

CSC361

Computer Networking

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Unit 3

Internet Applications

Important Concepts

- Well-known Internet Services
- DNS (UDP/53)
- HTTP (TCP/80)
- FTP (TCP/20)
- Email: POP3 (TCP/110) & SMTP (TCP/25)

What We Learned So Far

- The Transport Layer hides all details of how applications communicate with each other; the Network Layer is primarily responsible to delivery packets from end to end.
- The Transport Layer protocols (TCP and UDP) adds additional properties to the underlying unreliable IP datagram delivery service.
- Berkeley sockets API is a command standard API for Internet network programming.

DNS 1 (15:44)

(RFC1034)

Summary

- What is inside a URL?
- What is a `hostname`?
- The original `hosts.txt` file exists before DNS.
- DNS maps human readable hostnames to IP addresses.
- Each computer maintains a small DNS cache.
- DNS uses hierarchical zones; each zone is maintained separately.

Summary (continued)

- The **root** [DNS servers](#) maintain the entire replicated DNS database.
- A root server may use **IP anycast** to replicate its database.
- DNS supports both **recursive** and **iterative** queries.
- DNS query uses UDP port 53, max. 512 bytes.
- A local **resolver** may look up its cache first before query the DNS servers.

DNS 2 (19:27)

(**dig** and Wireshark examples)

Summary

- DNS queries and Resource Records (RR).
- The difference between a **recursive** and a **non-recursive** query.
- `dig` is a network utility for talking to DNS.
- There are several **types** of RRs: `A`, `AAAA`, `CNAME`, `NS`, `MX`.

Wireshark Demo

(dig `www.stanford.edu`)

```
Mantis-MacBook-Pro-Retina:~ mcheng$ dig www.stanford.edu
```

```
; <<>> DiG 9.8.3-P1 <<>> www.stanford.edu
```

```
;; global options: +cmd
```

```
;; Got answer:
```

```
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 46131
```

```
;; flags: qr rd ra; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 0
```

```
;; QUESTION SECTION:
```

```
;www.stanford.edu.          IN      A
```

```
;; ANSWER SECTION:
```

```
www.stanford.edu.          92      IN      CNAME   stanfordhs17.wpengine.com.
```

```
stanfordhs17.wpengine.com. 119     IN      CNAME   lbmaster-90886.wpengine.com.
```

```
lbmaster-90886.wpengine.com. 119    IN      CNAME   cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-e
```

```
cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com. 20 IN A 34.236.167.166
```

```
cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com. 20 IN A 34.237.173.243
```

```
;; Query time: 35 msec
```

```
;; SERVER: 8.8.8.8#53(8.8.8.8)
```

```
;; WHEN: Thu Jun 28 13:42:29 2018
```

```
;; MSG SIZE rcvd: 216
```

DNS 3 (11:52)

Summary

- How **recursive** query works?
- How to simulate **recursive** using **non-recursive** queries.
- Now is the time to study **Homework 6**, which is about working with DNS.

HTTP 1.0 (12:59)

(RFC1945)

Summary

- HyperText Transport Protocol (HTTP) is designed to transfer HTML documents.
- What is HyperText Markup Language (HTML)?
- An HTML document contains many tags, or many other **hyperlinked** documents.
- HTTP is a **human readable ASCII-text-based** protocol.
- **GET** is a standard HTTP request.

Summary (continued)

- `If-Modified-Since` is a special HTTP header field.
- `200 OK` and `304 not modified` are standard responses.
- HTTP is built on top of TCP.
- Performance analysis of HTTP 1.0.

Wireshark Demo

(curl `info.cern.ch`)

Summary

- Study the `info.cerh.ch.pcap` file using Wireshark.
- Understand the port numbers at both ends.
- Understand (3-way handshake) `SYN` + `SYN+ACK` + `ACK` connection setup.
- Understand the total latency.
- Try to read the **sequence numbers** and packet lengths, and how are they related?
- Understand `FIN+ACK`, `ACK`, `FIN+ACK`, `ACK` connection take-down.

HTTP 1.1 (5:13) (RFC2616)

Summary

- `Connection: keep-alive` header field is added to HTTP 1.1.
- Typically, after a server sends a response `200 OK`, the connection is closed immediately.
- Setup and takedown connections for every request is wasteful!
- SPDY is another extension of HTTP; it may become HTTP 2.0

Wireshark Demo

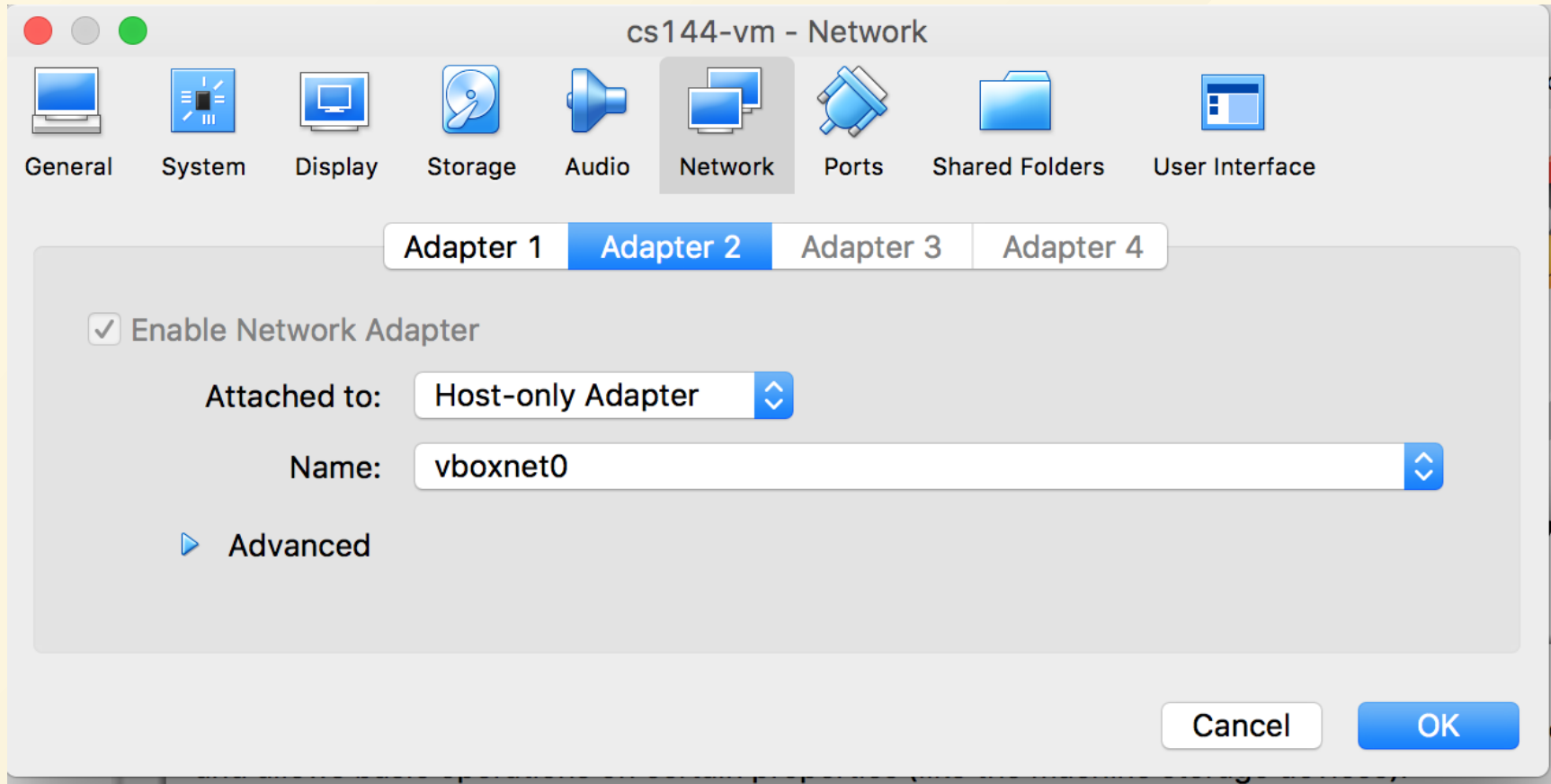
(<http://web.uvic.ca/~mcheng/lab1/csc100.html>)

FTP (11:56)

(RFC959)

Wireshark Demo

(ssh **CSC361-VM** VirtualBox)




```
cs144@mininet-vm: ~  
Desktop pox  
cs144@mininet-vm:~$  
cs144@mininet-vm:~$ ifconfig  
eth0      Link encap:Ethernet  HWaddr 08:00:27:6e:f2:1c  
          inet addr:192.168.56.10  Bcast:192.168.56.255  Mask:255.255.255.0  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:327 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:172 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:54190 (54.1 KB)  TX bytes:36248 (36.2 KB)  
  
eth1      Link encap:Ethernet  HWaddr 08:00:27:ea:8e:68  
          inet addr:10.0.2.15  Bcast:10.0.2.255  Mask:255.255.255.0  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:5213 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:2919 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:5467274 (5.4 MB)  TX bytes:249135 (249.1 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:2444 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:2444 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:144348 (144.3 KB)  TX bytes:144348 (144.3 KB)  
  
cs144@mininet-vm:~$
```

Summary

- [SSH/SFTP into VirtualBox](#)
- Once you can `ssh` into the VirtualBox, then you can start transferring files between your laptop and the virtualbox.

Email (1:00:00)

(SMTP & POP3)

Summary

- SMTP ([RFC2821](#)) is for sending 7bit ASCII text-based emails, which is the foundation of all email transfer.
- A mail client composes email messages which are then queued to a local SMTP server to be sent to another **remote** SMTP server.
- A SMTP server may **forward** its emails to another SMTP server for delivery, until it reaches the destination SMTP server.
- SMTP doesn't guarantee mail delivery; it doesn't have **ACK** for mail delivery.

Summary (continued)

- SMTP to SMTP servers are examples of a **peer-to-peer** network application; an SMTP server is also an SMTP client.
- Now is the time to study **Lab 3** (SMTP server).
- POP3 ([RFC1939](#)) is for accessing mail.
- Emails are typically hosted on a **remote** email server; most PCs don't run an email server.
- An email client uses POP3 protocol to access an individual's mailboxes on a remote email server.

Summary (continued)

- SMTP **cannot** transfer non-text-based messages.
- Multipurpose Internet Mail Extension (MIME) is a **translator** that sits on top of SMTP to translate non-ASCII-text messages into ASCII-text.
- MIME specifies the **content-type** of a message, e.g., `image/JPEG`, `image/GIF`, `video/MP4`, `audio/MP3`, etc.
- **Base64** is the most common encoding of any binary data into text; 3 binary bytes are encoded as 4 8-bit ASCII characters.

The End