

# **Mobile Computing**

**COMP5216**

**Assignment Project Exam Help**

**Week 04**

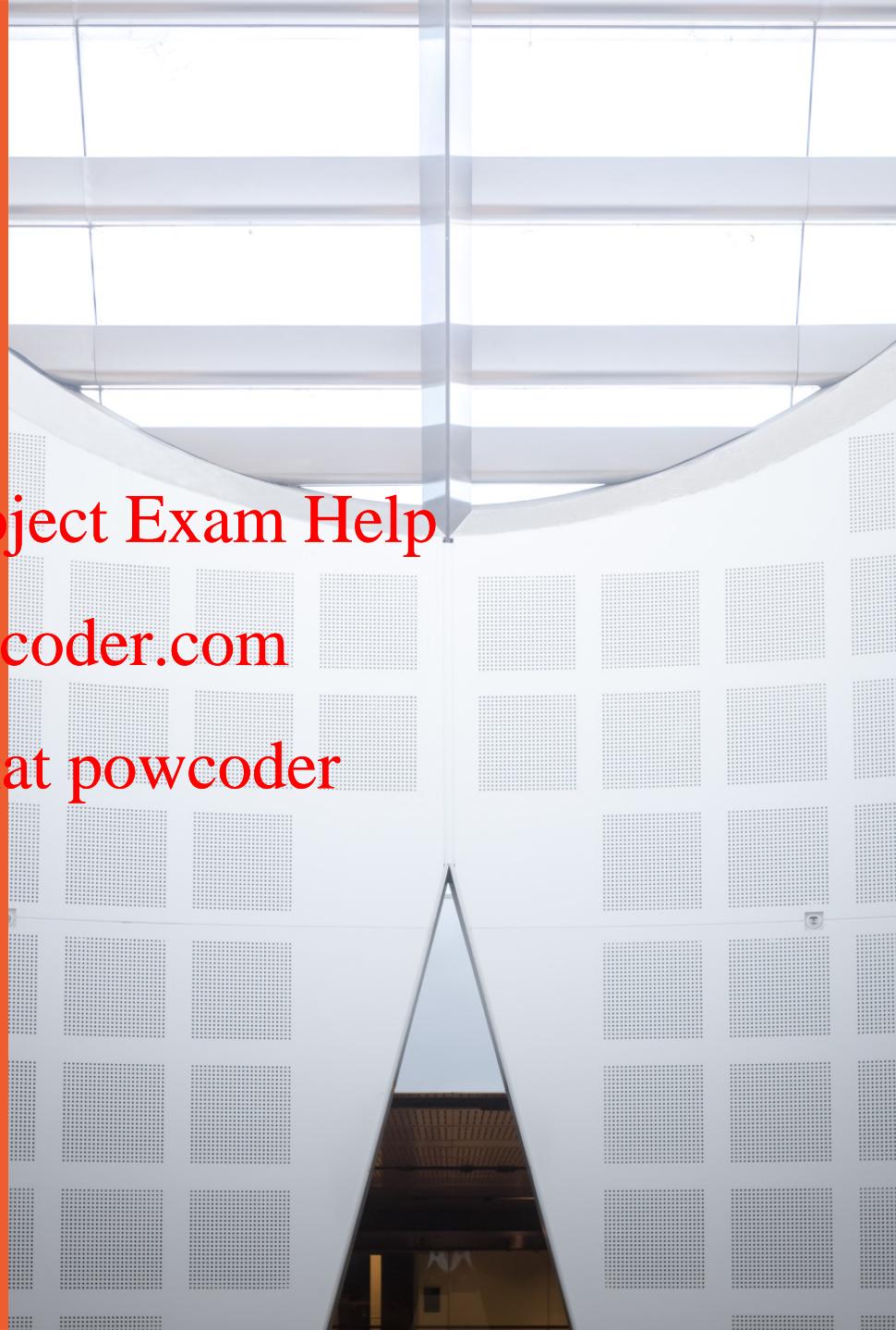
**Semester 2, 2020**

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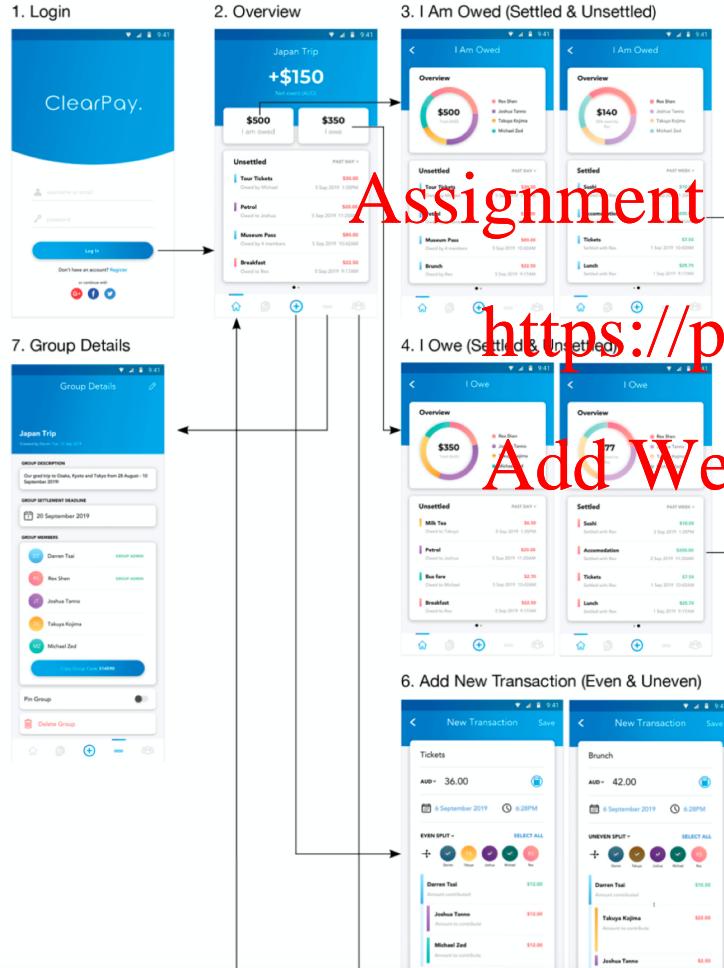
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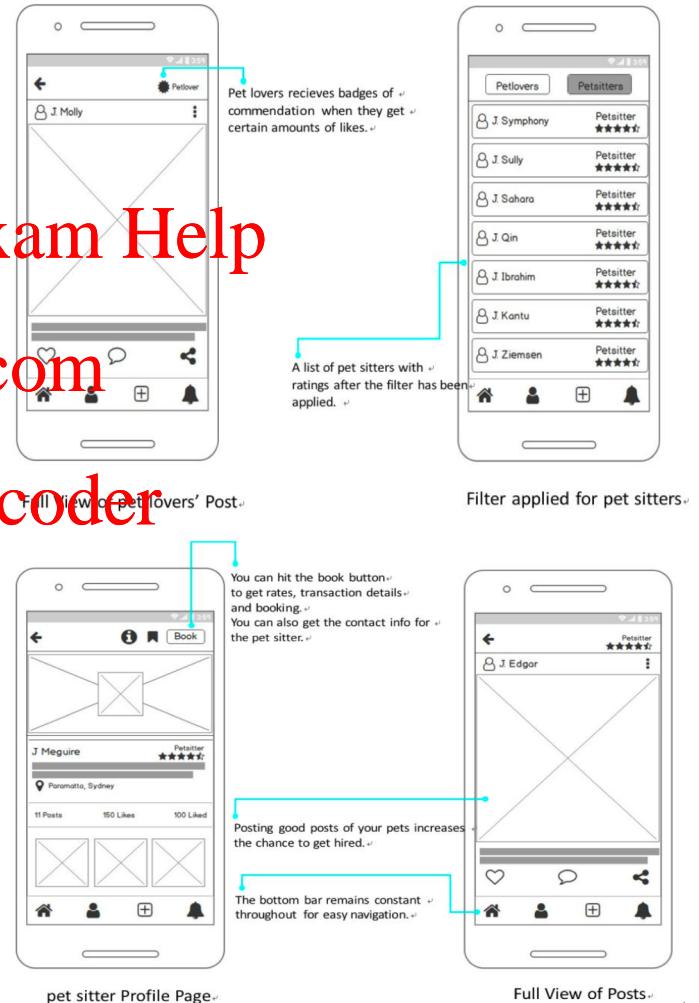
# Announcements

- It's great that you are talking...!
- What should be in the proposal?
  - App: background, related work, significance, requirements, and etc;
  - Solution: explaining how you are going to implement your solution describing the proposed workflow of the app and technical approaches that are required to implement the solution.  
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  - Plan: the implementation schedule, workload distribution among the group, how to develop collaboratively; and
  - Potential setbacks: identified risks, threats and proposed solutions;
  - References

# E.g. Workflow of the app

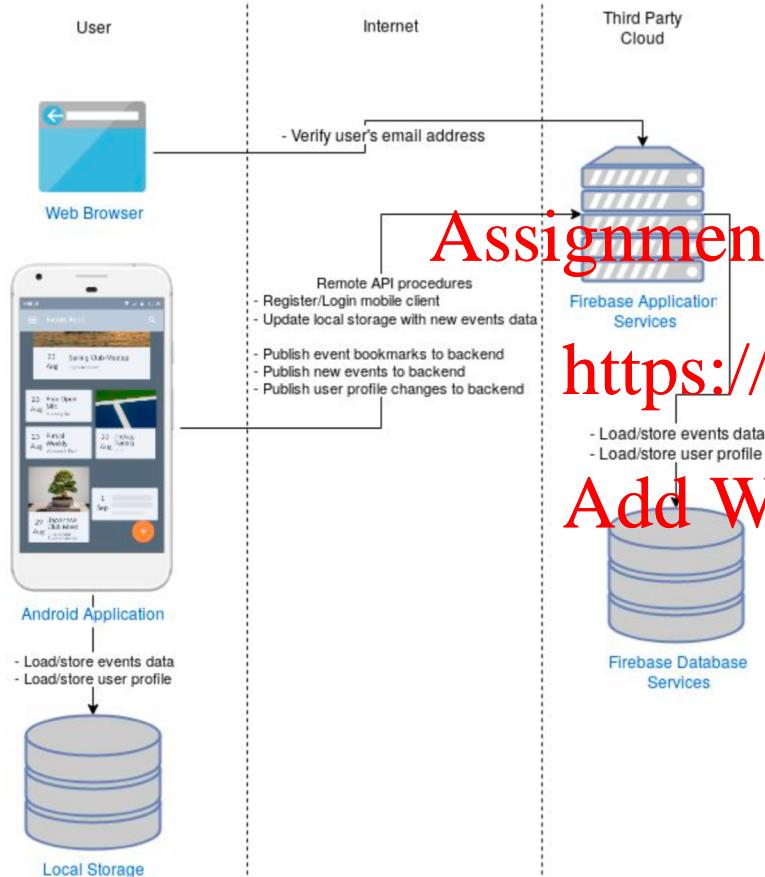


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# E.g. Technical approach

## System Architecture/Technical Approaches



- How you going to technically realize your app?

- Do you need server support?
- Are you going to rely on external libraries?
- What are the API that you going to use?
- Any specific ML models?

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etc...

Image: What's On system architecture diagram.

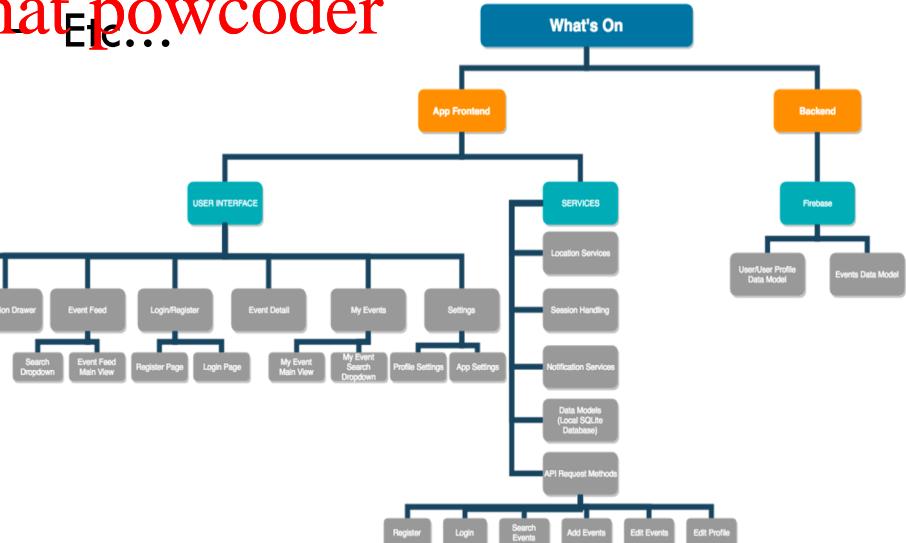


Image: Work breakdown structure for the What's On application and backend services.

# Outline

- User Quality of Experience
  - What to avoid ?
- Challenges in Mobile computing
  - Structure of the course
- E.g. Challenges in determining user location
  - Option 1            <https://powcoder.com>
  - Option 2
- Google Play Services
- Internet Protocol Basics

# User Quality of Experience (QoE)

- The main challenge
- Extremely difficult to measure – why ?
  - It is highly personal

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- Perception
- Culture
- Age
- Mood
- Gender
- Profession



# User Quality of Experience (QoE)

- How users react to apps also depends on...
  - Time of the day
    - Check weather in the morning vs checking whether at night
  - Season **Assignment Project Exam Help**
    - Rainy vs Summer
  - Current activity **https://powcoder.com**
    - Sitting in a couch vs standing on board crowded train

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# Understand your customer

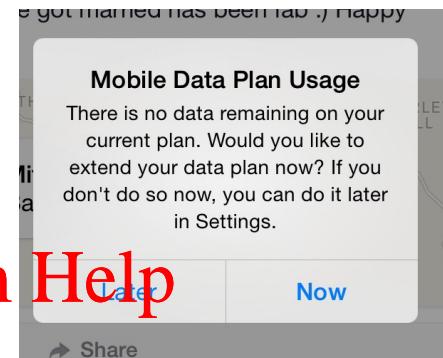
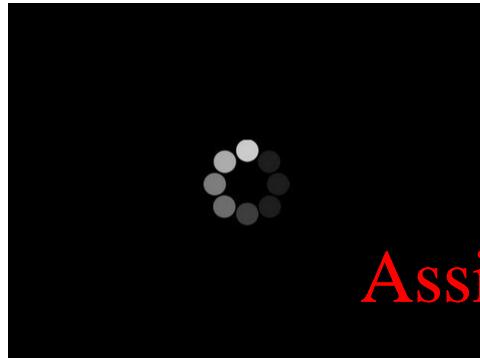
- Target a specific customer segment at the beginning
  - Snapchat → Teenagers
- What are the common things that annoy us?  
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# What to avoid ?



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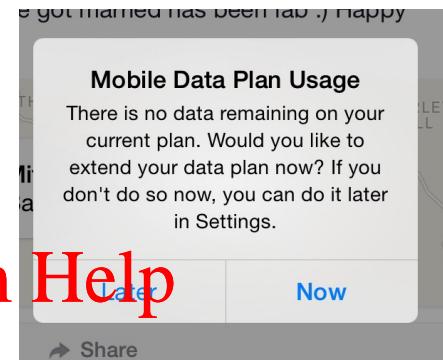
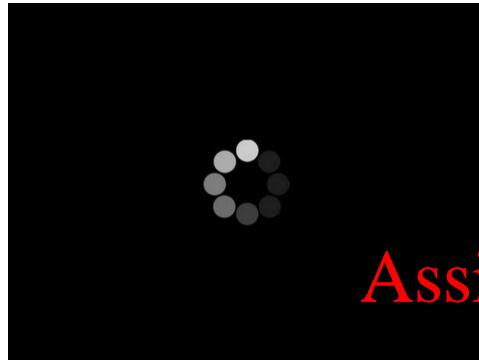
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User perception threshold – 50-100ms

Trewin, S., Swart, C., Koved, L., Martino, J., Singh, K. & Ben-David, S. (2012, December). Biometric authentication on a mobile device: a study of user effort, error and task disruption. In Proceedings of the 28th Annual Computer Security Applications Conference (pp. 159-168). ACM.

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# What to avoid ?



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- Potential causes
    - Faulty battery or device
    - Network issues
    - High speed mobility
    - Trying to download too much data
    - Not the right data flow
    - Too complex data processing
    - Not the right network for communication
    - Too frequent communication
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- Network  
- Computing  
- Energy

# What to avoid ?



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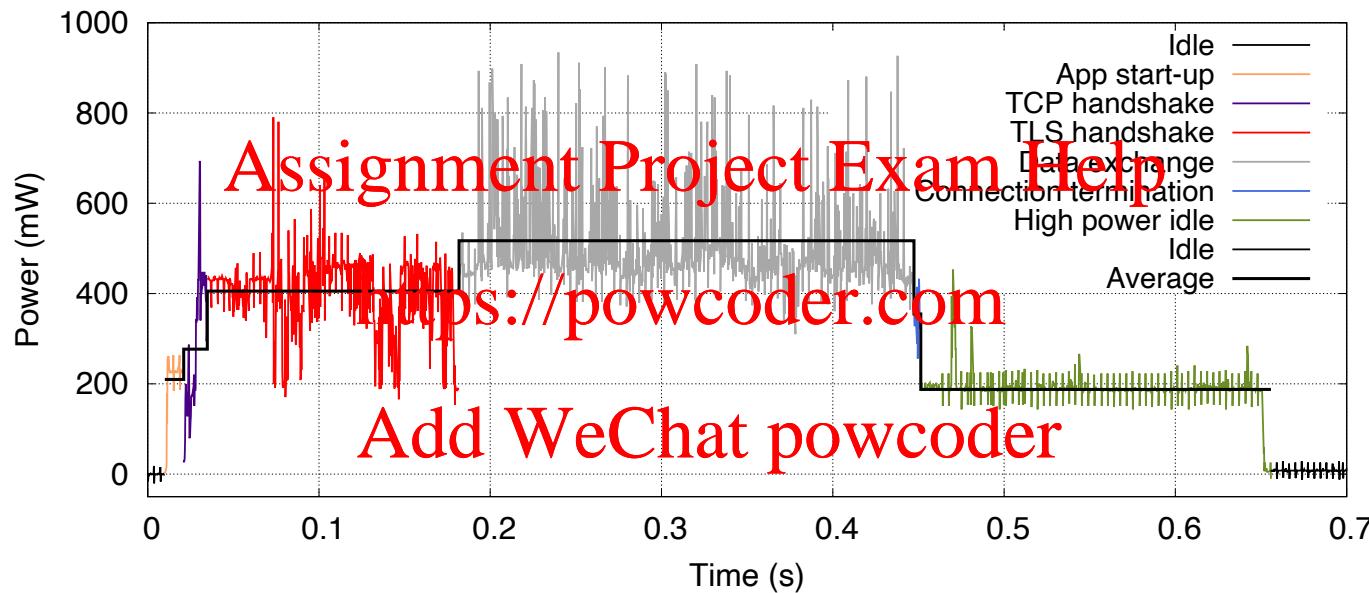
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- **STRIDE threat list**
  - Spoofing, Tampering, Repudiation, Information Disclosure, Denial of Service , Elevation of Privileges
- Potential causes
  - User mistakes
  - Unsecure communication
  - Unsecure storage of user data
  - Malicious ad library

} - **Security**  
- **Privacy**

## E.g. Power vs Communication

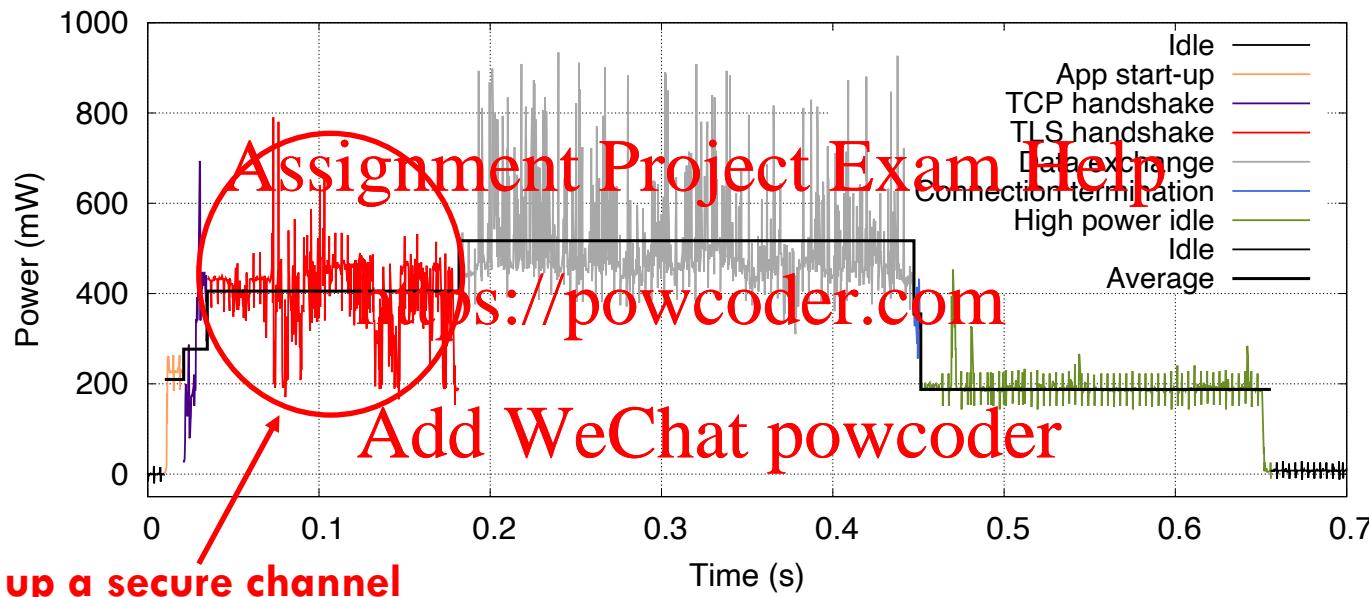
- Power consumption for HTTPS data transfer



- You design your app to transfer 1KB of data to your app server at every one 10 seconds.
  - What are the consequences ?

## E.g. Power vs Security

- Power consumption for HTTPS data transfer



- Every action has consequences

# Course Schedule

- We are going to have one lecture for each challenge

Week	Lectures	Labs/Tutorials
5	Mobile Networking	Media Access
6	Mobile Security & Privacy	AR/VR
7	Mobile Cloud & Energy	User management

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- There are other challenges:
  - User Interaction (did talk about them a bit on Week 2)
  - Policies and regulations
  - Advertising
  - App analytics
  - Monetization

# **Challenges in determining device location**

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# Challenges in determining device location

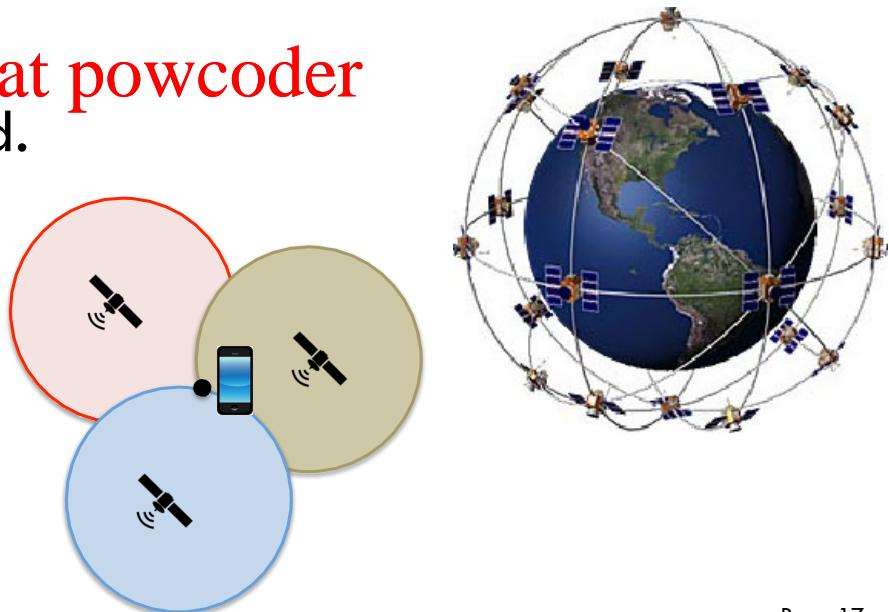
- Location adds “**Context**” to every action.
- The biggest challenge - User is moving.
- Various sources to determine the location.
  - GPS
  - Assisted-GPS
  - Cell towers
  - ...
  - ...
- **Each source comes with different accuracy, availability, resource requirement and efficiency**
- Dependent on the environmental factors.

# The Global Positioning System (GPS) Location

- Provided by the United States government  
<https://www.gps.gov>
- Use the signals received from satellites for localisation.
- Each location in the world is covered by at least four satellites.
- User device receives the signal and measure the time lag to estimate the distance to each satellite.  
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- No data connection is required.
- Longer time-to-fix.
  - Identifying the satellites
  - Synchronising the clocks.



# GPS Accuracy

- Standard Positioning Service (SPS)
  - Available to all users
  - No restrictions or direct charge
  - high-quality receivers have accuracies of 3m and better horizontally
  - In the level of 5-10m in worst case.

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- Precise Positioning Service (PPS)
  - Used by US and Allied military users
  - Use more satellites than public service
- US Government can selectively deny access
  - GLONASS (Russian), BeiDuo (China), Galileo (EU), NAVIC (India)

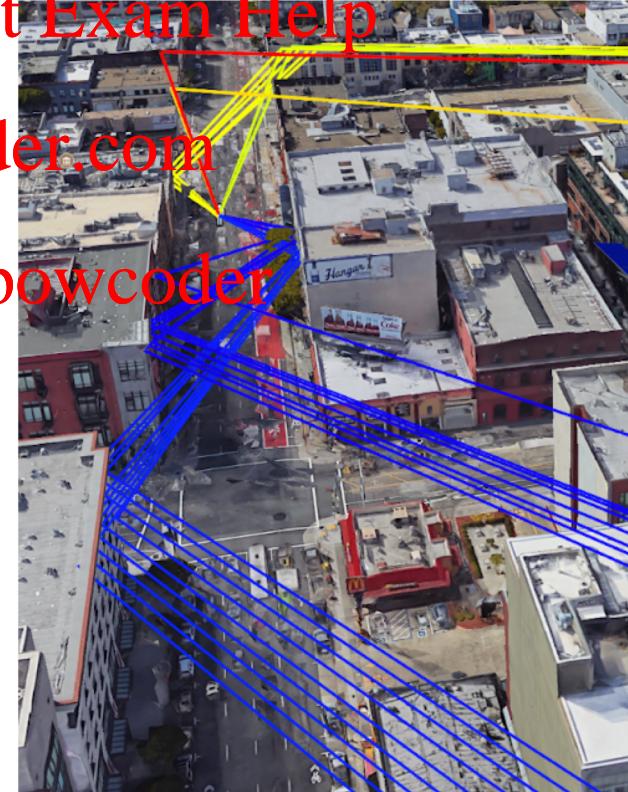
# GPS Location

- Smartphones can connect to multiple constellations to improve the accuracy: GPS or GLONASS & use the combined result.
  - Many apps in Google Play Store to check the status of GPS signals

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- However, GPS is not available everywhere, especially indoors.

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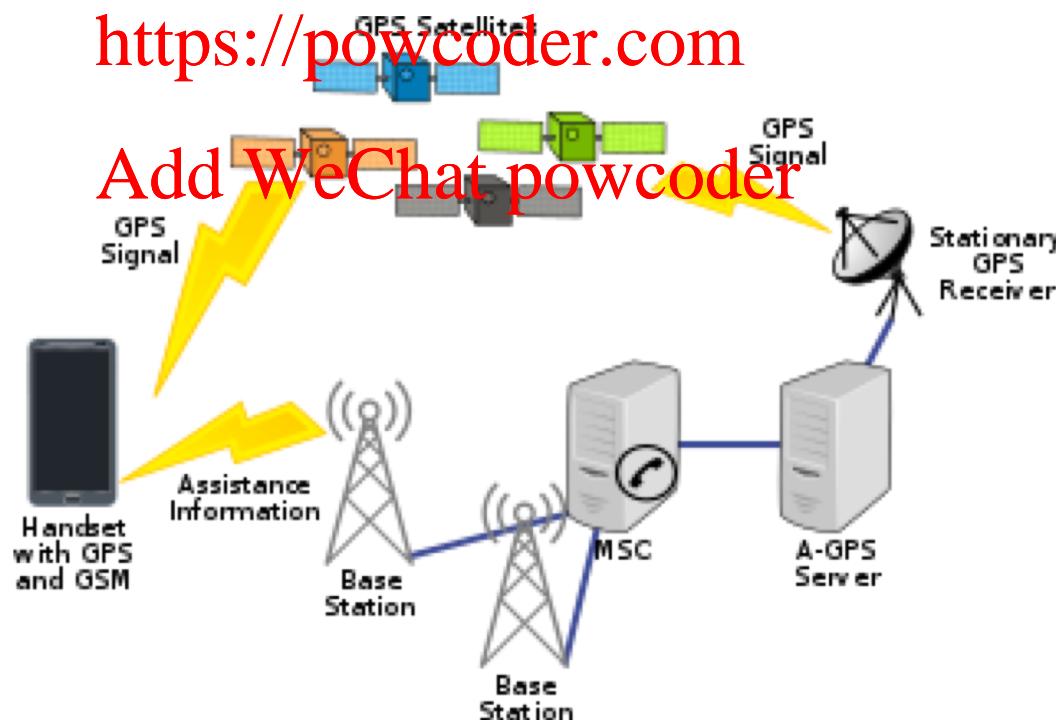


# Assisted GPS

- Tries to address some of the problems in GPS.
- Faster set-up time by getting satellite information through data connection.
- Lower energy consumption

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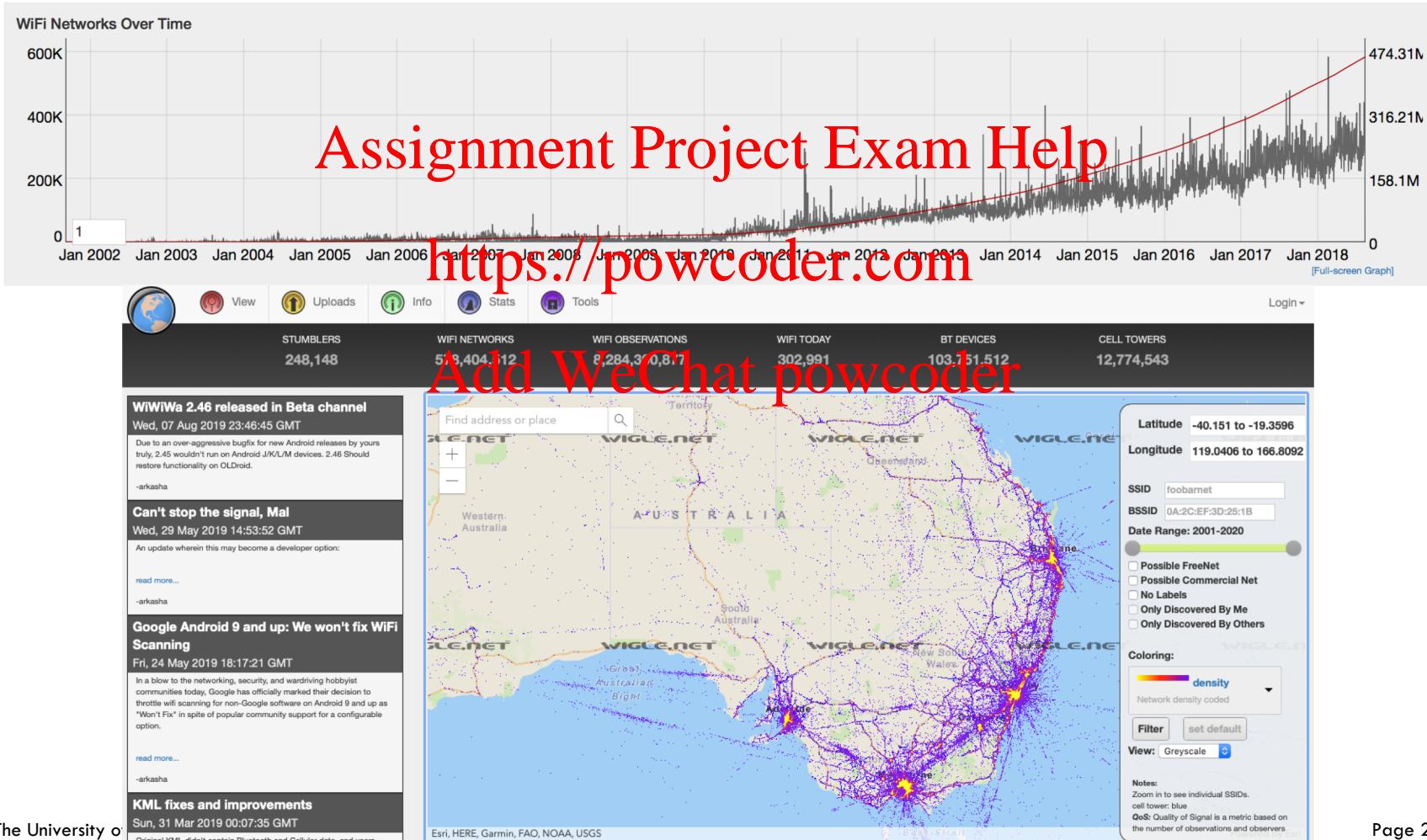


# Network Location

- Use near by cell tower & WiFi access point information to query a geo tagged database.
  - Energy Efficient
  - Needs a user data connection.
  - Who provide data to the geo DBs? – Everyone
    - It has been happening for sometime now
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- https://powcoder.com
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- <https://www.zdnet.com/article/how-google-and-everyone-else-gets-wi-fi-location-data/>

# Network Location

- WIGLE public database
    - [www.wigle.net](http://www.wigle.net)



# How to get location in Android – Option 1

- **Location API** in android.location [1]

- There are two main location providers:
- GPS\_PROVIDER
- NETWORK\_PROVIDER
- PASSIVE\_PROVIDER

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- Ask for the necessary permissions for the location providers.

- GPS\_PROVIDER: Add WeChat powcoder

<uses-permission android:name= "android.permission.ACCESS\_FINE\_LOCATION" />

- NETWORK\_PROVIDER:

<uses-permission android:name= "android.permission.ACCESS\_COARSE\_LOCATION" />

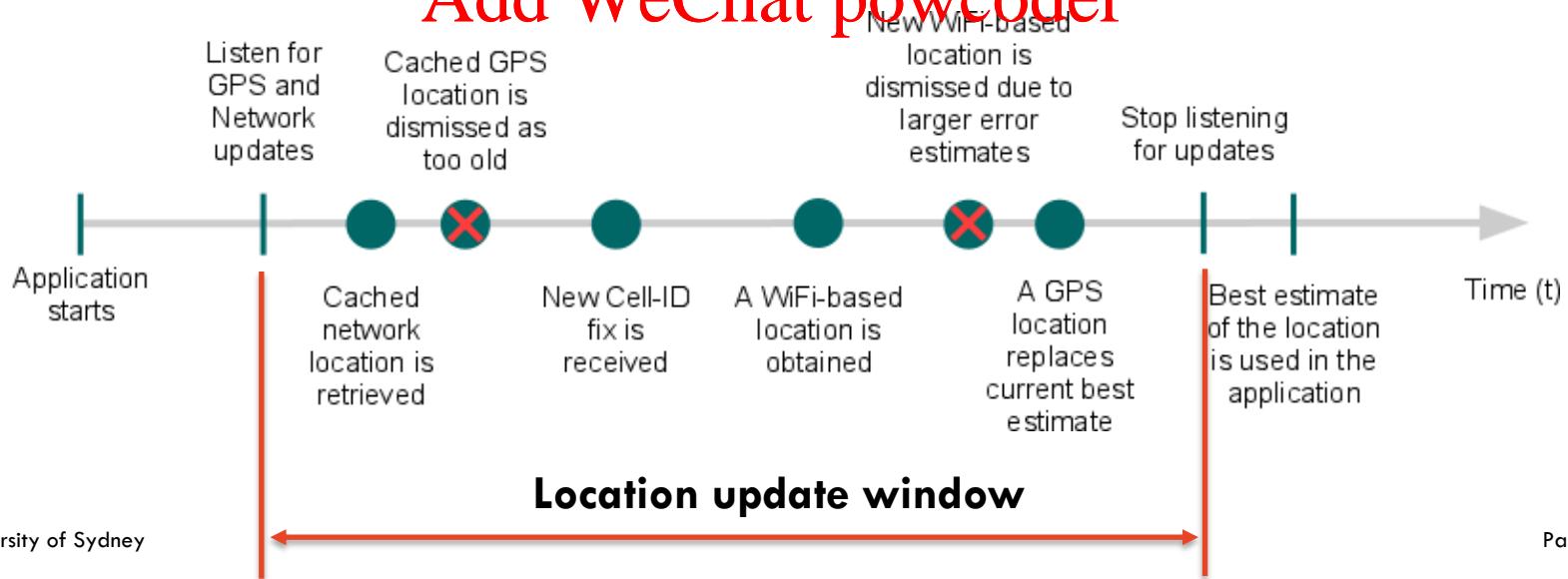
[1] <https://developer.android.com/reference/android/location/LocationManager>

# How to get location in Android – Option 1

- Flow for obtaining user location
  - Start application
  - Start listening to location
  - Get the cached location
  - Maintain “best-estimate” filtering out less accurate updates
  - Stop listing to location
  - Use last “best-estimate”

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# How to get location in Android – Option 1

- Start of the window
  - As soon as app starts or after a certain user action
- Period of the window
  - Long – More battery
  - Short – Less accurate
- Maintain the “best-estimate”
  - Most recent fix is not always the best
- PASSIVE\_PROVIDER
  - Getting the location fix often takes too long
  - Provides locations without actually initiating a location fix.
  - Only returns locations generated by other providers

# Android – Option 1: Best practices

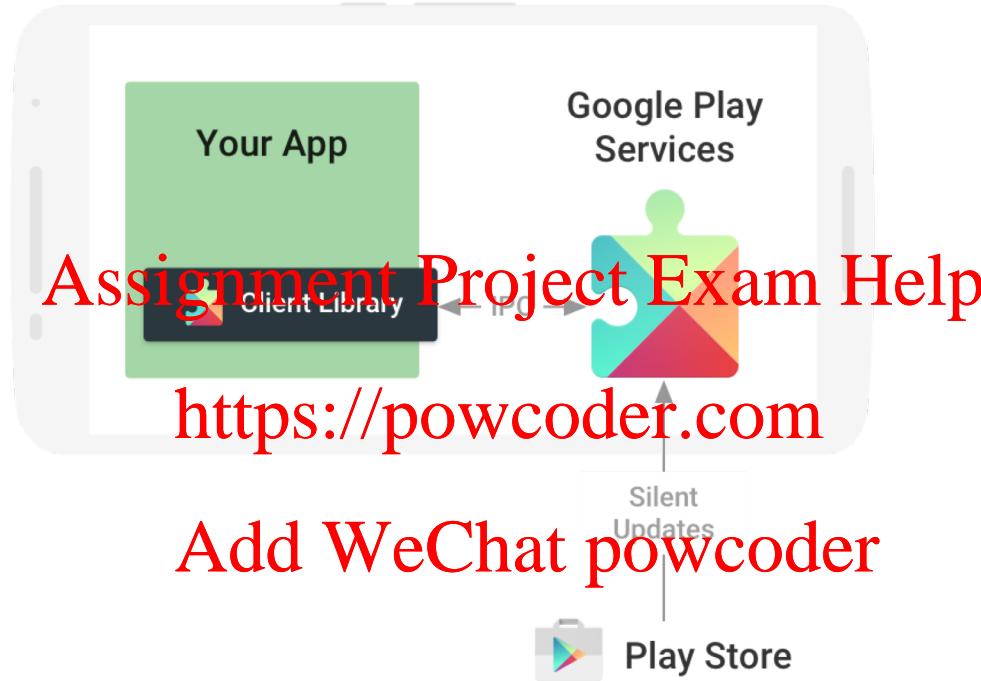
- Reduce the size of the window
  - As soon as you receive the information you need, stop listening to location
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- Reduce the frequency of Location Provider access
  - <https://powcoder.com>
- Restrict a set of providers
  - More provider – More battery
- App developers must not be troubled with all of these problems !!

# How to get location in Android – Option 2

## – Fused Location Provider API

- Current method [**Recommended by Google**].
- Google Play Services
- <https://developers.google.com/location-context/fused-location-provider> Assignment Project Exam Help
- <http://developer.android.com/training/location/index.html>
- Provides a much higher level view for the developer.
- Automatically changing the appropriate Location Provider, e.g. GPS or WiFi Add WeChat powcoder
- Your app must do is specify the desired level of service.
- Better accuracy and power management.

# Google Play Services



- Google Play services is installed as a separate application
- Run as a background Service
- <https://developers.google.com/android/guides/setup>

# Advantages of Google Play Services

- According to Google:
  1. Google Play services provide a **simple interface** and a cleaner API surface.
  2. You specify **Assignment Project Exam Help** desired quality of service and the APIs **manage the underlying technologies** for you.
  3. The Google Play services APIs are **optimized for performance** and battery usage.
  4. The Google Play services APIs are **actively maintained**. Google is constantly improving the algorithms and adding more features.

## Back to - How to get location in Android – Option 2

- How ? → Tutorial – Week 10

Optimize location for battery & efficiency

Recall: Assignment Project Exam Help

- **Accuracy:** higher the accuracy, the higher the battery drain.
- **Frequency:** More frequent location is computed, the more battery is used. Add WeChat powcoder
- **Latency:** Less latency usually requires more battery.
- **Step 1:**
  - Utilize cached location via `getLastKnownLocation(String)`:
  - Getting the location fix often takes too long and more resources

# Accuracy – Google Play Services Location

- Specify location accuracy using the `setPriority()` method
- **PRIORITY\_HIGH\_ACCURACY**
  - Most accurate
  - Use as many providers as necessary (GPS, WiFi, Cell-towers, etc. )
- **PRIORITY\_BALANCED\_POWER\_ACCURACY**
  - Accurate location
  - Rarely uses GPS.
- **PRIORITY\_LOW\_POWER**
  - Coarse (city-level) accuracy
  - Mostly using on cell towers
- **PRIORITY\_NO\_POWER**
  - Passive location
  - Rely on location computed by other apps

# Frequency & Latency – Google Play Services Location

- **setinterval()** method
  - The interval at which *location is computed for your app.*
  - Larger the better for battery
- **setMaxWaitTime()** method
  - Larger the better for battery
  - Delays the delivery of location
- Combination of the two methods can be used to batch requests
  - Set **setMaxWaitTime()** several times larger than **setinterval()**
- Set timeout to avoid keep trying
  - **setExpirationDuration()**

# Google Play Services Location APIs

- Seems a lot easier than Location APIs
- Why is it necessary to learn all location access methods ?
- **Low flexibility**
  - E.g. Can not restrict your app to receive only WiFi location.
- Not so easy after all...  
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⌚ 3 min read ⏴ 22 ▶ 2

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## Is Google Maps killing your battery? Here's how to fix it



Kris Carlson

Aug 28, 2014

## Google Maps battery draining issue: Here is how you can fix it

Wondering how to fix Google Maps battery draining issue? battery caused by Google Maps background processes

2  
SHARES



Written by [Meghna Dutta](#) | New Delhi | Updated: August 3, 2018 1:30:34 pm

## How to Fix Google Play Services Battery Drain on Android

By [Robert Zak](#) / Mar 15, 2020 / [Android](#)

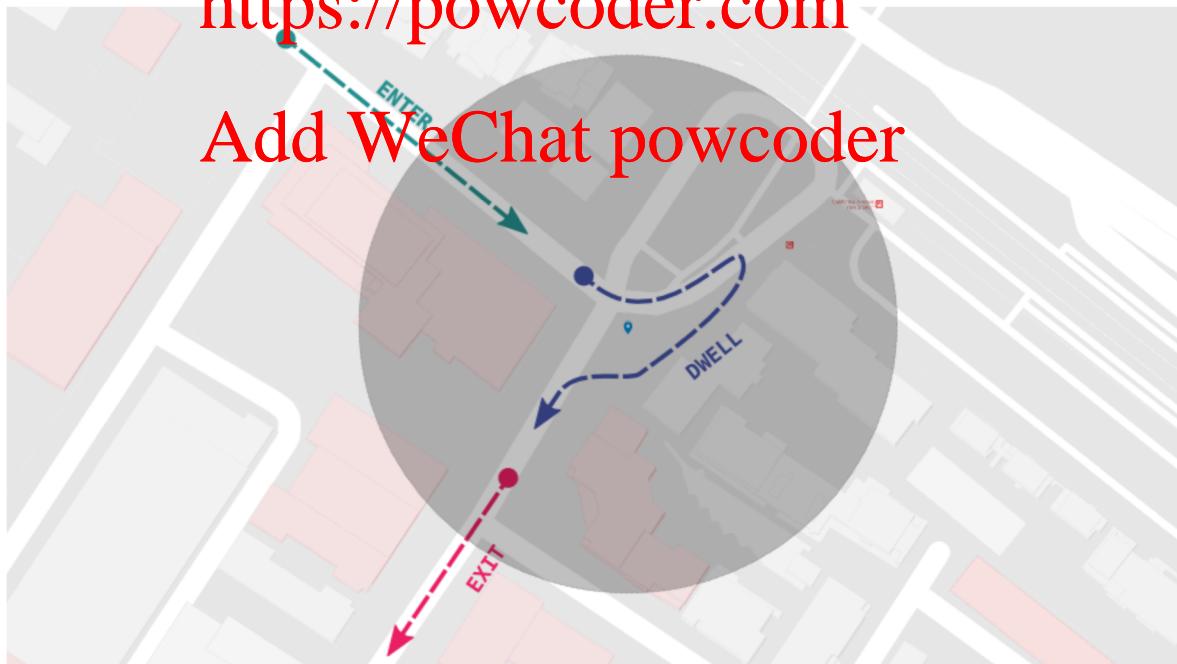


# How to get location in Android – Option 3

- **Geofencing API**
  - Google Play Services
  - <https://developers.google.com/location-context/geofencing>
  - Geofencing API allows you to define perimeters
  - Your app gets a notification when the device crosses a geofence

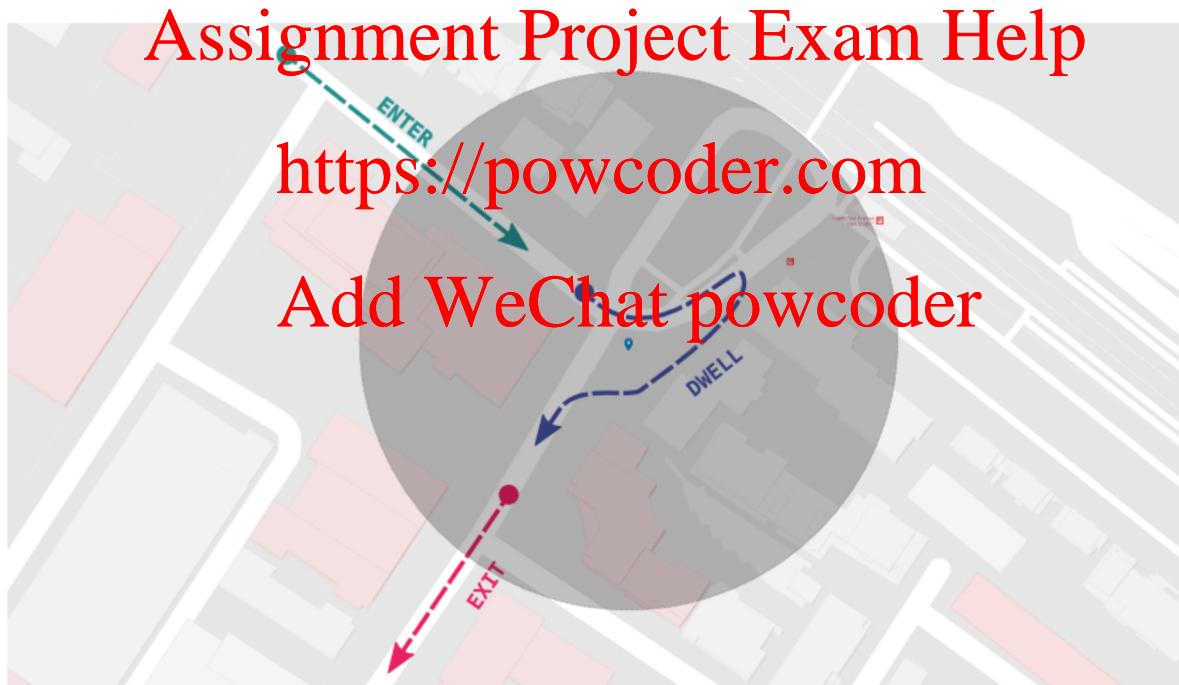
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## Exercise

- Can you suggest 2 alternatives to geofencing without using Geofencing API or GPS?



# Navigation is not only about GPS

- One of the consistent challenges when navigating with Google Maps is figuring out the right direction to go
- New approach for navigation with Global localization, which combines Visual Positioning Service (VPS), Street View, and Maps

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<https://powcoder.com>

Visual Positioning

Service (VPS), Street View, and

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# Google Play Services APIs

- **Develop**
  - Awareness, Fit, Places
- **Grow**
  - Analytics
- **Earn**
  - Ads

API	Description in build.gradle
Google+	com.google.android.gms:play-services-plus:15.0.1
Google Account Login	com.google.android.gms:play-services-auth:16.0.0
Google Actions, Base Client Library	com.google.android.gms:play-services-base:15.0.1
Google Sign In	com.google.android.gms:play-services-identity:15.0.1
Google Analytics	com.google.android.gms:play-services-analytics:16.0.1
Google Awareness	com.google.android.gms:play-services-awareness:15.0.1
Google Cast	com.google.android.gms:play-services-cast:16.0.1
Google Cloud Messaging	com.google.android.gms:play-services-gcm:15.0.1
Google Drive	com.google.android.gms:play-services-drive:15.0.1
Google Fit	com.google.android.gms:play-services-fitness:15.0.1
Google Location and Activity Recognition	com.google.android.gms:play-services-location:15.0.1
Google Maps	com.google.android.gms:play-services-maps:15.0.1
Google Mobile Ads	com.google.android.gms:play-services-ads:15.0.1
Google Places	com.google.android.gms:play-services-places:15.0.1
Mobile Vision	com.google.android.gms:play-services-vision:15.0.2
Google Nearby	com.google.android.gms:play-services-nearby:15.0.1
Google Panorama Viewer	com.google.android.gms:play-services-panorama:15.0.1
Google Play Game services	com.google.android.gms:play-services-games:15.0.1
SafetyNet	com.google.android.gms:play-services-safetynet:15.0.1
Google Pay	com.google.android.gms:play-services-wallet:15.0.1
Wear OS by Google	com.google.android.gms:play-services-wearable:15.0.1

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# Google Fit APIs

- Sensor API
  - Raw sensor data access from both smartphone and wearables
- Recording API
  - Automated storage with subscriptions
- History API <https://powcoder.com>
  - Access to historical fitness data
- Sessions API [Add WeChat powcoder](#)
  - Store data/meta data of fitness activities
- Goals API
  - Tracking users fitness goals
- Bluetooth Low Energy API
  - Connect companion devices to Google Fit

<https://developers.google.com/fit/android/>

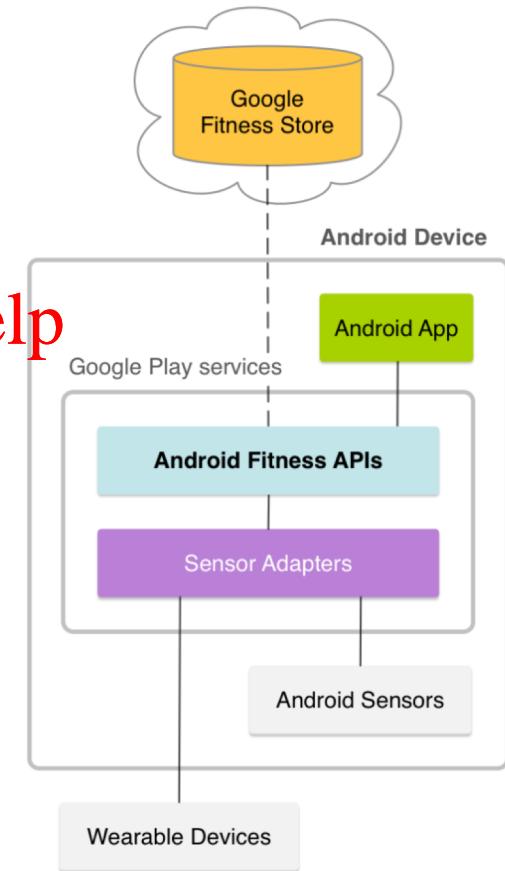


Figure 1: Google Fit on Android.

# Awareness APIs

- **Fence API**
  - React to changes in the user's environment
  - The user's current location (latitude/longitude)
  - The user's current activity, like walking or driving.
  - Device-specific conditions, such as whether the headphones are plugged in.
  - Proximity to nearby beacons

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- **Snapshot API** <https://powcoder.com>

- Get an idea about user's current environment using 7 sensor inputs
  1. Time
  2. Location
  3. Place
  4. Activity
  5. Beacons
  6. Headphones
  7. Weather

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- **Have fun developing “Context-Aware” apps...!**
- <https://developers.google.com/awareness/>

# What' Next ?

- **Start working on Project Proposal**
  - Due in week 6.
- **Tutorial 4 Assignment Project Exam Help**
  - Learn how to develop mobile app using Google's Firebase platform
  - Understand how to use Cloud Firestore to store and read data  
<https://powcoder.com>
- Next week              Add WeChat powcoder
  - How to respect and effectively manage Mobile Networking resources when you develop apps?

# Optional

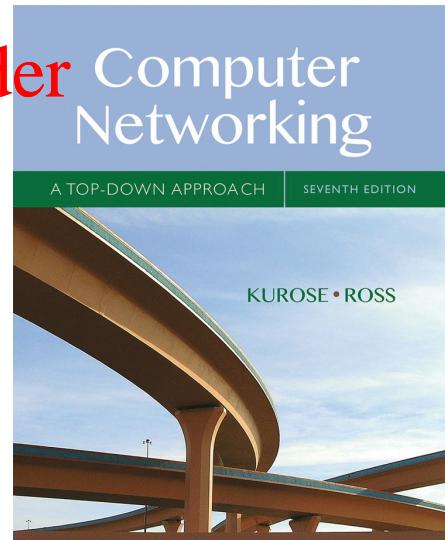
## Internet Protocols Basics

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These slides are adopted from

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*Computer Networking: A Top Down Approach*  
7<sup>th</sup> Ed. Jim Kurose, Keith Ross  
Pearson - Addison-Wesley



# What is Internet ?

- Billions of connected computing devices

- Communication links
  - Fiber, copper, radio, satellite
- Hosts – end devices
  - User devices, Servers
- Packet Switches
  - Routers, Switches

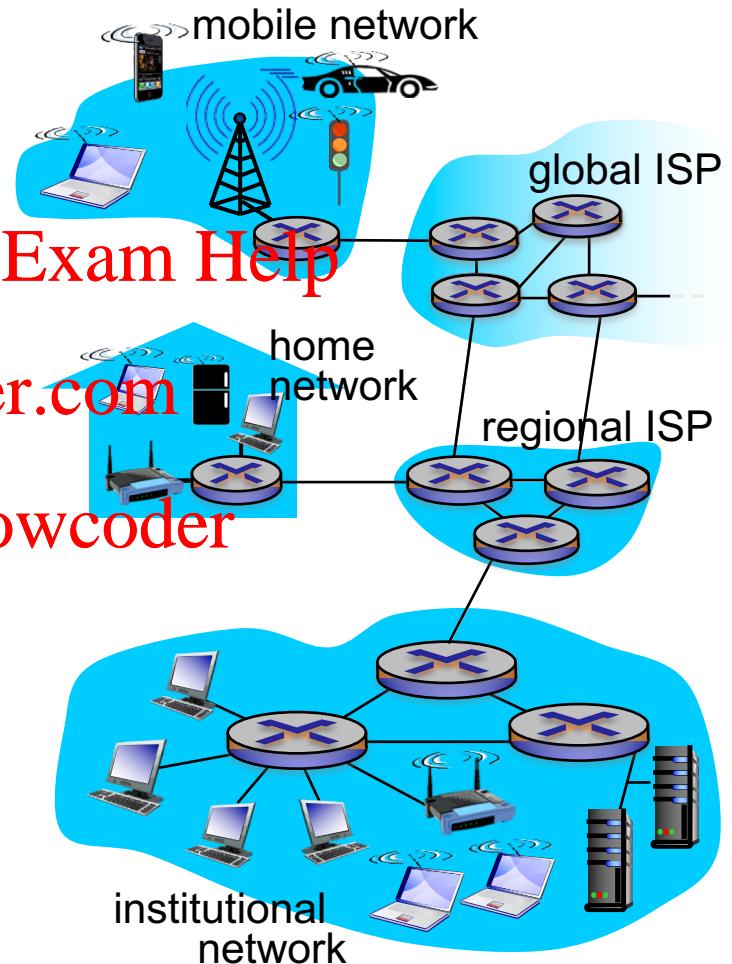
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- To inter-operate, we need;

- Protocols
  - TCP, IP, HTTP, 802.11
- Standards
  - RFC
  - IETF



# What is a Protocol ?

## human protocols:

- “what’s the time?”
- “I have a question”
- introductions

... specific messages sent

... specific actions taken

when messages received,  
or other events

## network protocols:

- machines rather than humans
- all communication activity in

Internet governed by  
protocols

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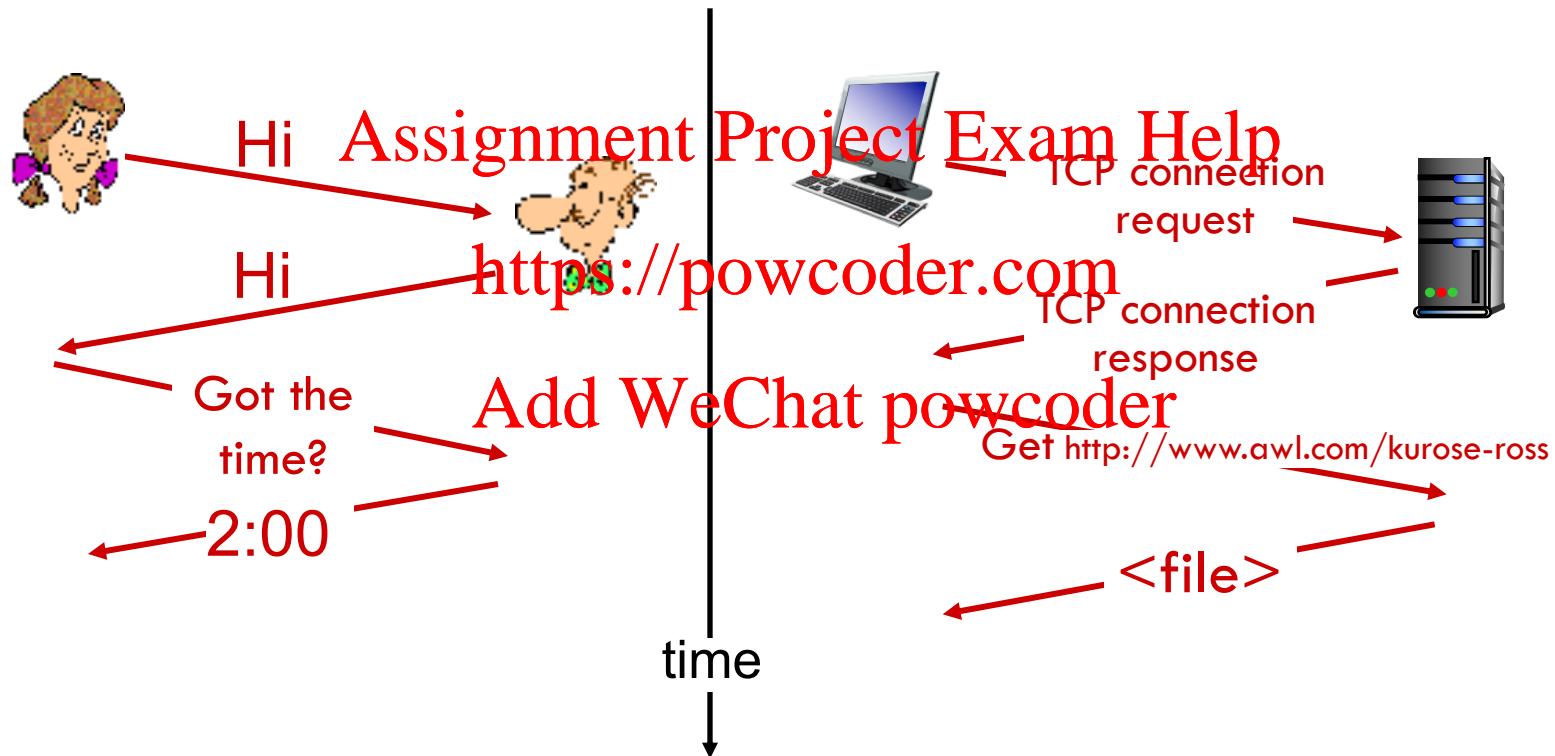
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*protocols define format, order of messages sent and received among network entities, and actions taken on message transmission, receipt*

# What is a protocol ?

a human protocol and a computer network protocol:



# Transport Service Requirement

application	data loss	throughput	time sensitive
file transfer	no loss	elastic	no
e-mail	no loss	elastic	no
Web documents	no loss	elastic	no
real-time audio/video	loss-tolerant	audio: 5kbps-1Mbps video: 10kbps-5Mbps	yes, 100's msec
stored audio/video	loss-tolerant	same as above	yes, few secs
interactive games	loss-tolerant	few kbps up	yes, 100's msec
text messaging	no loss	elastic	yes and no

# Common Internet Protocols

application	application layer protocol	underlying transport protocol
e-mail	SMTP [RFC 2821]	TCP
remote terminal access	Telnet [RFC 854]	TCP
Web	HTTP [RFC 2616]	TCP
file transfer	FTP [RFC 959]	TCP
streaming multimedia	HTTP (e.g., YouTube), RTP [RFC 1889]	TCP or UDP
Internet telephony	SIP, RTP, proprietary (e.g., Skype)	TCP or UDP

# TCP and UDP

## TCP service:

- *reliable transport* between sending and receiving process
- *flow control*: sender won't overwhelm receiver
- *congestion control*: throttle sender when network overloaded
- *does not provide*: timing, minimum throughput guarantee, security
- *connection-oriented*: setup required between client and server processes

## UDP service:

- *unreliable data transfer* between sending and receiving process

▪ *does not provide*: reliability, flow control, congestion control, timing, throughput guarantee, security, or connection setup,

**Q:** why bother? Why is there a UDP?

# Securing TCP

## TCP & UDP

- no encryption
- cleartext passwords sent into socket traverse Internet in cleartext

## SSL

- provides encrypted TCP connection
- data integrity
- end-point authentication

SSL is at app layer

- apps use SSL libraries, that

“talk” to TCP

SSL socket API

<https://powcoder.com>

- cleartext passwords sent into

socket traverse Internet  
encrypted

- see Chapter 8

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# HTTP Overview

## HTTP: hypertext transfer protocol

- Web's application layer protocol
- client/server model
  - *client*: browser that requests, receives, (using, HTTP protocol) and “displays” Web objects
  - *server*: Web server sends (using HTTP protocol) objects in response to requests



# HTTP overview

uses TCP:

- 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)
- TCP connection closed

HTTP is “stateless”

- server maintains no information about past client requests

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aside

protocols that maintain “state” are complex!

- past history (state) must be maintained
- if server/client crashes, their views of “state” may be inconsistent, must be reconciled

# Web and HTTP

- web page consists of *objects*
- object can be HTML file, JPEG image, Java applet, audio file,...
- web page ~~Assignment Project Exam Help~~ consists of *objects* which includes *several referenced objects*
- each object is addressable by a *URL*; e.g.,

**Add WeChat powcoder**  
www.someschool.edu/someDept/pic.gif

host name

path name

# HTTP Method Types

## HTTP/1.0:

- GET
- POST
- HEAD
  - asks server to leave requested object out of response

## HTTP/1.1:

- GET, POST, HEAD

- PUT

- uploads file in entity body to path specified in URL field

- DELETE

- deletes file specified in the URL field

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# HTTP Request Message

- two types of HTTP messages: *request, response*
- HTTP *request message*:

- ASCII (human-readable format)

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request line  
(GET, POST,  
HEAD commands)

header  
lines

carriage return,  
line feed at start  
of line indicates  
end of header lines

https://powcoder.com

GET /index.html HTTP/1.1\r\n

Host: www-net.cs.umass.edu\r\n

User-Agent: Firefox/3.6.10\r\n

Accept: text/html,application/xhtml+xml\r\n

Accept-Language: en-us,en;q=0.5\r\n

Accept-Encoding: gzip,deflate\r\n

Accept-Charset: ISO-8859-1,utf-8;q=0.7\r\n

Keep-Alive: 115\r\n

Connection: keep-alive\r\n

\r\n

carriage return character  
line-feed character

\* Check out the online interactive exercises for more  
examples: [http://gaia.cs.umass.edu/kurose\\_ross/interactive/](http://gaia.cs.umass.edu/kurose_ross/interactive/)

# HTTP Response Message

status line  
(protocol  
status code  
status phrase)

header  
lines

data, e.g.,  
requested  
HTML file

HTTP/1.1 200 OK\r\nDate: Sun, 26 Sep 2010 20:09:20 GMT\r\nServer: Apache/2.0.12 (CentOS)\r\nLast-Modified: Tue, 30 Oct 2007 17:00:02  
GMT\r\nETag: "17dc6-a5c-bf716880"\r\nAccept-Ranges: bytes\r\nContent-Length: 2652\r\nKeep-Alive: timeout=10, max=100\r\nConnection: Keep-Alive\r\nContent-Type: text/html; charset=ISO-8859-1\r\n\r\ndata data data data data ...

\* Check out the online interactive exercises for more  
examples: [http://gaia.cs.umass.edu/kurose\\_ross/interactive/](http://gaia.cs.umass.edu/kurose_ross/interactive/)

# HTTP response status codes

- status code appears in 1st line in server-to-client response message.
- some sample codes:

**200 OK Assignment Project Exam Help**

- request succeeded, requested object later in this msg

**301 Moved Permanently**

- requested object moved, new location specified later in this msg  
(Location: <https://powcoder.com>)

**400 Bad Request**

- request msg not understood by server

**404 Not Found**

- requested document not found on this server

**505 HTTP Version Not Supported**