



End-end Connectivity on Phones



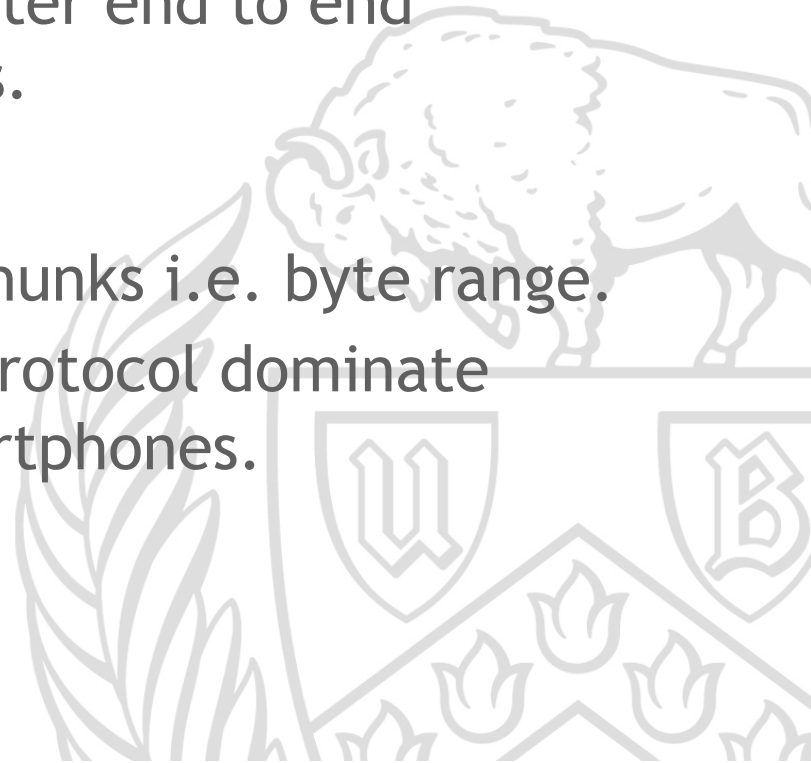
Outline

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

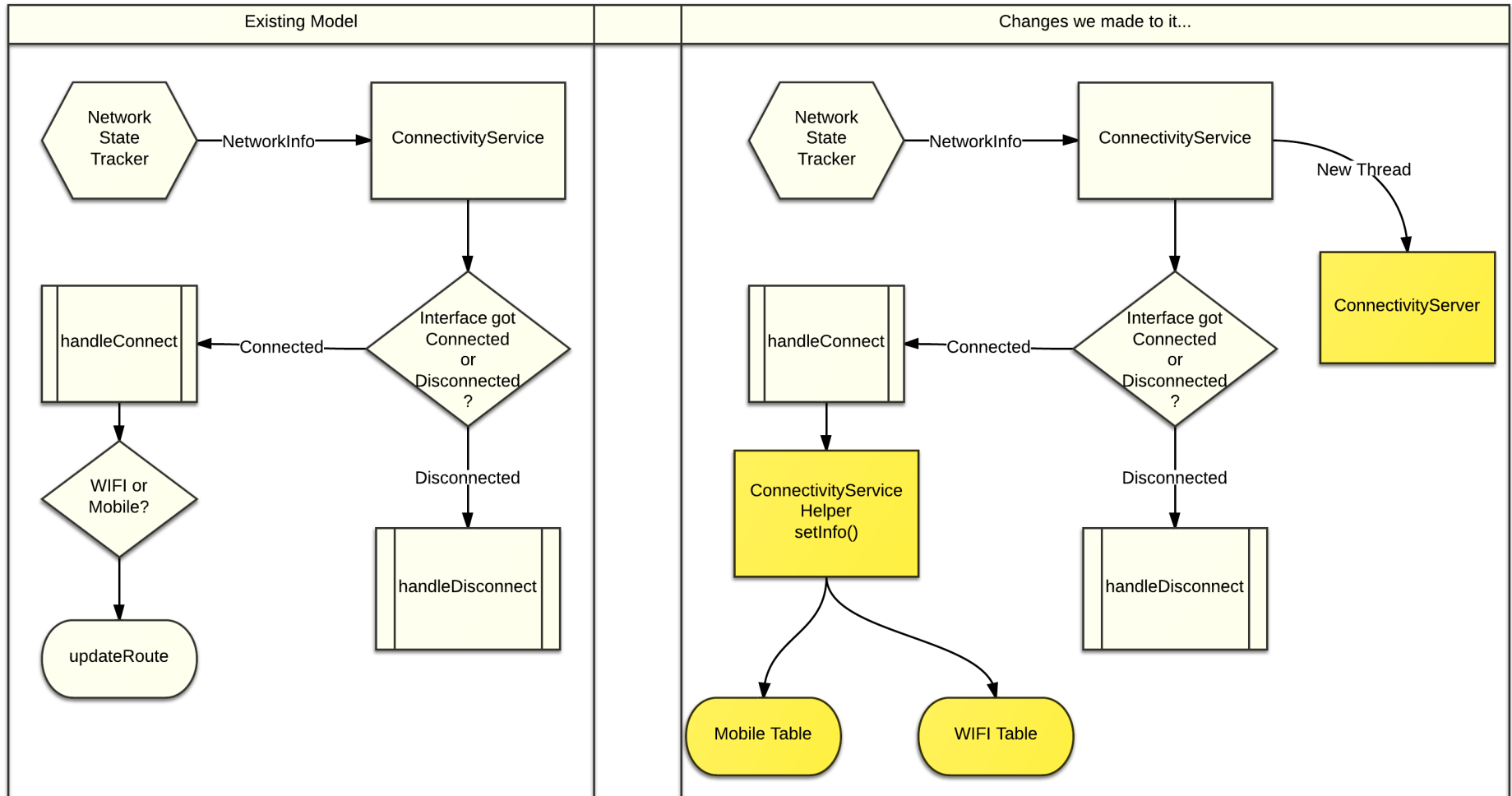


Motivations

- **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

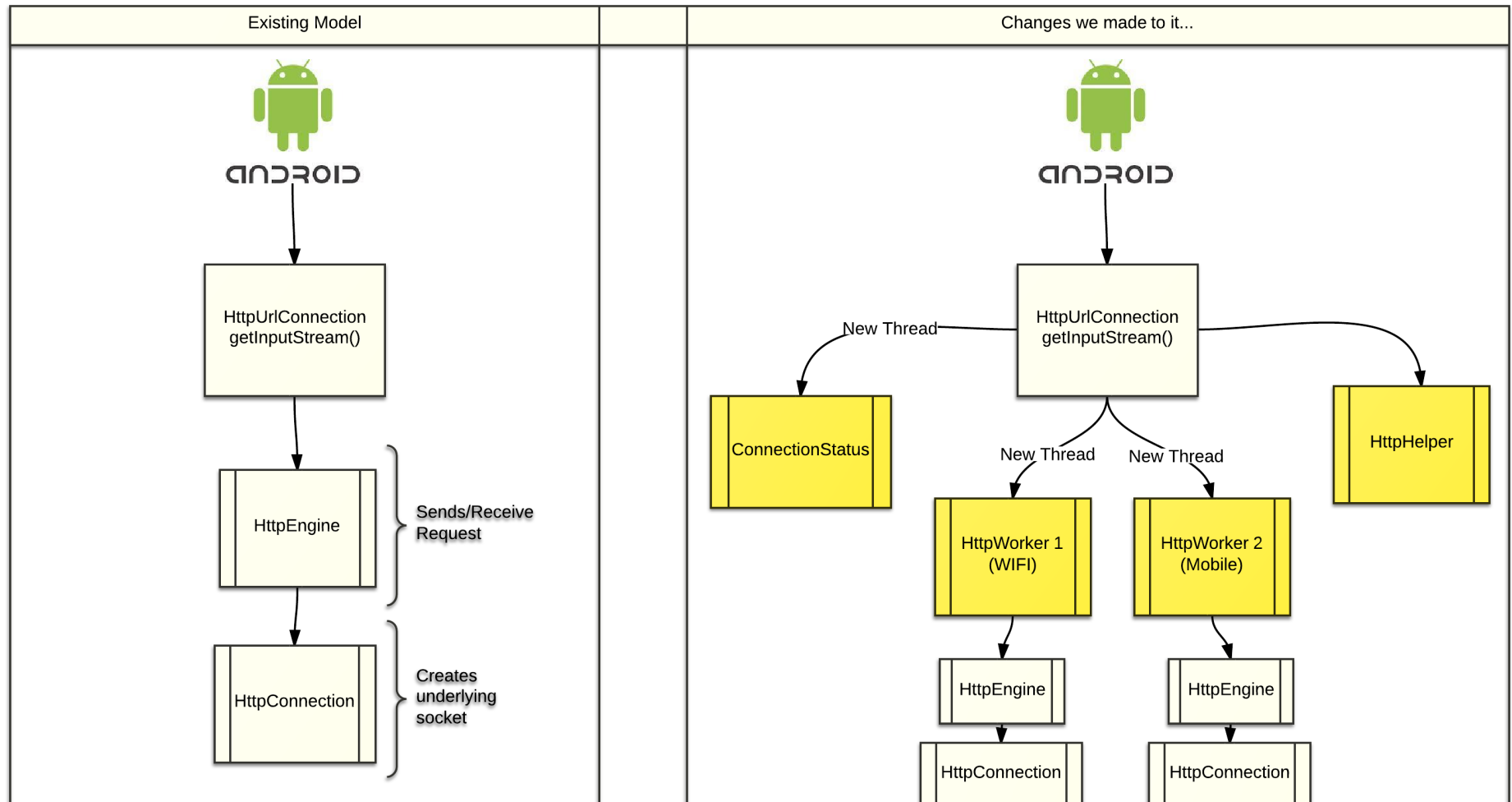


Http connection handlers in Android

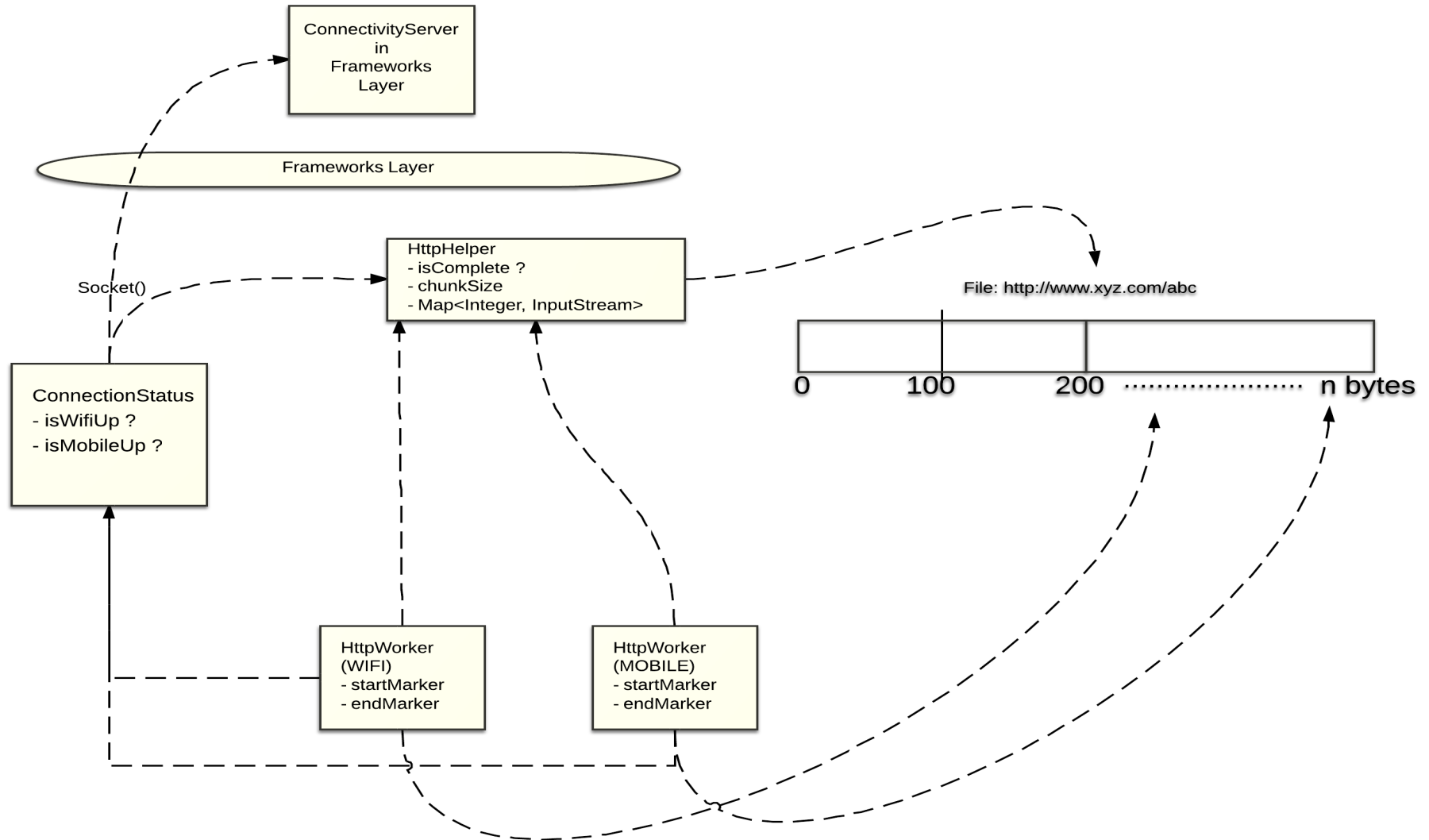
- **Apache HTTP client**
 - DefaultHttpClient and AndroidHttpClient
- **URLConnection**
 - General Purpose, and relatively lightweight
 - Preferred client for Gingerbread and following releases
 - Implemented inside core java library - libcore



The HttpURLConnection Library

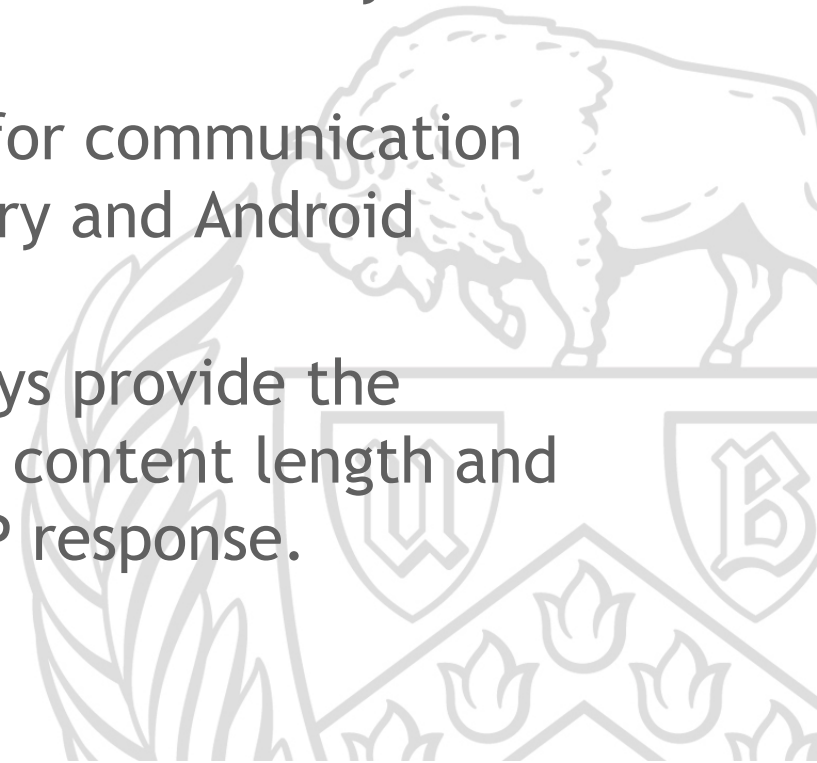


Work Stealing Implementation



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
properties.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 HttpURLConnectionImpl - inside getResponse() creating Worker WIFI
I/System.out( 1601): CSE622: From HttpURLConnectionImpl - 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!

