CS 118 Discussion Week 2: The Application Layer https://powcoder.com/

Add WeChat powcoder Winter 2021

Overview

- Brief introduction to the Application Layer
- Protocols that live an the Application Lavern Help
- Most Important take-aways: https://powcoder.com
 - 1: Paradigms
 - 2: Protocols Add WeChat powcoder
 - 3: Particular uses *

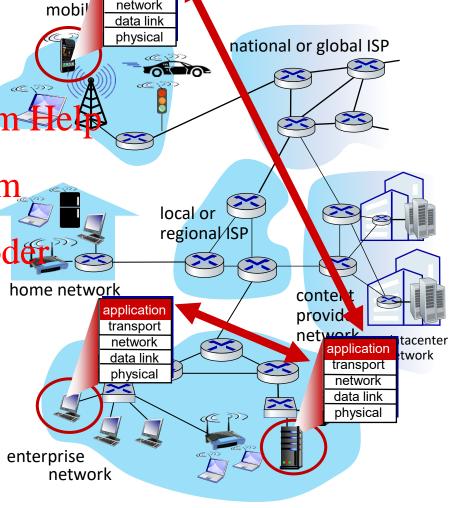
What is the Application Layer?

 "An application layer is an abstraction layer that specifies the shared protocols and interface methods gused by Projectin Exam Help a communications network."

https://powcoder.com

• Where essentially everything people

usually care about livesAdd WeChat powcoder



application transport

What lives on the Application Layer?

- The Web and HTTP
- E-mail, SMTP, IMAPsignment Project Exam Help
- The Domain Name System DNS https://powcoder.com
- Video streaming
- Content Distribution Networks Powcoder

What core concepts should you know about it?

- 1: What paradigms/models get used on the application layer?
 - E.g. transport-layer service models (note: this lives below application layer), client-server paradigm, peer-to-peer paradigm. Help
- 2: What protocols (withingthose models) care popular and well-used?
- SMTP, IMAP, DNS, HTTP, etc.
 Add WeChat powcoder
 3: How can you, personally, interface with it (project 1)?
 - Programming with sockets

1: What paradigms/models get used on the application layer?

 As we know, certain paradigms or model tend to predominate for a given set of tasks.

• Sending information over connections not fundamentally different.

• Most important differences between the two main types (Client-Server vs Peer-Peer) is who woldsthe data being transferred.

Client-Server Model -- Servers

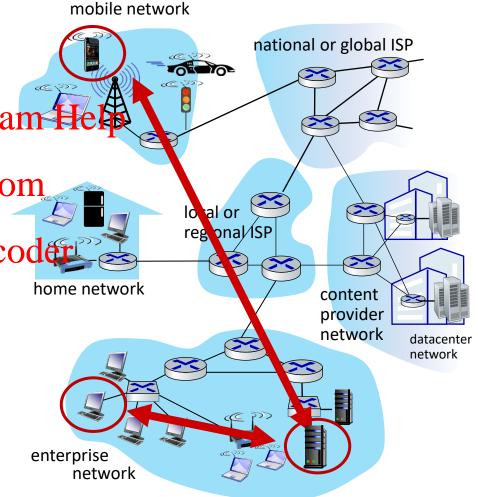
Server acts as an always-on host

• Thing of e.g. Googlessignment Project Exam Help

• Server must have permanent IP address (so you know where to the them) coder.com

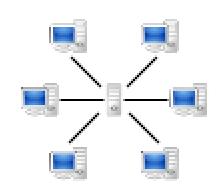
• Server, in general, must Abel Witchat powcoder powerful, to facilitate scaling

Server usually housed in data center



Client-Server -- Clients

- Example Client: your phone!
- Contact and commanicate with rejecte Exam Help
- May be intermittently represented coder.com
- May not have permanent IP address
 Add WeChat powcoder
 Does not communicate with other
- Does not communicate with other clients



- Examples of Client-Server Protocols:
 - HTTP
 - IMAP

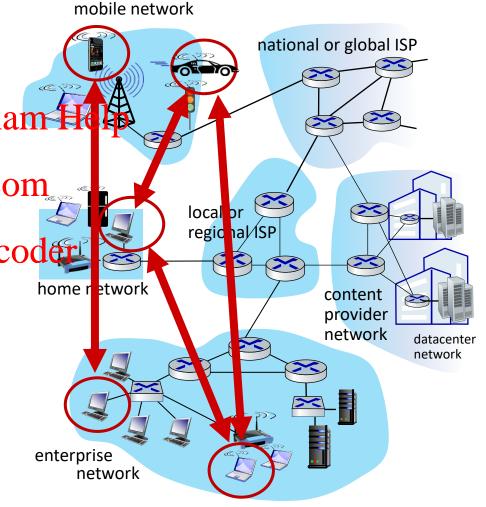
Peer-Peer Model

No central server that's always on

• Arbitrary nodes communicate directly Examined with one another

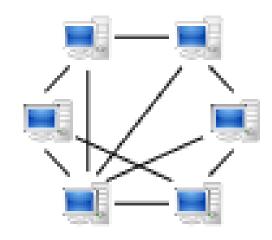
• peers request service from other peers, comprovide service in return to whether peers,

 Scales very easily – new peers bring new service capabilities and demands



Peer-Peer II

- Peers do not need to be always connected, and may have a dynamic IP address.
 Assignment Project Exam Help
 - This can make management difficult/non-trivial https://powcoder.com
- Example of Peer-Peer system eChat powcoder Bittorrent/P2P file sharing.
- Discussion questions: Overlap between these two systems? Advantages/Disadvantages between them?



Comparisons

PEER TO PEER NETWORK VERSUS

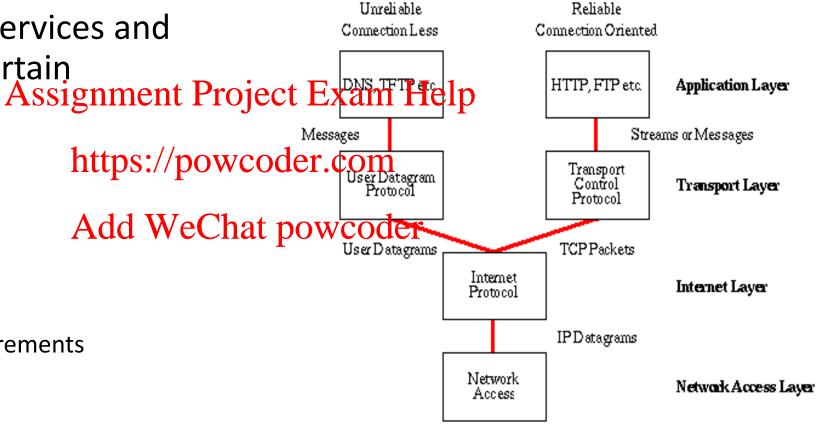
CLIENT SERVER NETWORK

PEER TO PEER NETWORK **CLIENT SERVER NETWORK** A distributed application are title in the far partitions (A distributed application structure based on lesource tasks or workloads or service providers called between peers servers and service requesters called clients Each node can request for Client requests for service services and provide and server responds with A decentralized network A centralized network Reliable as there are multiple Clients depend on the server service providing nodes failure in the server will disrupt the functioning of all clients Service requesting node does Access time for a service is not need to wait long higher Expensive to implement Does not require extensive hardware to set up the network Comparatively less stable More stable and secure Visit www.PEDIAA.com

What do these services run on 'top of'?

Application level services and protocols make certain assumptions:

- Data Integrity
 - Reliability?
- Timing
 - Real time?
- Throughput
 - Streaming requirements
- Security
 - E.g. encryption



- The absolute bare-bones
- Provides port-level multiplexing and absolutely pothing else.
- UDP is unreliable datagram transfer https://powcoder.com
 Discussion question: Why do UDP?
- - Hint: Think about applicated west at spowcoder

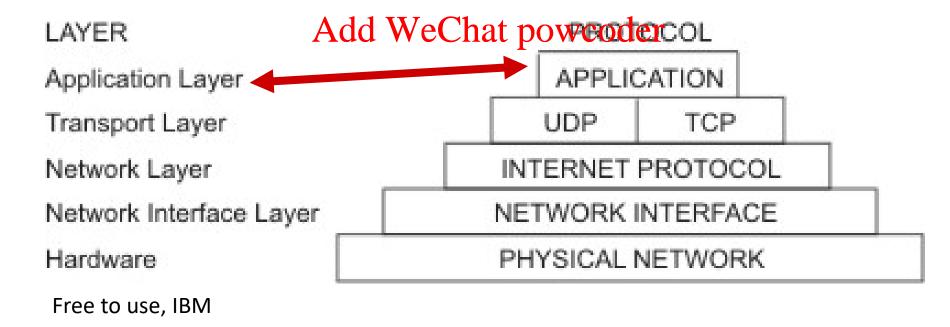
TCP

- Reliable data transfer (accomplished via retransmissions)
- Flow control Assignment Project Exam Help
- Congestion control https://powcoder.com
- Provides a reliable connection
- However, does not provide: timing, minimum throughput guarantee, security (on its own)
- How do we provide security? TLS,

2: What protocols are popular and well-used?

Assignment Project Exam Help

https://powcoder.com



HTTP

HyperText Transfer Protocol

• What your browser uses (or used ject Exam Help to use) to retrieve Web objects

Firefox browsers

• Now generally uses secures for powcoder. com https

• Also what the Server uses to send those objects in response to the request!

rser Arraphesponse server running Apache Web server

iPhone running Safari browser

HTTP Basics

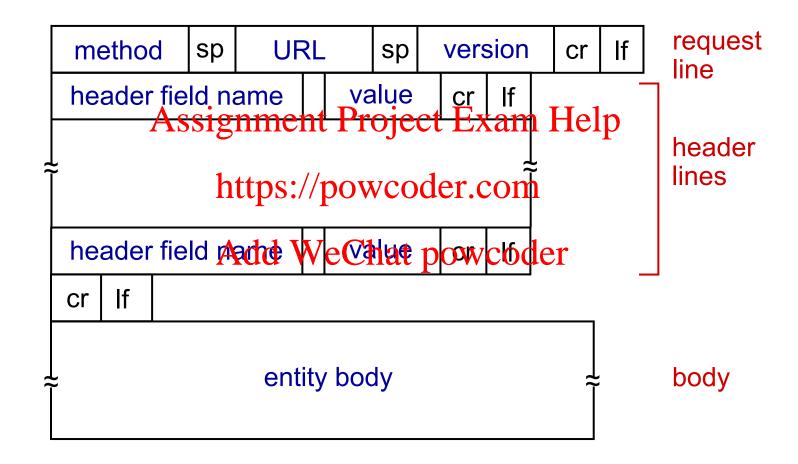
- HTTP uses a *Client-Server* model.
 - Client: Browser that requests, receives, (using HTTP protocol) and "displays"
 Web objects Assignment Project Exam Help
 - Server: Web server sends (using HTTP protocol) objects in response to requests
- HTTP uses TCP: Add WeChat powcoder
 - Client initiates TCP connection (creates socket) to server, port 80
 - Server accepts TCP connection from client
 - HTTP messages (application-layer protocol messages) exchanged between browser (HTTP client) and Web server (HTTP server)

Persistent vs Non-Persistent HTTP

Non-Persistent	Persistent
1: TCP connection opened Assignment Pro	ject Exam Help
2: at most one object sent over TCP connection https://powe	2: Multiple objects can be sent over <i>single</i> TCP connection between client, and that server
3: TCP connection closed Add WeCh	3: TCP connection closed at powcoder

For non-persistent connections, downloading multiple objects requires multiple connections.

HTTP Format



HTTP Messages

- Two Types:
- Request

- Assignment Project Exam Help
- POST (send data to server)
- GET (request data from the second copyes od copyes object od copyes object od copyes object od copyes od copyes od copyes od copyes object object od copyes object od copyes object object object od copyes object obje
- HEAD
- PUT

Add WeChat powcoder

- Response
 - HTTP/1.1 200 OK (protocol, status code, status phrase)

HTTP: New and Improved

Largely going to gloss over in this discussion section.

• HTTP/2

Assignment Project Exam Help

Decreasing delay in multi-object HTTP requests

• HTTP/3

https://powcoder.com

• Add security, change congestion control over dep (read up on QUIC if interested)

SMTP Explanation

- The protocol that (used to be) used for email! (nowadays extended version largely used)
- SMTP is run between the client and server.
 - Client: sending mail serversignment Project Exam Help
 Server: receiving mail server
- uses TCP to reliably transfer email message from client (mail server initiating connection) to server, port 25ttps://powcoder.com
 - direct transfer: sending server (acting like client) to receiving server
- three phases of transfer
 Add WeChat powcoder
 - SMTP handshaking (greeting)
 - SMTP transfer of messages
 - SMTP closure
- command/response interaction (like HTTP)
 - commands: ASCII text
 - response: status code and phrase

SMTP

```
S: 220 hamburger.edu
C: HELO crepes.fr
S: 250 Hello crepes.fr, pleased to meet you
C: MAIL FROMSignhicate Project Exam Help
S: 250 alice@crepes.fr... Sender ok
C: RCPT TO: <bh/>
<br/>
c) httpkamburgerderdrom
S: 250 bob@hamburger.edu ... Recipient ok
              Add WeChat powcoder
C: DATA
S: 354 Enter mail, end with "." on a line by itself
C: Do you like ketchup?
C: How about pickles?
C: .
S: 250 Message accepted for delivery
C: QUIT
S: 221 hamburger.edu closing connection
```

DNS

 DNS (Domain Name System) is how we go from 'amazon.com' to an IP address we can send actual traffic to.

• Every computer on the Internetuses it ment Project Exam Help
• e.g. URL to DNS query to IP address to set up

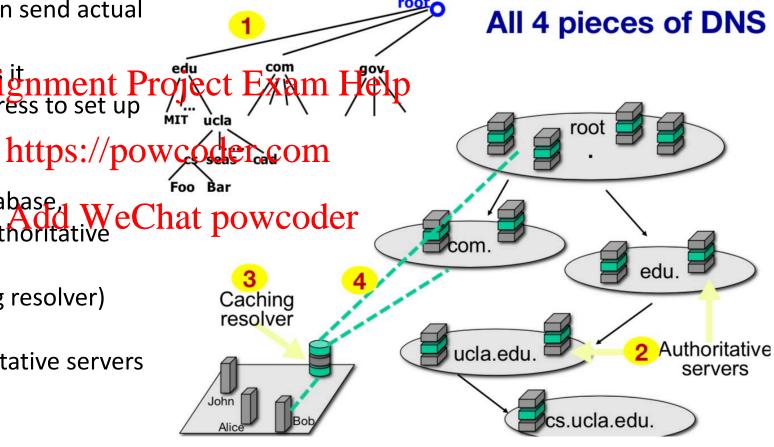
TCP conn

1: Defines a hierarchical name space

2: Creates a distributed (federated) database we Chat powcoder implemented through a hierarchy of authoritative servers

3. Local DNS servers (also called caching resolver) look up the database

4. Local caching resolvers query authoritative servers using DNS query protocol



How do we define this namespace?

- Starting from the root, growing downwards
- Each leaf node is a DNS regiment Project Exam Help root: (e.g. amazon.com)
- Each other node is a domain.https://powcoder.com
- Note that this hierarchy is independent of the topological connectivity.

 Note that this hierarchy is independent of the topological connectivity.

edu.

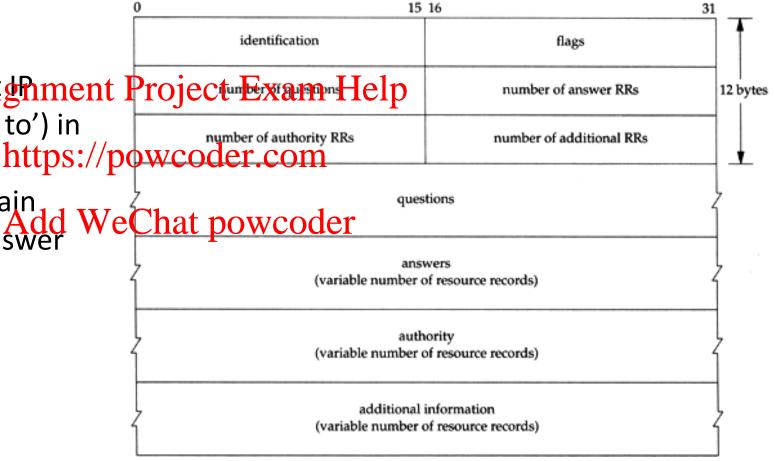
org.

DNS Message Format

 Any particular DNS query or response broken up as such

• Contains questions (e.g. 'Matghment Project Exam Help address does x.y.z correspond to') in the questions section. https://powcoder.com

• Response messages with contain RRs (resource records) that answer these queries.



3: How can you, personally, interface with the application layer?

- Socket programming!
 - What's a socket?
 - An abstraction of a FIF pipe (where the pipe is the network connection).
 - UDP: Unreliable datagram service wcoder.com
 - TCP: reliable, byte stream-oriented service
- Example Application: Add WeChat powcoder
 - Client reads a line of characters from terminal and sends to server
 - Server reads the lines, creates a response from them, sends back to client.
 - Client receives and displays this responses

Photo by <u>Neven</u> Krcmarek on Unsplash

Extra Time: How do we speed all of this up?

- Better Hardware
- Caching!
 - Web caching
 - CDNs

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

client server State ebay 8734 usual HTTP request msg Amazon server cookie file creates ID usual HTTP response 1678 for user backend create set-cookie: 1678 ebay 8734 entry databas amazon 1678 Assignment charge request msg Help cookieaccess specific psyall the contraction of the co action one week later dd WeChat powcoder access usual HTTP request msg ebay 8734 cookieamazon 1678 **cookie: 1678** specific usual HTTP response msg action

- HTTP is naturally stateless
- How do we then do multi-stage transactions?
- Cookies!