End-end Connectivity on Phones

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Outline

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2. Turn on and manage both interfaces
3. The HTTPUrlConnection library
4. HTTP download with two interfaces
5. Challenges Faced
6. Future work
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Motivations

- ## Goal of this study:
  - Utilize WIFI and 3G network Interfaces concurrently to provide better end to end connectivity to applications.

- ## Why HTTP protocol?
  - Ability to request data in chunks i.e. byte range.
  - Recent study shows HTTP protocol dominate today's data traffic on smartphones.
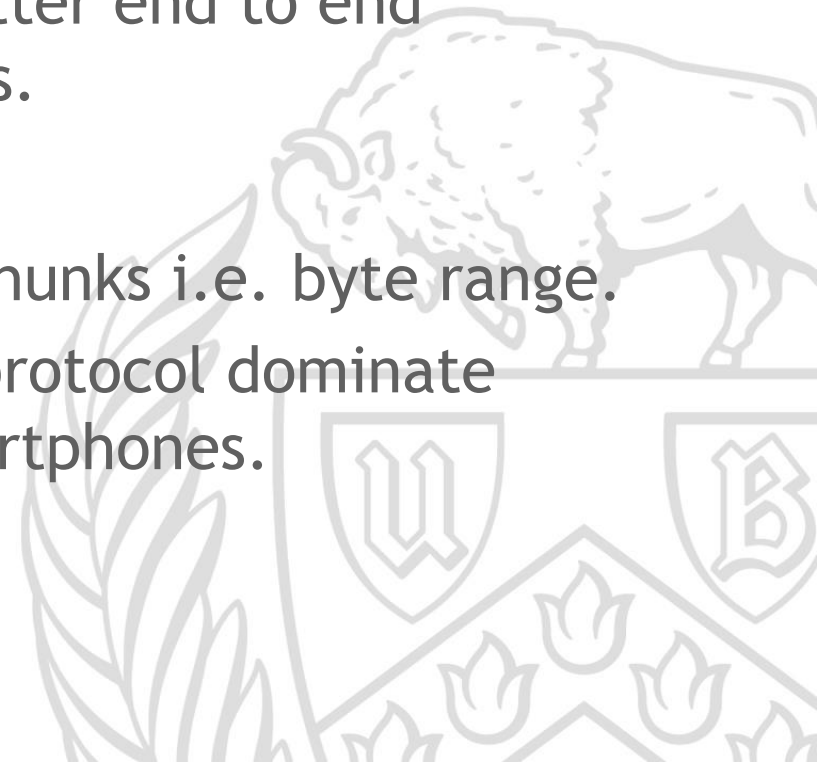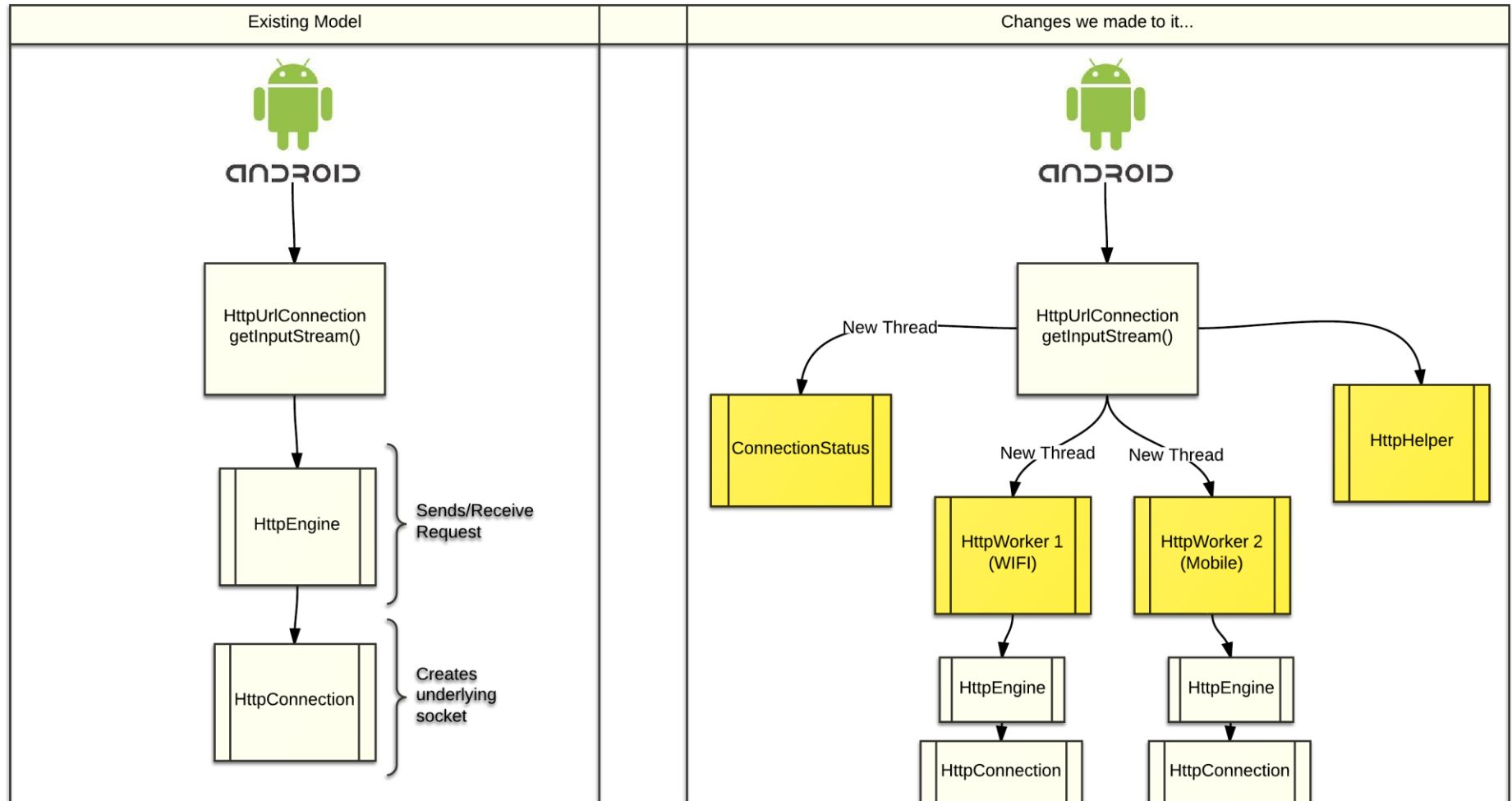
Turn on and manage both interfaces
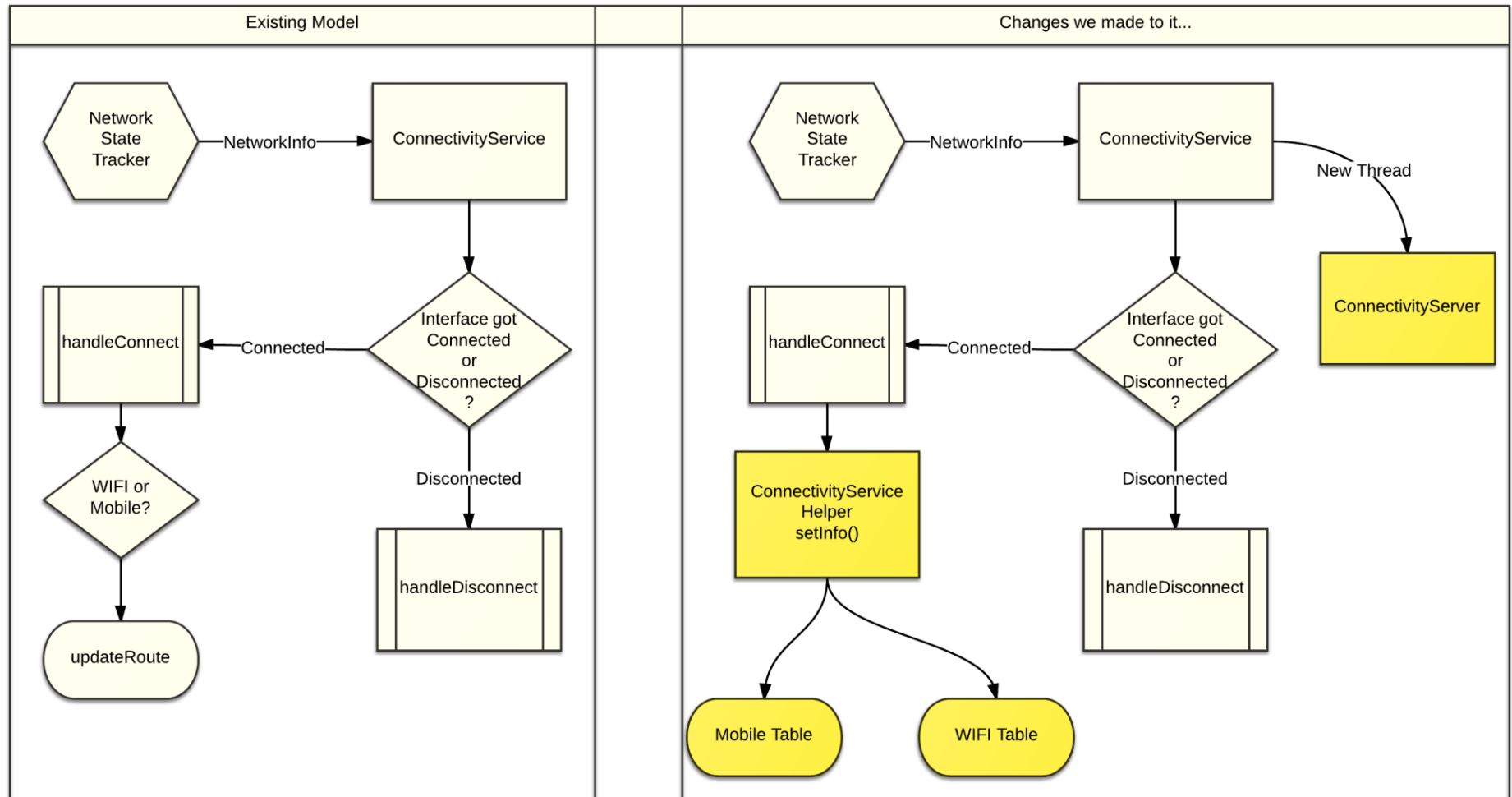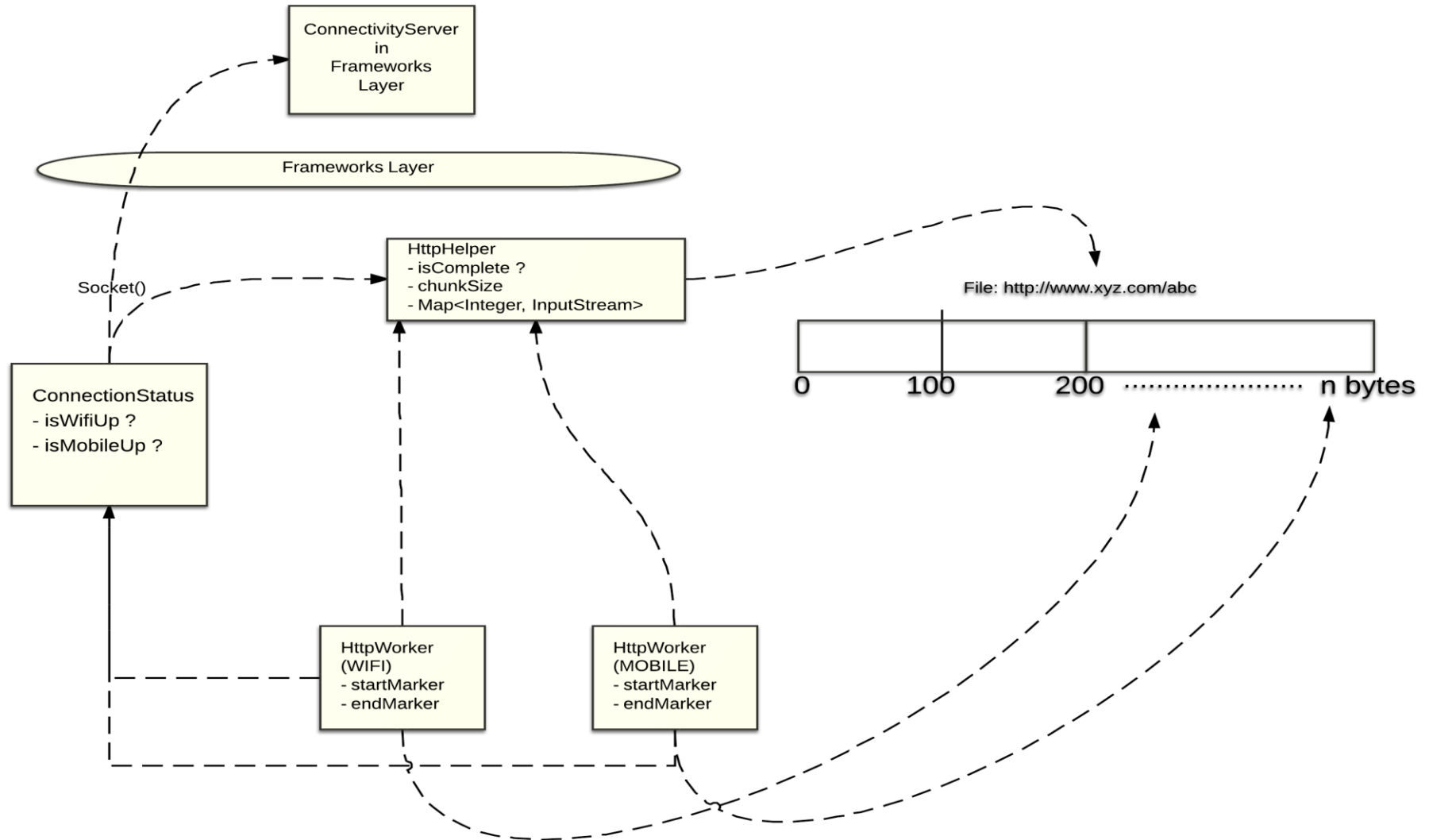
Http connection handlers in Android

- **Apache HTTP client**
  - DefaultHttpClient and AndroidHttpClient

- **HttpURLConnection**
  - General Purpose, and relatively lightweight
    - Preferred client for Gingerbread and following releases
  - Implemented inside core java library – libcore

The HttpURLConnection Library

Work Stealing Implementation

Challenges Faced

- Setting up 2 kernel routing tables.
- Creating Native interface (JNI) for updating routing tables using "ip" and "su" utility.
- Understanding HttpUrlConnection library implementation!
- Finding an IPC mechanism for communication between JAVA libcore library and Android Frameworks library.
- HTTP servers may not always provide the information we want, e.g., content length and content size range, in HTTP response.
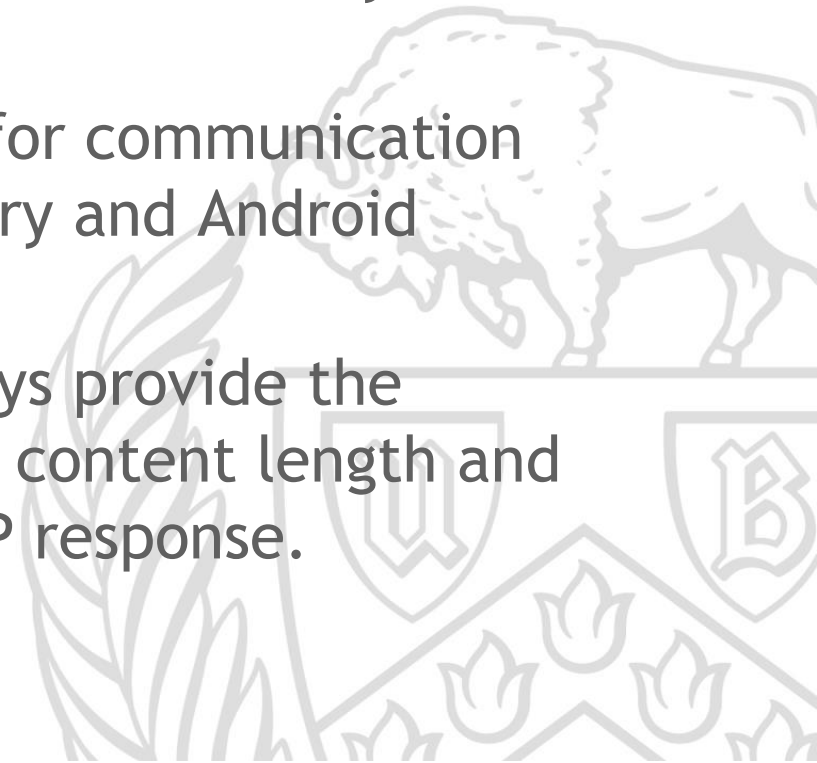
Future Work

- Finding out "optimal" chunk size or maybe have variable chunk size.

- Add download policies to restrict download from an interface depending on factors such as Cost, Latencies etc.

Screenshots

```
I/622      (   382): NetworkstateTracker – EVENT_STATE_CHANGED
I/622      (   382): ConnectivityChange for WIFI: CONNECTED/CONNECTED
I/622      (   382): handleConnectivityChange: changed linkProperty[1]: doReset=false resetMask=0
I/622      (   382):     curLp=null
I/622      (   382):     newLp=InterfaceName: wlan0 LinkAddresses: [192.168.0.10/24,] Routes: [0.0.0.0/0 -> 192
operties.mHost == null]
I/622      (   382): Inside setInfo function
I/622      (   382): Checkpoint – 1
I/622      (   382): Helper: setInfo: IP = 192.168.0.10, gateway = 192.168.0.1, link = 192.168.0.0
I/622      (   382): Execute commands for setting up WIFI table
I/622      (   382): To execute = su 0 ip route add 192.168.0.0 dev wlan0 src 192.168.0.10 table WIFI
I/622      (   382): INSIDE native function
I/622      (   382): Command executed = su 0 ip route add 192.168.0.0 dev wlan0 src 192.168.0.10 table WIFI
I/622      (   382): system() return value = 0
I/622      (   382): To execute = su 0 ip route add default via 192.168.0.1 table WIFI
I/622      (   382): INSIDE native function
I/622      (   382): Command executed = su 0 ip route add default via 192.168.0.1 table WIFI
I/622      (   382): system() return value = 0
I/622      (   382): To execute = su 0 ip rule add from 192.168.0.10 table WIFI
I/622      (   382): INSIDE native function
I/622      (   382): Command executed = su 0 ip rule add from 192.168.0.10 table WIFI
I/622      (   382): system() return value = 0
I/622      (   382): To execute = su 0 ip rule add to 192.168.0.10 table WIFI
I/622      (   382): INSIDE native function
I/622      (   382): Command executed = su 0 ip rule add to 192.168.0.10 table WIFI
I/622      (   382): system() return value = 0
I/622      (   382): modifyRoute: COMMENTED cmd = interface route add wlan0 default 192.168.0.1 32 0.0.0.0
I/622      (   382): modifyRoute: COMMENTED cmd = interface route add wlan0 default 0.0.0.0 0 192.168.0.1
I/622      (   382): Adding Default route through WIFI for main table
I/622      (   382): To execute = su 0 ip route add default via 192.168.0.1
I/622      (   382): INSIDE native function
I/622      (   382): Command executed = su 0 ip route add default via 192.168.0.1
I/622      (   382): system() return value = 0
```

```
Varuns-MacBook-Pro:~ varunanand$ adb shell
shell@android:/ $ ip rule
0:       from all lookup local
32762:   from all to 21.141.214.185 lookup CDMA
32763:   from 21.141.214.185 lookup CDMA
32764:   from all to 192.168.0.10 lookup WIFI
32765:   from 192.168.0.10 lookup WIFI
32766:   from all lookup main
32767:   from all lookup default
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $ ip route show table WIFI
default via 192.168.0.1 dev wlan0
192.168.0.0 dev wlan0  scope link  src 192.168.0.10
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $ ip route show table CDMA
default via 21.141.214.1 dev cdma_rmnet4
21.141.214.0 dev cdma_rmnet4  scope link  src 21.141.214.185
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $ ip route show table main
default via 192.168.0.1 dev wlan0
21.141.214.0/24 dev cdma_rmnet4  proto kernel  scope link  src 21.141.214.185
192.168.0.0/24 dev wlan0  proto kernel  scope link  src 192.168.0.10
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $
shell@android:/ $ ▮
```

```
I/System.out( 1601): CSE622: From HttpURLConnImpl - inside getResponse() creating Worker WIFI
I/System.out( 1601): CSE622: From HttpURLConnImpl - inside getResponse() creating Worker MOBILE
I/System.out( 1601): 622 - Worker: <wifi>... Waiting for WIFI to be AVAILABLE
I/System.out( 1601): 622 - HttpURLConnectionImpl - Waiting for workers to complete
I/System.out( 1601): 622 - Worker: <mobile>... Waiting for MOBILE to be AVAILABLE
I/System.out( 1601): 622 - ConnectionStatus Thread: Wifi = true
I/System.out( 1601): 622 - ConnectionStatus Thread: Mobile = true
I/System.out( 1601): 622 - ConnectionStatus Thread: UseBoth = true
I/System.out( 1601): 622 - Worker: <wifi>...sending to http://www.google.com/robots.txt ........bytes=0 - 999999
I/System.out( 1601): 622 - HttpEngine...Sending Request for HttpConnection
I/System.out( 1601): 622 - HttpConnection: Getting instance from connection pool
I/System.out( 1601): 622 - HttpConnectionPool: No reusable connection...creating a new one
I/System.out( 1601): CSE622 From HttpConnection.java: Inside constr.
I/System.out( 1601): CSE622 From HttpConnection.java: Creating new Socket and trying all addresses.
I/System.out( 1601): CSE622: Using Wifi address:  192.168.0.10
I/System.out( 1601): 622 - Worker: <mobile>...sending to http://www.google.com/robots.txt ........bytes=1000000 - 1999999
I/System.out( 1601): 622 - HttpEngine...Sending Request for HttpConnection
I/System.out( 1601): 622 - HttpConnection: Getting instance from connection pool
I/System.out( 1601): 622 - HttpConnectionPool: No reusable connection...creating a new one
```

Thank You!