CSE 127 Week 8 Discussion

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Zoom

Props to Deian Stefan for Slides
This is being recorded
PA4 due tomorrow!
Overview of Today

• Overview of last two lectures
  • Some new information
• Brief overview of PA5
  • Tools that might be helpful during the PA
• Open office hours (if time)
OSI Layers
(Open Systems Interconnection)

- **Application**
  - End user layer
  - HTTP, FTP, Skype, SSH, SMTP, DNS

- **Presentation**
  - Syntax, byte order, compression, encryption
  - SSL, SSH, MPEG, JPEG

- **Session**
  - Connection establishment and maintenance
  - APIs, sockets

- **Transport**
  - End-to-end connections between processes
  - TCP, UDP

- **Network**
  - Addressing, routing between nodes
  - IP

- **Data Link**
  - Link management, frames
  - Ethernet, WiFi

- **Physical**
  - Physical wires
  - Photons, RF modulation
Basic Internet Architecture “Hourglass”

Narrow waist = interoperability

- NTP
- DNS
- SMTP
- HTTP
- FTP

- UDP
- TCP

- IP

- Cellular
- WiFi
- Ethernet

- Radio
- Copper
- Fiber

Layers:
- Application layer
- Transport layer
- Network layer
- Link layer
- Physical layer
Working example

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   B. Broadcasts DHCPDISCOVER to 255.255.255.255 with its MAC address
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   B. Broadcasts DHCPDISCOVER to 255.255.255.255 with its MAC address
   C. DHCP server responds with config: lease on host IP address, gateway IP address, DNS server information
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   A. Every connection outside the local network will be encapsulated in a link-layer frame with the local router’s MAC address as the destination.
   B. Your laptop encapsulates each IP packet in an Ethernet frame addressed to the local router
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   A. Every connection outside the local network will be encapsulated in a link-layer frame with the local router’s MAC address as the destination.
   B. Your laptop encapsulates each IP packet in a WIFI Ethernet frame addressed to the local router
   C. The local router de-capsulates these Ethernet frames and re-encodes them to forward them on its fiber connection to its upstream ISP, or to another part of the network.
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   D. Each hop re-encodes the link layer for its own network.
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   A. It learned the IP address of a DNS server from the router or was already hardcoded in (8.8.8.8)
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   D. This address is cached, along with the authorities for the hierarchy in the hostname
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   A. Each packet of the TCP handshake is encoded in an IP packet that is encoded as Ethernet frames that are decoded and re-encoded as they pass through the network
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   B. The local router has a routing table that contains IP prefixes that it matches against the IP address that tells it what address to forward the packets to
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   C. The packet passes through a series of Autonomous Systems (AS)
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   B. The local router has a routing table that contains IP prefixes that it matches against the IP address that tells it what address to forward the packets to
   C. The packet passes through a series of Autonomous Systems (AS)
   D. E.g. sbcglobal.net -> att.net -> leve3.net -> cenic.net -> ucsd.edu
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5. Your laptop sends a HTTP GET request inside the TCP connection
6. Based on the HTTP response, your laptop performs a new DNS lookup, TCP handshake, and HTTP GET for every resource in the HTML as it renders
Network attacks overview

• DNS Cache poisoning
DNS over TLS and DNS over HTTPS

- DNS over TLS – uses TLS over UDP to protect DNS queries
  - Port 853
- DNS over HTTPS – uses HTTPS protocol/port to transfer DNS queries
  - Port 443
- Why two different solutions? Aren’t they the same?
  - Two different protocols/groups of people writing them
  - Pros and Cons of each
With unencrypted DNS, an attacker connected to the same network can observe other users’ browsing habits.
Network attacks overview

• DNS Cache poisoning
• Denial of Service
  • Resource consumption of service
  • TCP handshakes are expensive
• Network perimeter defenses
  • Hey you! Get off my firewall!
PA5 Overview!
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• Planned to be released Thursday or Friday, 2 weeks to finish it (hard deadline of June 11th because we need to turn in grades)

• Scavenger hunt! You need to find Stefan’s “password”
  • Not his actual password...

• We’ll send you an email with a tar file
  • From there, need to figure out how to get the password
  • Scavenger hunt so please be cautious of spoilers...come to office hours or utilize private posts on Piazza
Overview of tools you may need

• nc
• nmap
• ssh
• tcpdump
• wget
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• Nc – allows you to make connections locally
• Nmap – scan ports/IPS (locally and externally)
• Ssh – connect to servers
• Tcpdump – view traffic on machine
• Wget – download of files from internet

• All of these have “man” pages!
NetCat (shoutout to Julia Evans)

**netcat**

- **nc**
  - like ‘cat’ for your network!
  - it lets you create TCP (or UDP) connections from the command line & send/receive data

- **nc -l PORT**
  - start a server! this listens on PORT & prints everything received

- **nc IP PORT**
  - be a client! opens a TCP/UDP connection to IP:PORT

**send files**

- want to send a 100 GB file to someone on the same wifi network? easy!
  - receiver: `nc -l 8080 > file`
  - sender: `192.168.x.x`
  - cat file | nc YOUR_IP 8080

**make HTTP requests by hand**

- `printf 'GET / HTTP/ 1.1\nHost: example.com\r\n\r\n' | nc example.com 80` type in any weird HTTP request you want!

**I love that sending files trick! it works on your local network even if you're not connected to the internet!**
Happy hunting!