Linux and the Internet, Servers, Ports, Firewalls

Linux User Group @ UTA

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What is Linux

- Free and open source operating system

- Linux kernel was written by Linus Torvalds in 1991

- Community developed

Linux Adoption

- Most popular server OS
- >95% worlds fastest 500 supercomputers
- Leader in cloud computing
- Embedded devices
    - Android phones and tablets
    - Network routers
    - Smart TVs
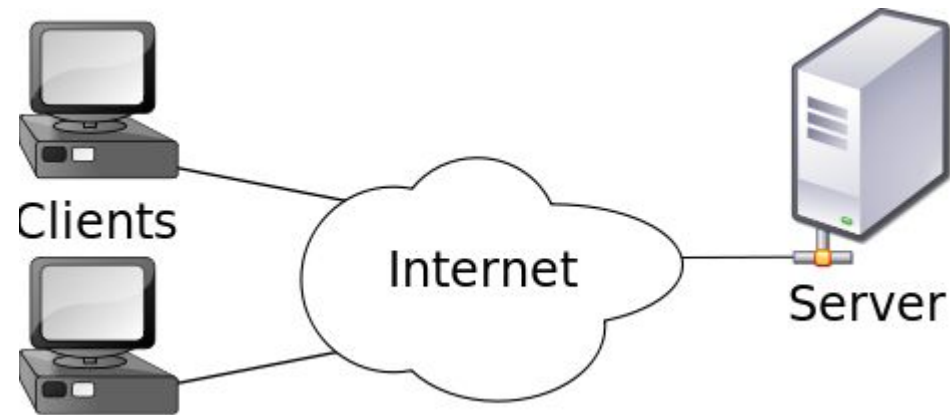
[1]

Reasons

- Reduced operating system cost

- Open source

    - Better performance and stability

    - Security

    - Customizable

Internet

- Global network of computers using the Internet Protocol (IP)

- Most commonly used services:

    - World Wide Web (WWW)

    - Email

    - Peer-to-peer

- Most services use the client-server model

Client server model

Clients

Internet

Server

Internet Addressing

- Internet addresses can be compared to postal addresses

- If a computer connected to the internet is an apartment building:

  – Domain name – building's well known name

  – IP addresses – building's street address

  – Port / protocol – apartment number

Domain name & IP address

- Well known registered name for a website
    - Google.com, yahoo.com
- DNS service maps these names to IP address
    - Google.com → 173.194.115.116
    - Yahoo.com → 98.139.183.24
- Just like yellow pages map the name of a building to a street address
    - UTA ERB → 500 UTA Blvd., Arlington, TX

Services and ports

- One server may be offering both WWW and email services

  – WWW is offered through port 80 of the server

  – Email is sent through port 25 of the server

- Ports are a part of TCP/IP

  – Virtual connection end points

  – Keep data flow separated

  – Standard ports defined for well known services

Services and ports

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- Mail example: ERB building

  - Bioengineering department – 2nd floor
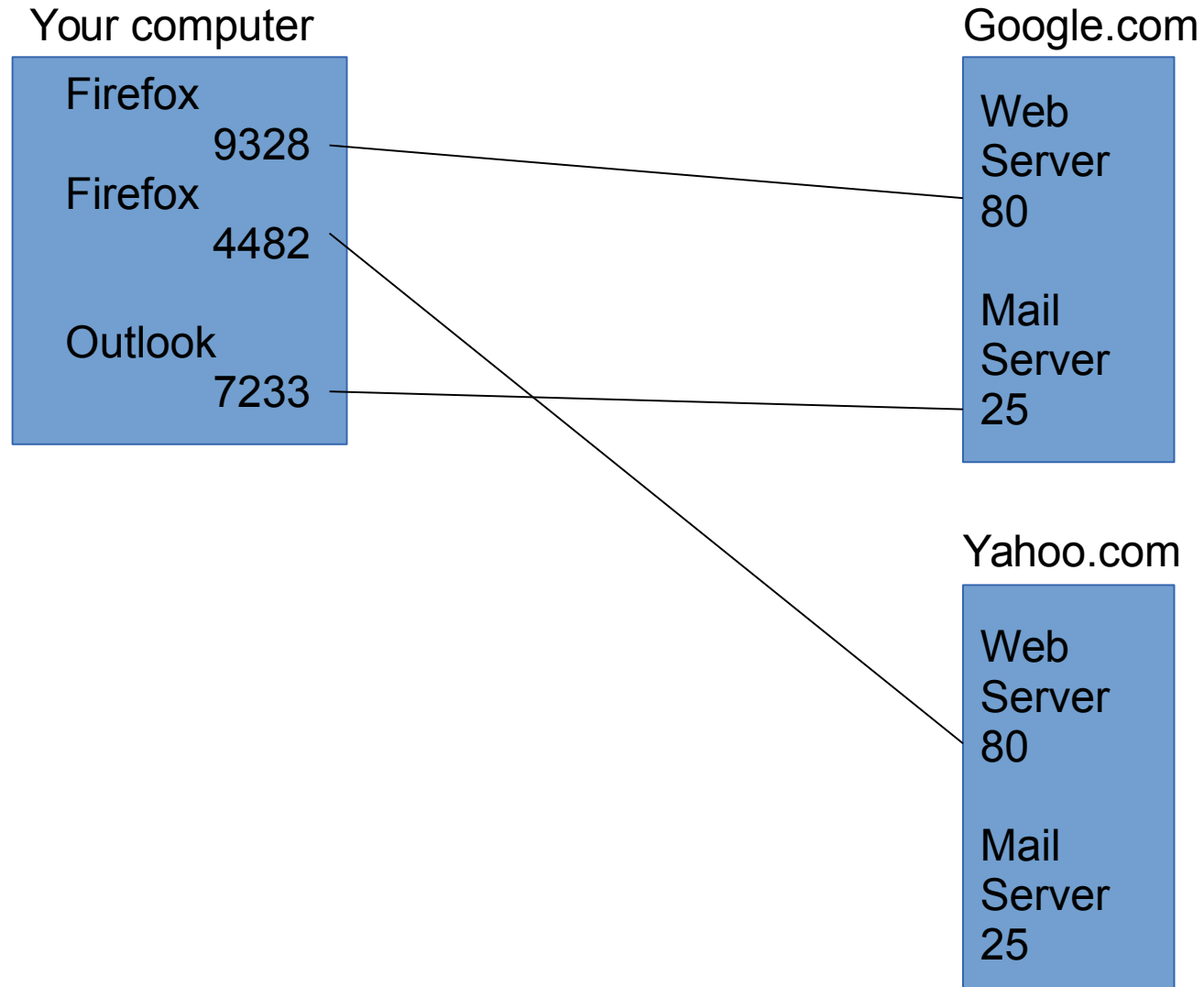
  - CSE department – 6th floor

Server

- Runs dedicated programs to handle user requests
  - Web server like Apache or Nginx runs and listens to requests coming on port 80
  - Email routing program like Sendmail listens to requests coming on port 25

Client

- Runs a client software
  - WWW clients like Firefox/Chrome/Opera
  - Email clients like Thunderbird/Outlook
- For every new connection the WWW client
  - Uses any random unused port on the computer
  - Always sends request to port 80 of the web server
- For every email transmission the Email client
  - Again uses a random port at its end
  - Always sends requests to port 25 of the email server
- Server replies to the port from which the request came

Multiple connections

Your computer

Firefox
9328

Firefox
4482

Outlook
7233

Google.com

Web
Server
80

Mail
Server
25

Yahoo.com

Web
Server
80

Mail
Server
25

Linux system as a WWW server

- Linux is robust enough for 24x7 operation
- Free & easy to integrate software to serve complex websites
  - Core web server to respond to requests
  - PHP for dynamic content
  - MySQL for databases

Basic static website

- Install the Apache or Nginx server

- Review the web server configuration file

- Save your web content in designated folder

- Give your IP address to other people to let them see your site

– WEB SERVER SETUP DEMO --

Continued..

May not work

- Firewalls

- Network Address Translation (NAT)

- On laptops using the UTA network: UTA's firewall implements wifi client isolation – one wifi device cannot make direct connections to other wifi devices on the network (probably)

Firewall

- Blocks connections to ports on computers which are not supposed to be servers

- Open ports on machines running out of date software are a security risk

  - Port 80 is blocked by many ISPs

  - Also block port 21 (ftp), port 25 (smtp) etc.

- Sometimes we cannot change firewall rules (corporate?)

- Solution:

  - Run our server on a different non-blocked port

Apache config file

- Apache config files are stored in /etc/apache2/

- Look in /etc/apache2/ports.conf

NAT

- Most ISPs give one public IP address per internet connection

- We usually have several computers sharing the same internet connection at home through a router

- Each computer cannot have its own public IP, so the router assigns a private IP to each local device

  - 10.0.0.0 – 10.255.255.255

  - 172.16.0.0 – 172.31.255.255

  - 192.168.0.0 – 192.168.255.255

NAT - outgoing

- Firefox on machine 1 uses port 2700 to send a request to google.com at port 80

  – 192.168.1.5:2700 → router → google.com:80

- Chrome on machine 2 uses port 5107 to send a request to google.com at port 80

  – 192.168.1.6:5107 → router → google.com:80

- To avoid potential conflicts, the router changes the return address on the requests to a different port, and sends from the public IP (e.g. 44.19.33.204)

  – 192.168.1.5:2700 → router 44.19.33.204:2357 → google.com:80
  – 192.168.1.6:5107 → router 44.19.33.204:2433 → google.com:80

Server side

- Google sees multiple requests from thousands of IPs at its port 80

- In case of multiple requests from the same IP, it uses the source port number and cookies to distinguish between clients and gives them different content

NAT - incoming

- The router receives responses from google.com for both clients at respective ports

  - google.com:80 → router 44.19.33.204:2357

  - google.com:80 → router 44.19.33.204:2433

- The router looks up the port number in it's NAT table and sends the request to the appropriate machine

External port	Internal IP:port
2357	192.168.1.5:2700
2433	192.168.1.6:5107

Router firewalls

- As the router does NAT, it has full control on connections

- Most routers have firewalls enabled

  - Blocks unsolicited incoming connections

  - Outgoing connections are usually not blocked

- Running a web server on port 80 behind a NAT router

  - Random clients will be sending requests to you

  - Since you did not initiate these connections, they are not in the NAT table and the router will block them – your web server won't work!

Port forwarding

- All routers have a port forwarding option in their config page

- You can redirect all traffic coming to port 80 on your router to a specific local machine

- If machine 1 is running a WWW server at port 80

  - Create a rule to redirect all requests coming on public port 44.19.33.204:80 to local IP 192.168.1.5:80

- Configuration help: www.portforward.com

  - Instructions with screencaps for all brands of routers

Debugging a live web server

- Trueability.com is Linux job screening company

- Also host Linux server debugging competitions

  - You can try out past challenges and view solutions

- We will look at one of the introductory blogs at http://blog.trueability.com/category/give-it-a-shot/

– DEMO GIVE-IT-A-SHOT CHALLENGE --

References

[1] http://en.wikipedia.org/wiki/Linux

[2] http://en.wikipedia.org/wiki/Client-server_model