Smartphone & Mobile Network Project

Mobile Network Project

Mobile Network Project

❖ **Network Analysis Project (Android)**

- Monitor and analyze the network status of your smartphone
  - Mobile network types: 2G, 3G, 4G (LTE), 5G
  - Signal strength
  - Serving cell information
  - Neighboring cell information

Network Cell Info Lite

Available at Google Play Store

https://play.google.com/store/apps/details?id=com.wilysis.cellinfolite&hl=ko

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❖ Gauge Tap

- Visualized general information
  - Show your cellular network status (if connected)
  - Show your Wi-Fi status (if connected)

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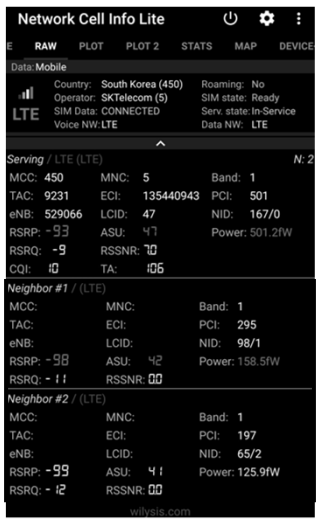
❖ Raw Tap



- Provide detail information of the network status
  - Compares the RSRP of the Serving cell & Neighboring cells
    - RSRP: Reference Signal Received Power
  - Compares the PCI of the Serving cell & Neighboring cells
    - PCI: Physical Cell ID

← This might be blank if there is no Neighboring cell detected

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❖ Signal Measurement Indicators

- RSSI (Received Signal Strength Indicator)
  - Average total received power observed (only in OFDM symbols) containing reference symbol for antenna port 0 in the measurement bandwidth over *N* resource blocks
  - Power Measurement Values
    - Co-channel serving cells
    - Non-serving cells
    - Adjacent channel interference
    - Thermal noise
    - etc.

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❖ Signal Measurement Indicators

- RSRP (Reference Signal Received Power)
  - Power of the (LTE) reference signals spread over the full bandwidth and narrowband
- RSRQ (Reference Signal Received Quality)
  - **C/I** based measurement that indicates the quality of the received reference signal
    - **C/I**: Carrier to Interference
  - Provides additional information when RSRP is not sufficient to make a reliable handover or cell reselection decision

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❖ Signal Measurement Indicators

- RSSNR (Reference Signal Signal-to-Noise Ratio)
  - SNR of the reference signal
  - Provides an indication of the quality of the link
- ASU (Arbitrary Strength Unit)
  - Integer value proportional to the received signal strength measured by the mobile phone
- CQI (Channel Quality Indicator)
  - Indicator carrying the information on how good/bad the communication channel quality is

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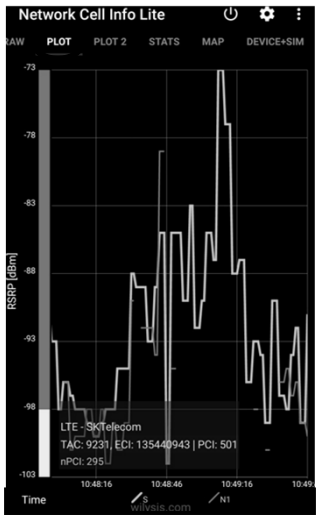
❖ Plot Tap



- Provides a visualized RSRP plot
  - Green line
    – RSRP of the serving cell
  - Blue line
    – RSRP of the neighboring cell 1

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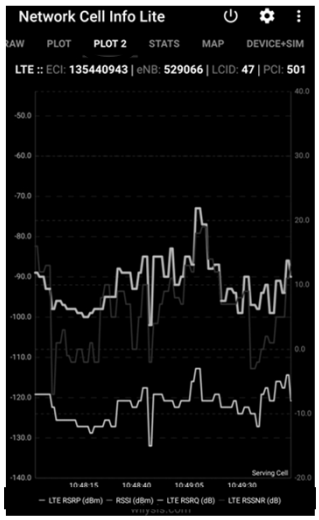
❖ Plot 2 Tap



- Provides visualized signal strength information of the Serving cell
  - Green line
    - RSRP of the Serving cell
  - Skyblue line
    - RSRQ of the Serving cell
  - Blue line
    - RSSNR of the Serving cell
- Units are in dBm and dB = dBW

dBW vs. dBm

◆ dBW

- **Power ratio in decibels (dB) in reference to 1 W**
- **Used in electrical, power, and energy systems**
- **dBW calculation: X = $10log_{10}\left(\frac{P}{1\,W}\right)$**

◆ dBm

- **Power ratio in dB in reference to 1 mW**
- **Used in radio, microwave, and fiber-optical signal measurements**
- **dBm calculation: Y = $10log_{10}\left(\frac{P}{1\,mW}\right)$**

dBW vs. dBm

◆ Important Units: dBW = dBm = W

- 30 dBW = 60 dBm = 1 kW = 1000 W
  - Microwave oven combined radiated RF power
- 3 dBW = 33 dBm = 2 W
  - GSM850/900, UMTS/3G (power class 1) mobile phone max. output
- -3 dBW = 27 dBm = 500 mW = 0.5 W
  - UMTS/3G (power class 2) mobile phone max. output
- -6 dBW = 24 dBm = 251 mW = 0.251 W
  - UMTS/3G (power class 3) mobile phone max. output
  - Wi-Fi (IEEE 802.11a, 20 MHz channels) 5 GHz subband 1 (5,180-5,320 MHz) EIRP
  - EIRP: Effective Radiated Power

dBW vs. dBm

◆ Important Units: dBW = dBm = W

- -10 dBW = 20 dBm = 100 mW = 0.1 W
  - Wi-Fi (IEEE 802.11b/g, 20 MHz channels) 2.4 GHz ISM band EIRP
  - Bluetooth Class 1 radio
- -15 dBW = 15 dBm = 32 mW
  - Laptop Wi-Fi typical power level
- -26 dBW = 4 dBm = 2.5 mW
  - Bluetooth Class 2 radio (10 m range)
- -30 dBW = 0 dBm = 1 mW
  - Bluetooth Class 3 radio (1 m range)
- -130 dBW = −100 dBm = 0.1 pW
  - Wi-Fi (IEEE 802.11 variants) minimal received signal power level

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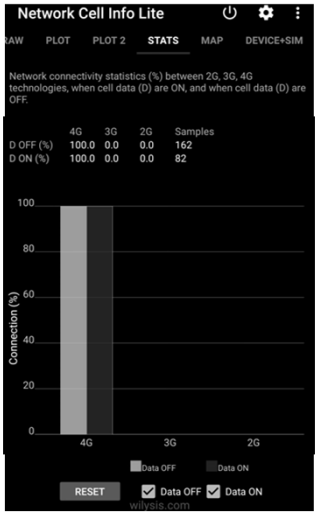
❖ Stats Tap



- Statistics of network connectivity

- Check your usage ratio (percentage) of mobile RAT (Radio Access Technology) usage
  - 2G, 3G, 4G (LTE), 5G

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❖ Similar Applications in App Store

- **OpenSignal - Speed Test & Maps** (iPhone)
  - Find free Wi-Fi connections
  - Wi-Fi & Cellular network speed test
  - Check data usage

OpenSignal - Speed Test & Maps

Available at the Apple App Store

https://itunes.apple.com/us/app/opensignal-speed-test-maps/id598298030?mt=8

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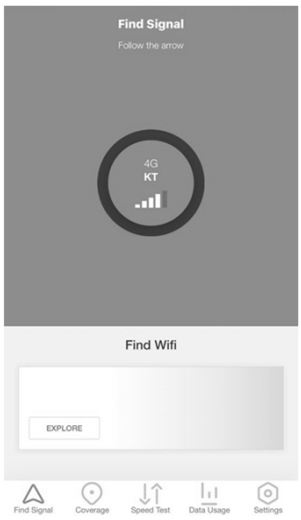
❖ Similar Applications in App Store

- **OpenSignal**



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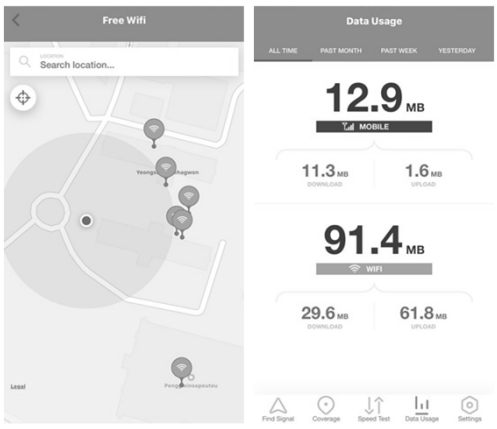
❖ Similar Applications in App Store

- **OpenSignal - Speed Test & Maps** (iPhone)
  - Find free Wi-Fi near your smartphone
  - Conduct speed tests and compare the performance of mobile communications to Wi-Fi



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❖ Similar Applications in App Store

- FieldTester (iPhone)
  - Evaluate the strength of your phone signal, and the quality of your data/WiFi network
  - Available for iOS 10

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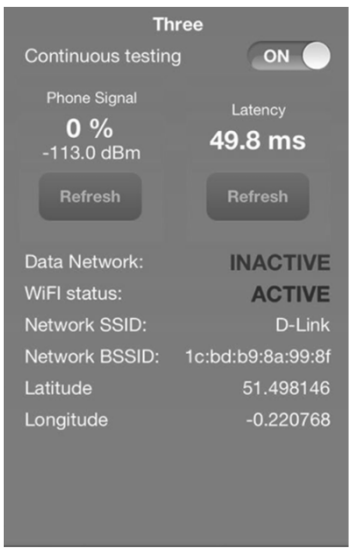
❖ Similar Applications in App Store

- FieldTester (iPhone)
  - Available for iOS 10



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❖ Similar Applications in App Store

- **Network Utility** (iPhone)
  - Provides information about your network
  - Wi-Fi and cellular network information

Network Utility
Available at the Apple App Store
https://itunes.apple.com/us/app/network-utility/id573021799?mt=8

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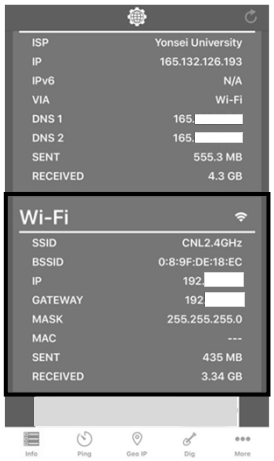
❖ Similar Applications in App Store

- **Network Utility** (iPhone)



Wi-Fi information
• IP, gateway, mask data usage

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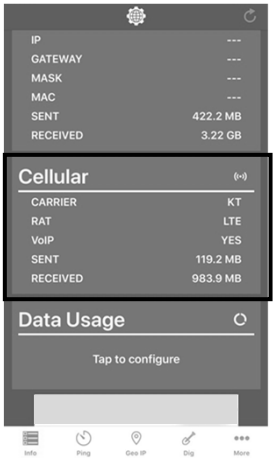
❖ Similar Applications in App Store

- **Network Utility** (iPhone)



Cellular network information
- Carrier, RAT type, data usage
- RAT: Radio Access Technology
  - 2G, 3G, 4G (LTE), 5G

Mobile Network Project

❖ iOS Field Test Mode

- You can check actual signal strength of the mobile network using Field Test Mode
  - Serving cell measurements
    - Measured RSSI
    - Average RSRP
    - Physical cell ID
- To exit Field Test Mode, tap the home button
  - Direct return to your iPhone's home screen

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❖ iOS Field Test Mode

- Step 1: Dial *3001#12345#* then press the Call button

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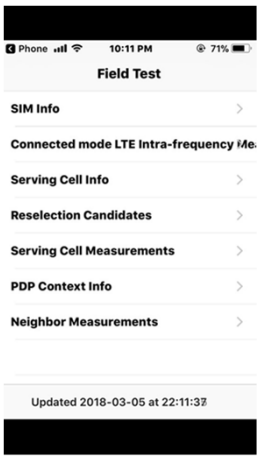
❖ iOS Field Test Mode

- Step 2: Now enter Field Test mode



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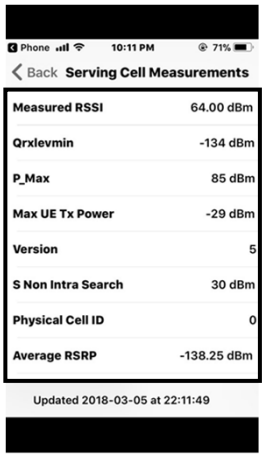
❖ iOS Field Test Mode

- Step 3: Check Serving Cell Measurements



You can find the signal strength of the serving cell (RSSI, RSRP), and the PCI (Physical cell ID)

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References

References

- "AIDA64," FinalWire Ltd, [Online] Available from: https://play.google.com/store/apps/details?id=com.finalwire.aida64&hl=ko
- "AIDA64," FinalWire Ltd, [Online] Available from: https://itunes.apple.com/kr/app/aida64/id979579523?mt=8
- "Network cell info lite," Wilysis, [Online] Available from: https://play.google.com/store/apps/details?id=com.wilysis.cellinfolite&hl=ko
- "RSRP and RSRQ measurement in LTE," laroccasolutions, [Online] Available from: https://www.laroccasolutions.com/78-rsrp-and-rsrq-measurement-in-lte
- "Use This Clever Trick To See Your iPhone's True Signal Strength," laroccasolutions, [Online] Available from: http://www.businessinsider.com/how-to-see-your-iphones-true-cell-signal-strength-2014-11