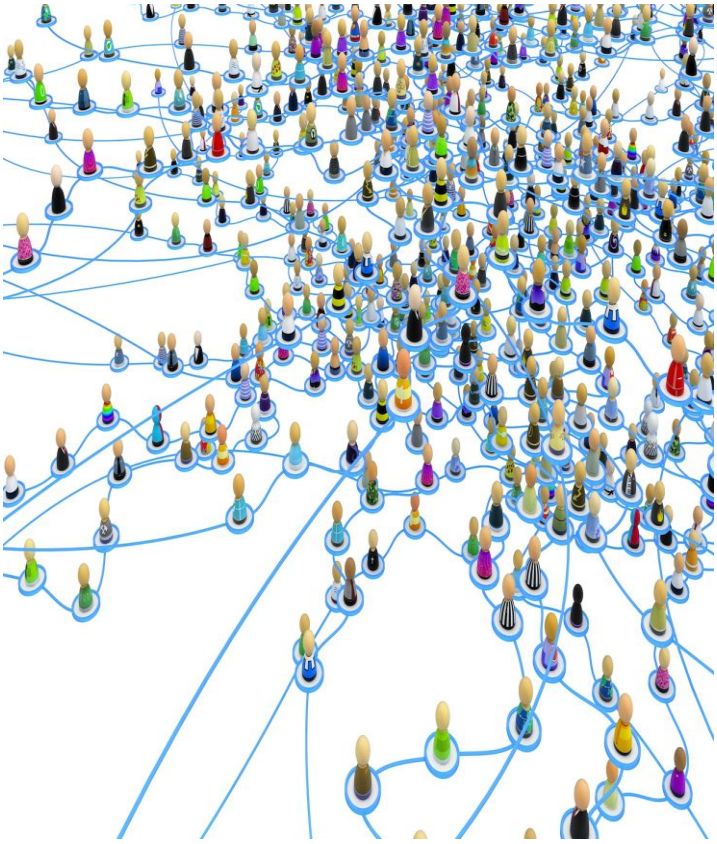

Networks

INTRODUCTION

Gowri R| Networks | 24-02-2017

NETWORKS

This activity is to introduce students to networking in a play way. This can stretch over a several 1 or 2 hour classes or can be compressed to one. Can be used from fifth grade to college level and above.

Covers the following activities –

- A short introduction to the concept. Heads up on what is going to come. A quiz with vocabulary to be introduced to judge the level of the audience and gauge the depth to get into.
- Role play game enacting the entire system.
- Practical activity required to delve into the subject – (Grades 9 and above)
- Quiz: Will gauge how much vocabulary has improved post the session.
- References and plenary videos.

INTRODUCTORY QUIZ

Vocabulary:

- Internet
- Server and client
- Stack Layers
- Protocols (TCP/UDP/IP)
- IP address and Socket
- Packets
- Routers
- Switches
- Modem

ROLE PLAY

Activity:

Your dad's birthday is coming up and you need to send his card with his gift, loads of colored gems over the network, in another country, passing through loads of hurdles and

complex paths. Since you don't want mom to know about the surprise, you do not use the courier service and send it in bulk but use the internet to send it through.

Scenario for UDP- This time it is your aunt's birthday and you got to know just a few minutes back, you are not bothered about accuracy but want it to reach her soon enough. You decide to enact a play on her and send it across to her.

Required:

- A presentation to run the audience through each activity
- Placards with their roles and definitions in one phrase as to what the role is about (Detailed definition and what each role should enact can run on the presentation and can be shared with audience post the session)
- Moderator describes the game and gives a short introduction to protocols beforehand and guides the audience throughout the game.
- Envelopes or zip lock to store data in the packets
- Network drawn on the floor, with one or two deadlock like drainage pipe flooding or an avalanche to force the packet to reroute
- Clothes hanging wire for connection establishment
- Ring to hold/tie the connection zip lock to.
- Physical (cardboard) boxes at the network junctions for
  - Home Router (Modem – for telephone lines)
  - ISP Router
  - DNS
  - Other Routers (4 of them at least)

Points to be Discussed post the session/during:

- Explain, all this happens in seconds
- Shift from TCP to UDP. UDP does not need the initial connection hand shake. Ordering and lost packets are not handled by UDP. Client handles it or lets it be.
- All the layers exist on your computer system and is programmed in the Operating System
- Introduce the mnemonic "A Turtle Never Lies" to remember layers

Commented [GR1]: A quick presentation on what the kids need to refer to or see

- Post using TCP, you are ready to lose a few pieces of gems and **decide not to send a physical card but a video wishing her** but want it to reach your aunt this time and it is really late.
- Packets when very tiny can be sent over UDP and can't be too huge in size
- TCP waits till it gets a considerable packet size
- Discuss- WhatsApp uses TCP or UDP? Online multiplayer games use TCP or UDP?
- Extension activity
  - use wireless access points and wireless devices like phones to add to the network
  - IPV4 and IPV6. If the number of users are huge, need to move from a 32-bit to 128-bit system to have more combinations of IP addresses.
  - Proxies and firewalls

Placards and Pointers (Written in square brackets is what is to be written on the Placards or Pointers)

- [User: Kid's name]
- [Dad's name]
- Client [Client– Application Layer: www.dadreceivesmessages.com: Port (80)]
- Server [Server – Application Layer: www.dadreceivesmessages.com: Port (80)]
- [Physical Layer] for the wires layer
- [Home Router] ([Modem] placard for telephone lines)
- [ISP Router] box and [ISP Router] placard
- [Router] box and [Router] placard
- [.com] [.org] [.in]
- [Destination IP address:192.168.1.9]
- [DNS server] box and [DNS server] placard
- Client: [TCP layer]
- Client: [IP layer]

- Client: [Network layer]
- Server: [TCP layer]
- Server: [IP layer]
- Server: [Network layer]
- Zip Lock with [www.dadreceivesmessages.com: [School name, Class and section]: hand shake] inside. Hang using rings. **NOTE:** Not required for UDP connection.
- Zip Locks with [www.dadreceivesmessages.com: [School name, Class and section]: Gift split n] inside into multiple packets all numbered. To illustrate UDP and TCP-
  - Make a very small packet
  - Make a huge packet
- [Packet] role carrier
- [Avalanche]
- [Drainage Flooding]

Roles (Volunteers called out for) (Total - 22):

- Moderator announcing roles and tasks
- User sending gift packet the kids
- Dad receiving the gift
- Client [Client– Application Layer: www.dadreceivesmessages.com: Port (80)]
- [Avalanche]
- [Drainage Flooding]
- *Passive Element:* Network, not a person but lines drawn using chalk on the ground
- Client: [TCP layer]
- Client: [IP layer]
- Client: [Network layer]
- Server: [TCP layer]
- Server: [IP layer]

- Server: [Network layer]
- Server [Server– Application Layer: www.dadreceivesmessages.com: Port (80)] (Dad's receptionist receiving all his messages)
- [Home Router] ([Modem] to leverage telephone lines)
- [ISP Router]
- [Router] box and [Router] (5 of them)
- [DNS server]
- Connection thread carrier
- Packet carrier

Steps involved:

- Network, not a person but lines drawn using chalk on the ground. Before the session starts.
- Keep zip lock packets ready (instruct TCP to add the use case of one small and one large packet)
- Take positions:
  - Kid sending the gift
  - Client application layer
  - Dad
  - Server (Receptionist – application layer)
  - TCP Layer to pass connection and make packets (on the client and server side)
  - IP layer to pass packets (on the client and server side)
  - Network layer (on the client and server side)
  - Person standing in the physical box [Home router]
  - Person standing in the physical box ISP Router
  - Person standing in the DNS box
  - Persons standing in the physical box Routers (5 of them)

Commented [GR2]: Think of how this network would be

- Avalanche and Drainage standing ready to attack
- Connection thread role ready to establish connection

- User passes the gift to the client
  - With dad's address www.dadreceivesmessages.com
  - User sends the gift through client, to the dad staying across the globe

- Client accepts the gift with www.dadreceivesmessages.com and opens a port 80
  - The port number is well known and you will know it using google or the client will show it to you

- Next step: Moderator announces this - Establishing a connection with the server, post that the secretary knows you are going to send something.
- Keep a zip lock packet with the initial handshake connection ready. [www.dadreceivesmessages.com: [School name, Class and section]: hand shake] (Destination address, source address and data)
- Person holding Connection thread (use clothes hanging wire), zigzagging through paths to reach the server. Client holds one end, finally server holds the other end and passes through all layers.
  - Person standing in the physical box home router to take the connection
  - Person standing in the physical box ISP Router to take the connection
  - Person standing in the DNS box to retrieve the IP address out of the domain name www.dadreceivesmessages.com. [Destination IP address:192.168.1.9] placard used here.
  - Persons standing in the physical box Routers (5 of them) to route the connection. [.com] [.org] [.in] placards used here to route based on the destination address. Pass maximum one or two.
  - Server (Receptionist) receives the connection
- Client hands over the GIFT to TCP layer, TCP makes packets of the gifts of different sizes.
  - Use the one too huge and the one too small.
- Start passing packets.

Commented [GR3]: Client requests for something. How to change the game accordingly?

- Student carrying the Packet scurries along the **SAME** handshake path to reach the destination
- [www.dadreceivesmessages.com: [School name, Class and section]: Gift split n] – Destination address, Source address and Packet number
- Put in the hurdles now. Drainage blocking the route at random (allowed only once in the whole exercise to speed up the process. Avalanche blocking the route at random (allowed only once in the whole exercise to speed up the process). Handshake repeated again?
- Network and IP layer on the other side just pass it on to TCP
- Once all the packets are passed, TCP layer on the other end checks if all packets have been received and in order.
  - If misses are there it requests for it again and receives it.
- Server, receptionist receiving the ordered birthday gift

- Replace TCP with UDP.
  - This time the client forms packets
  - UDP just checks the size of the packet misses and out of order are just passed to the client.
  - Dad receives some unordered and lost packets in UDP and in TCP it gets an ordered one and nothing is lost.

PRACTICAL ACTIVITIES

- Connect the pi to internet
- Visual tracert (http://www.yougetsignal.com/tools/visual-tracert/)
- Use a raspberry pi to establish a LAN (physical connection)
- Do the same activity wirelessly (connect to a wireless access point here)
- Demonstrate FTP (Mail and web browser, many are usually aware off)
- Make raspberry pi a WiFi router
- Code a simple client server communication using TCP and UDP sockets on C/Python
- Client establishing a virtual connection to the server on the rack

Commented [GR4]: Verify this

- Show pictures of:
  - Hubs
  - Router switches
  - Server racks
  - Client
  - Fiber optic cables
  - Network interface card
- Display commands on the command line
  - tracert
  - ipconfig
  - ping
  - notice the default gateway of the router

QUIZ

Multiple choice/ORAL/Write answers based on the level being taken to. College students can be expected to give answers in a paragraph

- Internet
- Server and client
- Stack Layers
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- Packets
- Routers
- Switches
- Modem

REFERENCES AND PLENARY VIDEOS

- Warriors of the net video (~12 mins) (https://www.youtube.com/watch?v=PBWhzz_Gn10)
- World Science Festival (~3mins) (https://www.youtube.com/watch?v=ewrBalT_eBM)
- TCP/IP Illustrated by W. Richard Stevens (http://www.cs.newpaltz.edu/~pletcha/NET_PY/the-protocols-tcp-ip-illustrated-volume-1.9780201633467.24290.pdf)