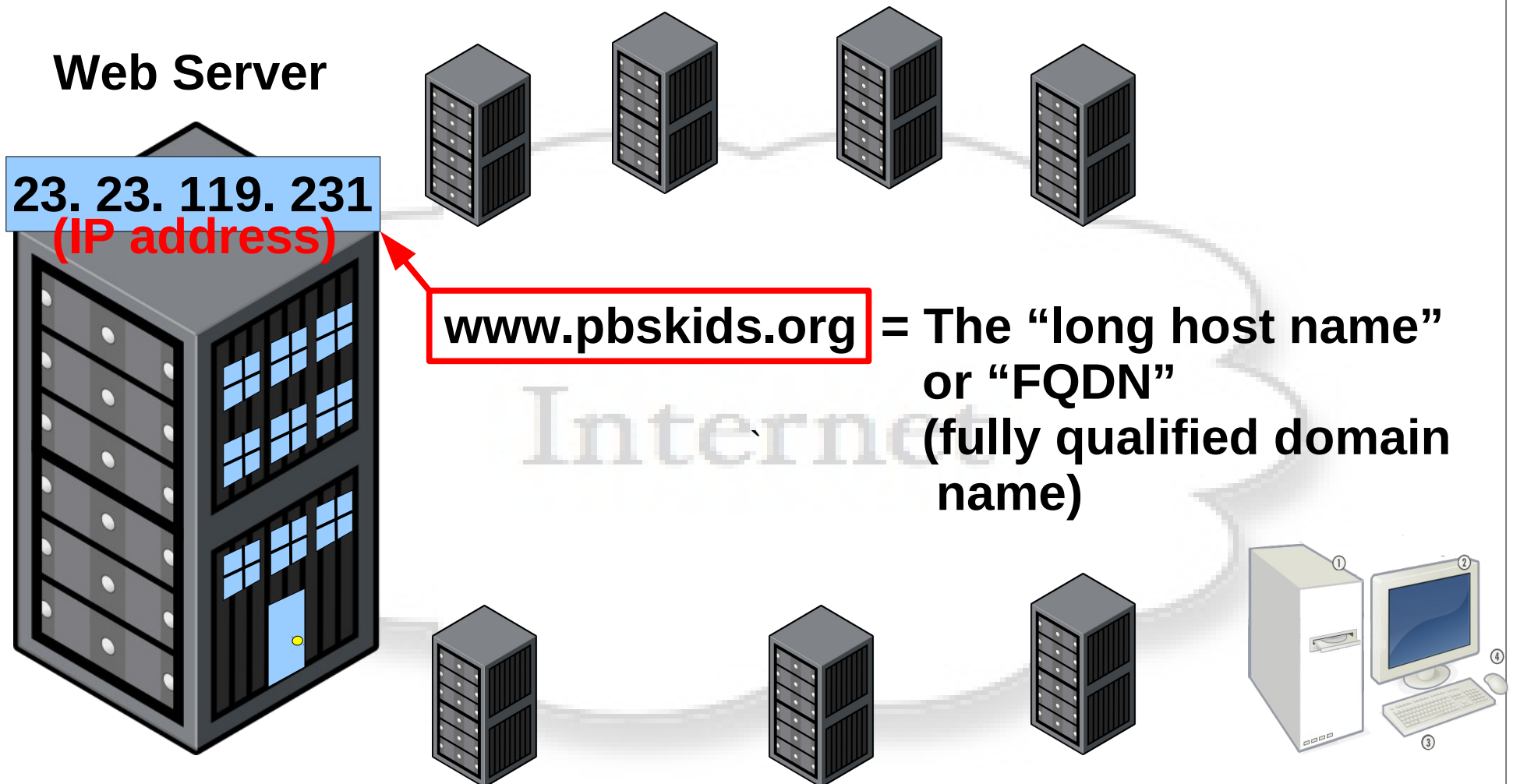




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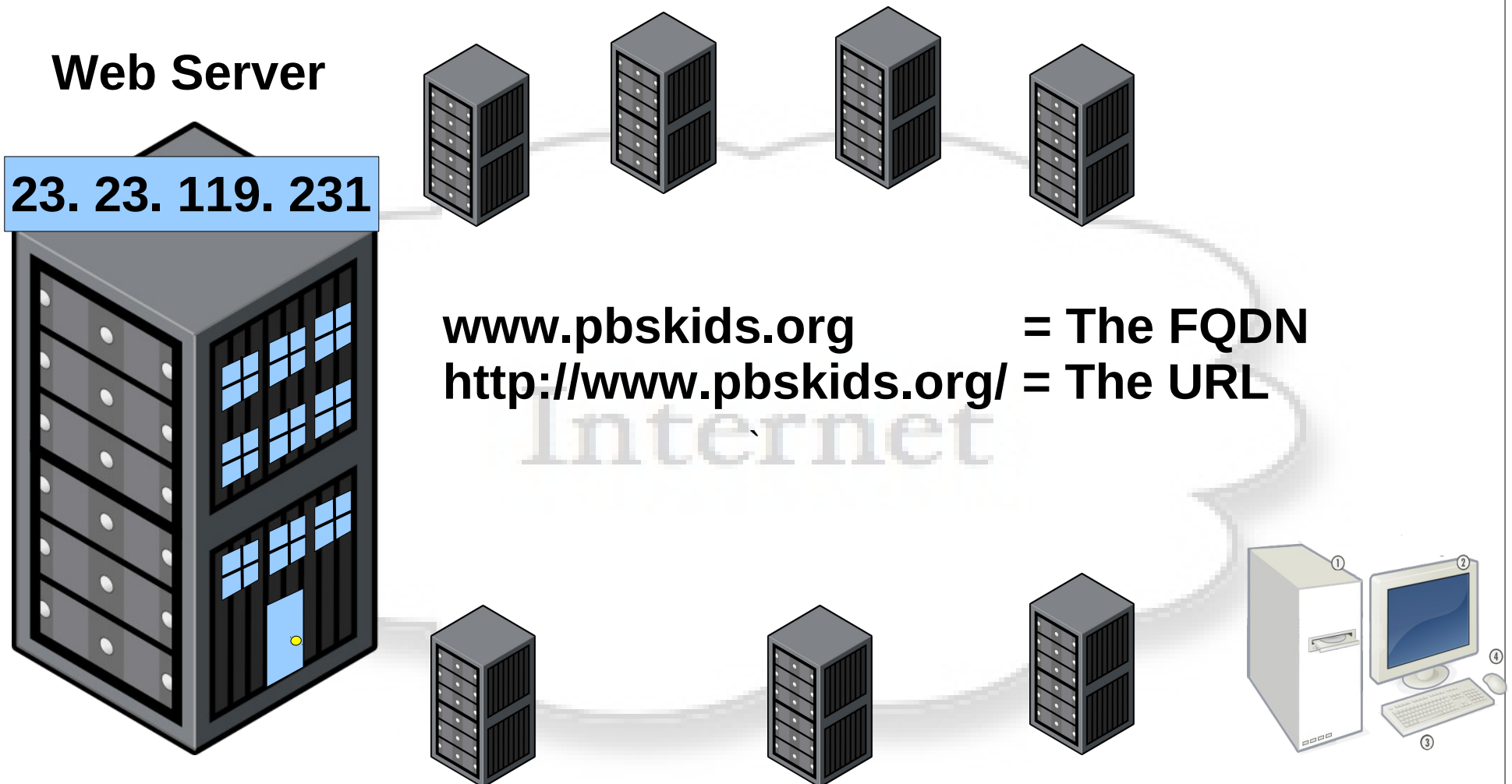
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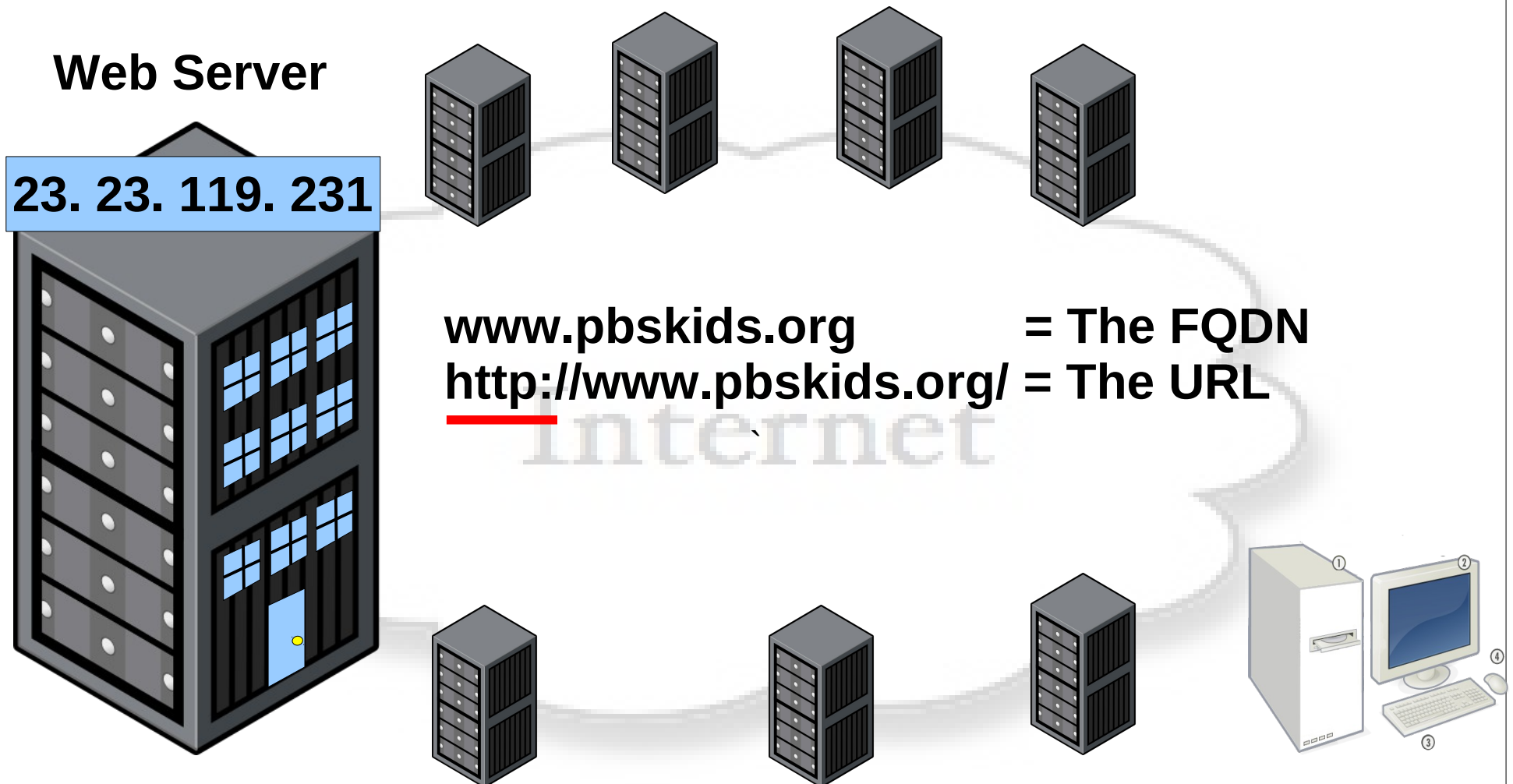
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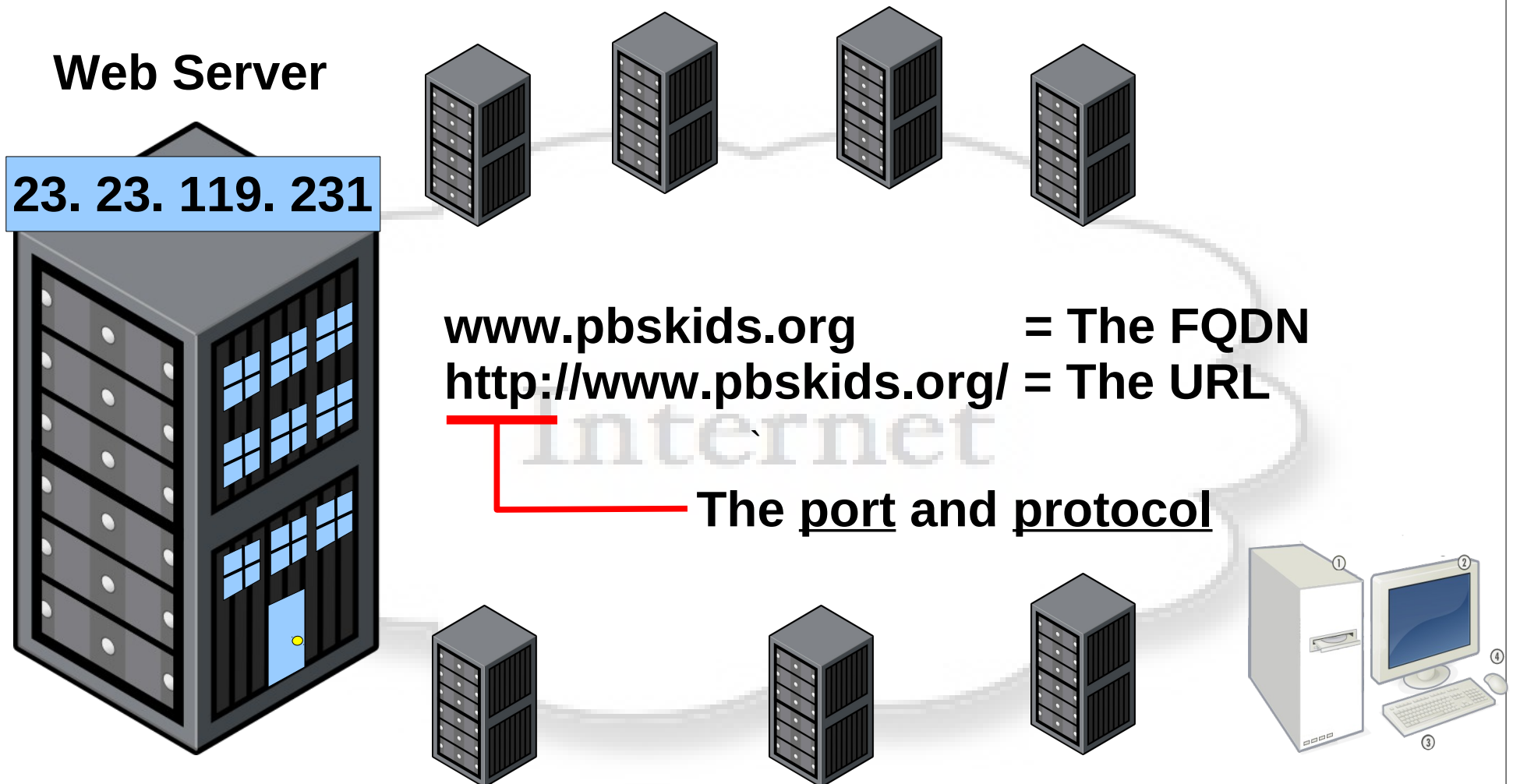
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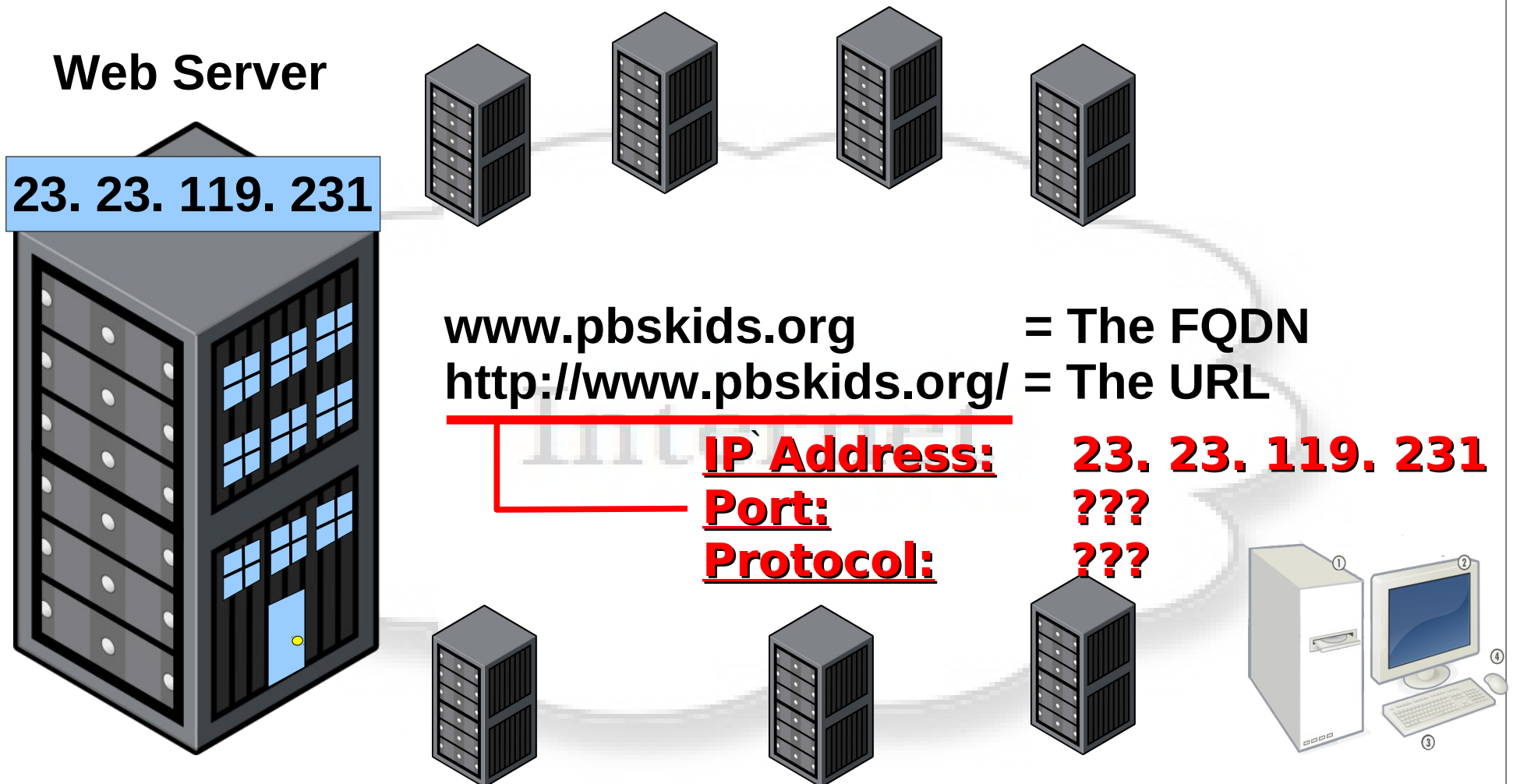
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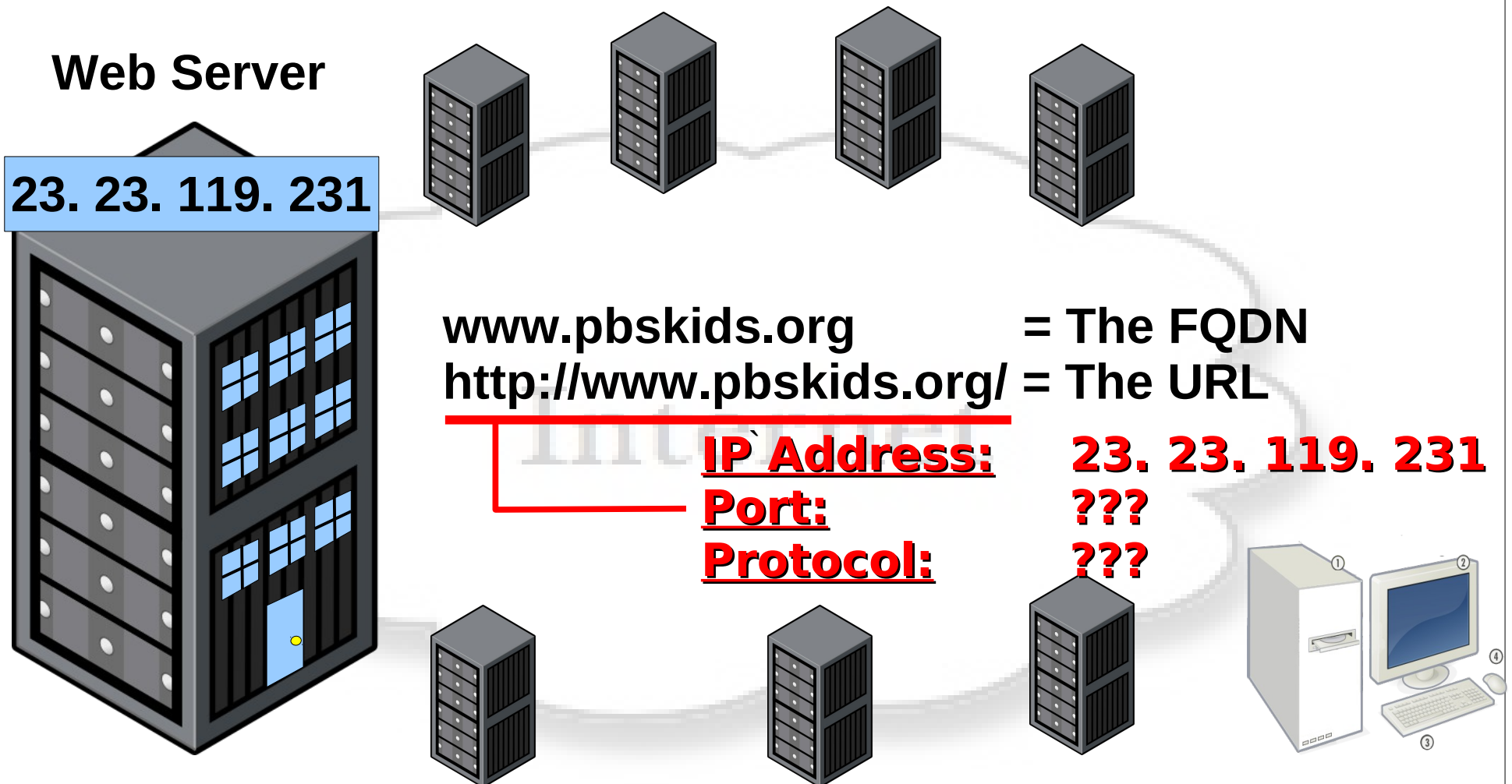
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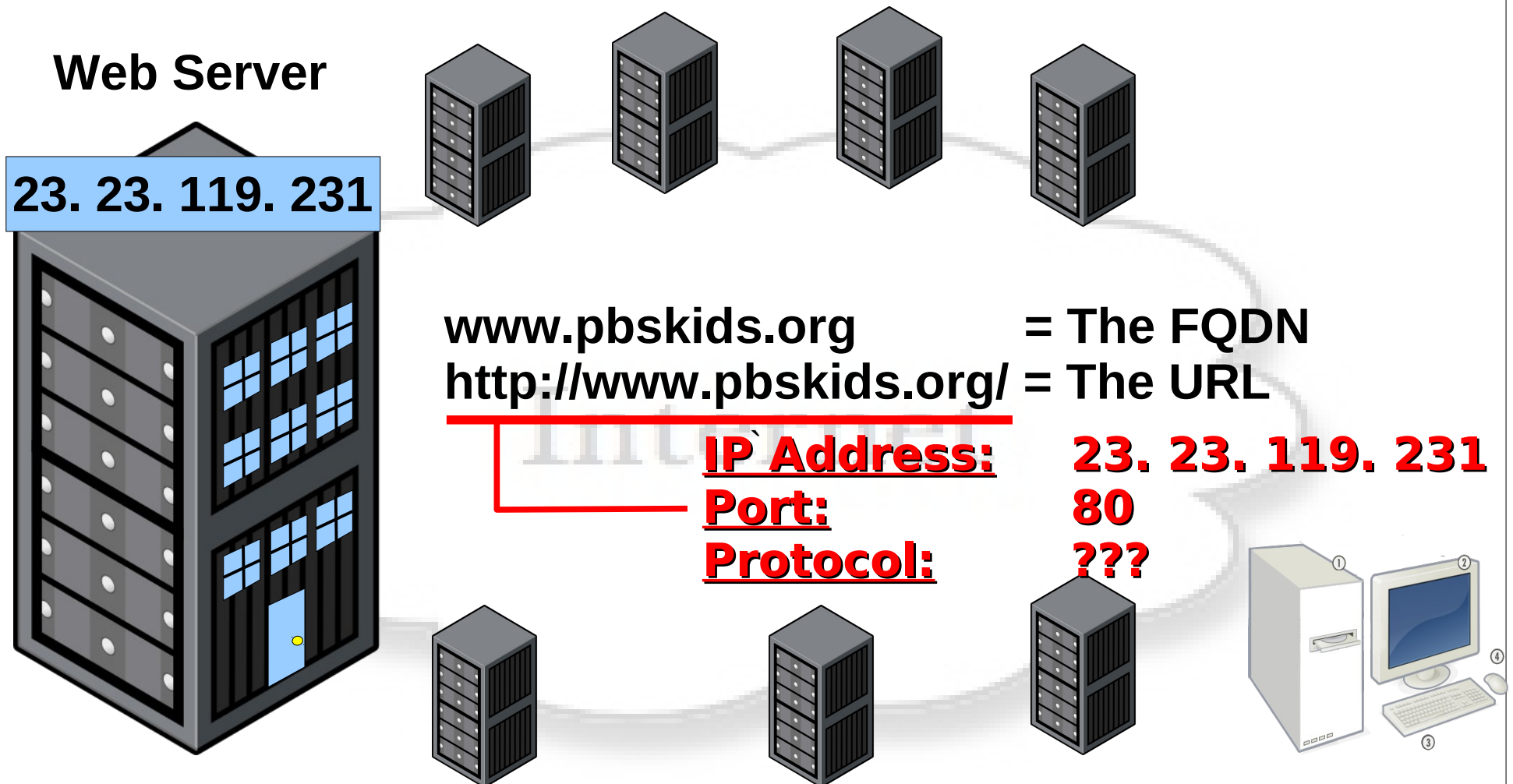
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## Computer Names vs IP Addresses

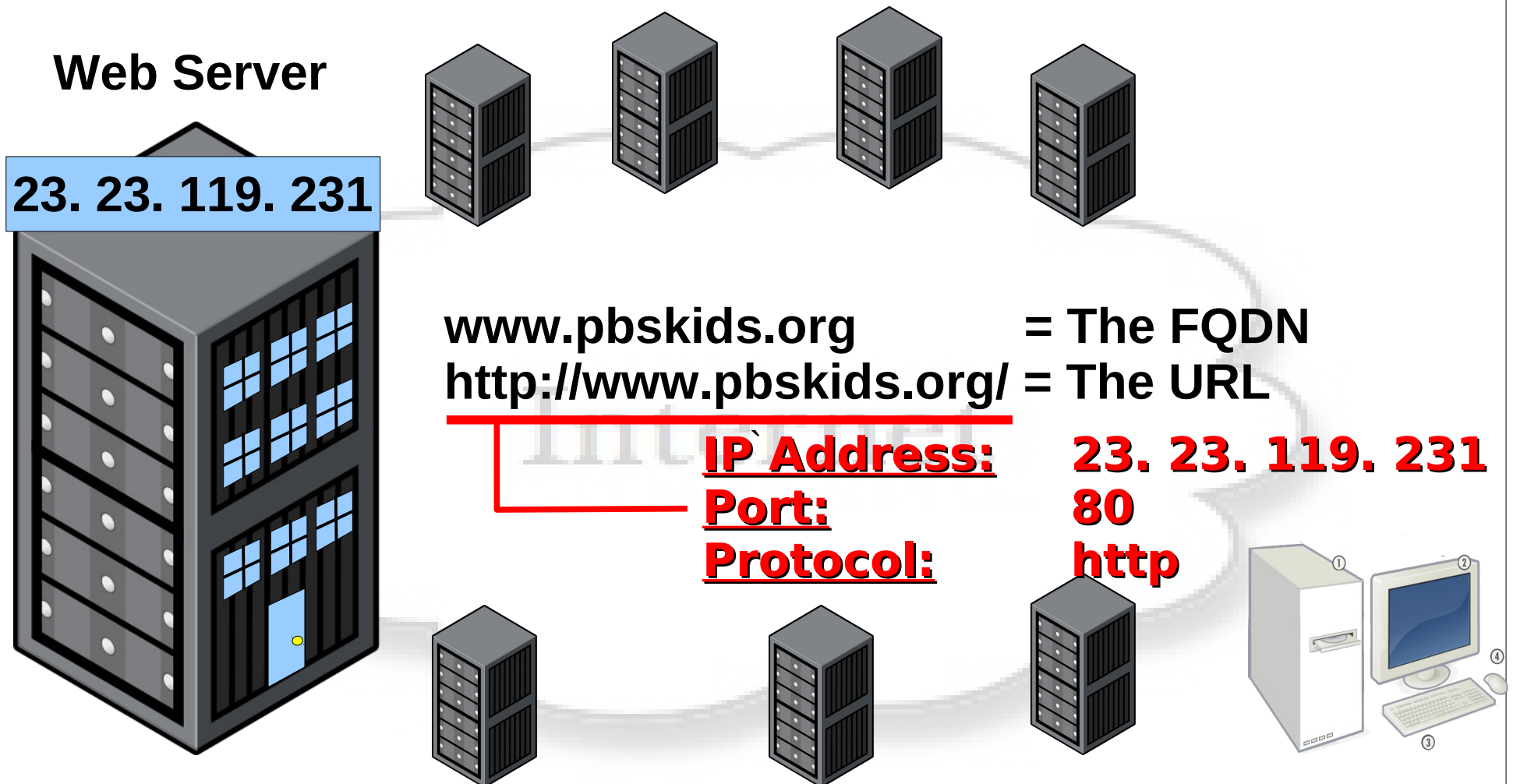
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## Computer Names vs IP Addresses

### What is a Computer Name?



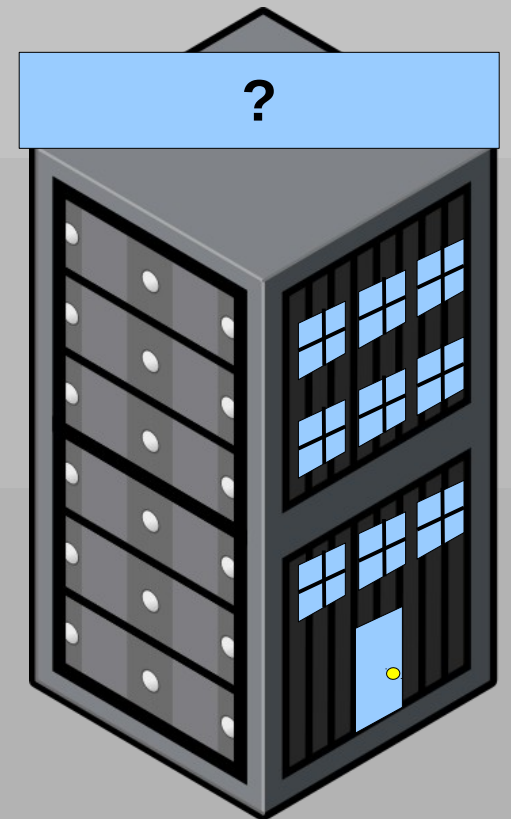


# TTC: Intro To Networking

## Computer Networking Tools

- How Were Computers Created?
- How Do Computers Work?
- How Data and File Storage Works
- Modern Computers Operating Systems
- Computer System's Files vs People's Files
- Exploring Computer Operating Systems
- Client Computers and Server Computers
- How Computer Networks Work
- Computer Names vs IP Addresses
- **Computer Networking Tool Labs**

[www.pbskids.org](http://www.pbskids.org)



# TTC: Intro To Networking

## Computer Networking Tools

**DNS Lookup IP/Hostnames** – DNS lookup - `host <host>`  
DNS root trace - `dig +trace <host>`  
Windows DNS lookup - `nslookup <host>`

**Getting Your Own Hostname** – `hostname`

**Lookup Domain Ownership** – `whois <domain.com>`

**Connecting to hosts** – secure shell - `ssh <user@example.com>`  
insecure shell - `telnet <ip/host> <port>`  
netcat - `nc <ip/host> <port>`  
cli web browser – `elinks <http://url>`

**Computer's static IP/hostname file** – `/etc/hosts`  
(on Windows `C:\Windows\System32\drivers\etc\hosts`)

**Computer's static service/port translation file** – `/etc/services`  
(on Windows `C:\Windows\System32\drivers\etc\services`)

# TTC: Intro To Networking

## Computer Networking Tools

Looking up IP/Hostnames – `host <host>`  
`dig <host>`  
`nslookup <host>`

Getting Your Own Hostname – `hostname`

Lookup Domain Ownership – `whois <domain.com>`

Connecting to hosts – `ssh <user@example.com>`

`secure shell - telnet <ip/host>`

`netcat - nc <host> <port>`

`cli web browser - elinks <http://ip>`

Computer's static IP/hostname file – `/etc/hosts`  
(on Windows `C:\Windows\System32\drivers\etc\hosts`)

Computer's static service/port translation – `/etc/services`  
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**Lab Time!**

Let's explore

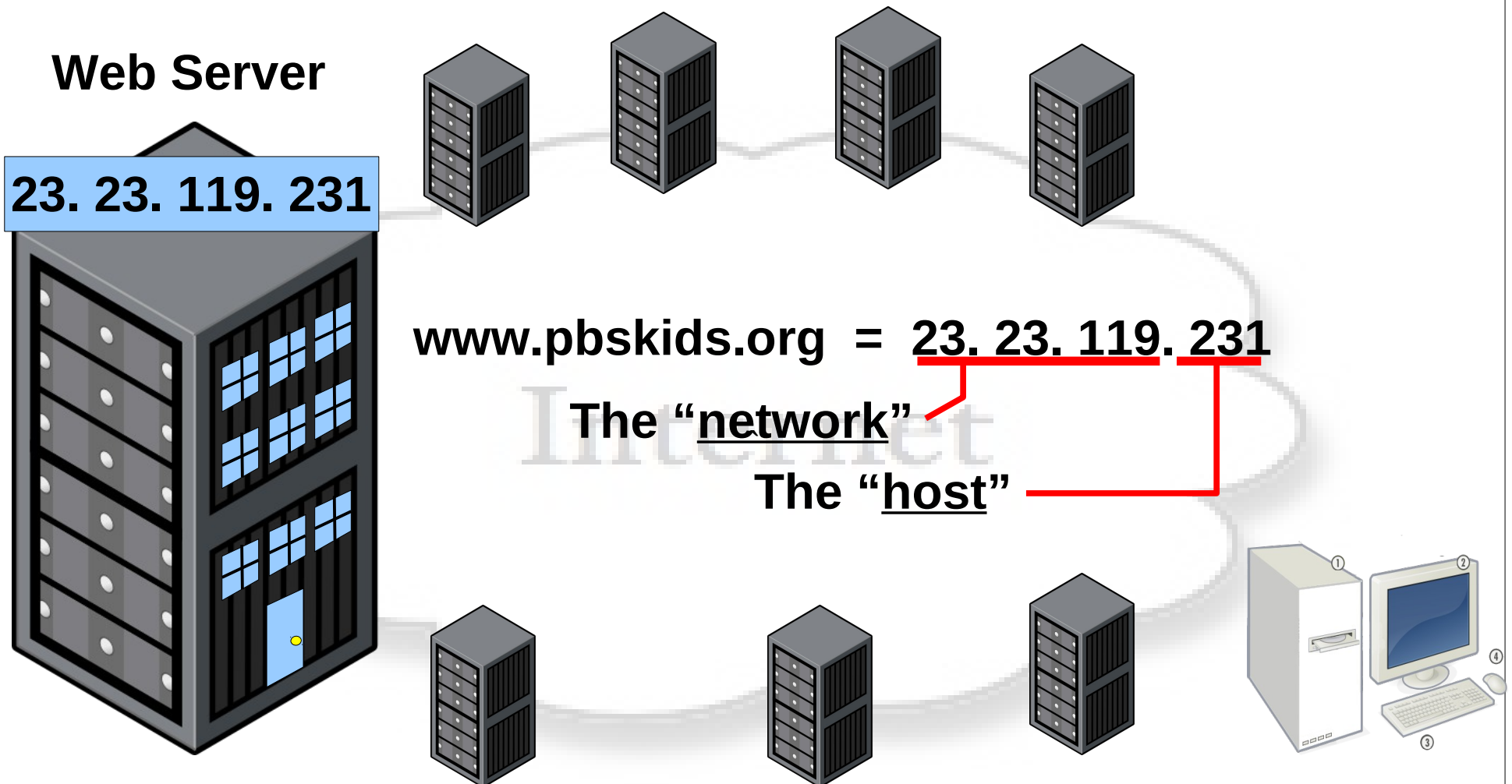
these network host commands!



# TTC: Intro To Networking

## Computer Networking Tools

### What is an IP Address?



# TTC: Intro To Networking

## Computer Networking Tools

### IP Addressing/Network Testing Tools

Listing your machine IP Addresses – Linux/Mac – `ip addr show`  
Legacy – `ifconfig -a`  
Windows DNS lookup – `ipconfig /all`

Testing (pinging) and IP Address – Linux/Mac – `ping <ip/host>`  
Windows – `ping -c <ip/host>`

Port/IP Scanning –  
Ping Network Scan – `nmap -sP 192.168.1.0/24`  
Host Port Scan – `nmap -sS <ip/host>`  
Host Fingerprint Scan – `nmap -O -v <ip/host>`

Network/Internet Routes – Your routes (legacy/Windows) - `route -n`  
Your routes (new/Lin/Mac) - `ip route show table local`  
Test routes to host (ICMP/legacy) - `tracert <host>`  
Test path to host (UDP) - `tracert -c <host>`  
Nice network stats diagnostic tool (TCP) - `mtr <host/ip>`

# TTC: Intro To Networking

## Computer Networking Tools

### IP Addressing/Network Testing Tools

Listing your machine IP Addresses – Linux/Mac – `ip addr show`  
Legacy – `ifconfig -a`  
Windows DNS lookup – `ipconfig /all`

Testing (pinging) and IP Address – Linux/Mac – `ping <ip/host>`  
Windows – `ping -c <ip/host>`

### Port/IP Scanning

**SECURITY WARNING!**  
Don't do this without  
network/host admin permission,  
or you could go to jail!



Ping Network Scan – `nmap -sP 192.168.1.0/24`  
Host Port Scan – `nmap -sS <ip/host>`  
Host Fingerprint Scan – `nmap -O -v <ip/host>`

Network/Internet Routes – Your routes (legacy/Windows) - `route -n`  
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# TTC: Intro To Networking

## Computer Networking Tools

### IP, Port and Protocols Lab

Follow steps below and record discoveries.

- Use “`ping 8.8.8.8`” to test your Internet connection
- Find out what your IP Address is & ping yourself
- What is your LAN's "gateway" address?
- Ask your neighbor if you can port scan their machine. If okay, use “`nmap -sS <IP>`” to scan them.
- What ports & protocols are "open"?
- Ask to connect to one of your neighbor's IP:ports
  - After successfully connecting –
- Turn off your computer's network connection
- Now try to connect to your neighbor
- Try pinging “`ping 8.8.8.8`”
- Try pinging “`ping 127.0.0.1`”

# TTC: Intro To Networking

## Computer Networking Tools

ISP

DHCP
DNS

## Networking LAB

- 1) run "mtr google.com" from your machine.
- 2) How many "hops" from you to google.com?
- 3) Now, watch the instructor do it from his machine.
- 4) Q: Are the number of hops from your PC to google different than from the router?

**Why the difference?**



# TTC: Intro To Networking Q & A

**Questions, Answers  
and Discussion Time**