

# WISP RF Engineering Services



**COURSE  
CERTIFICATE**

## CBRS SAS

09/27/2019

**4G Unwired**

has successfully completed

**CBRS Professional Training**

an online non-credit course authorized by Google - Spectrum Sharing and offered through Coursera



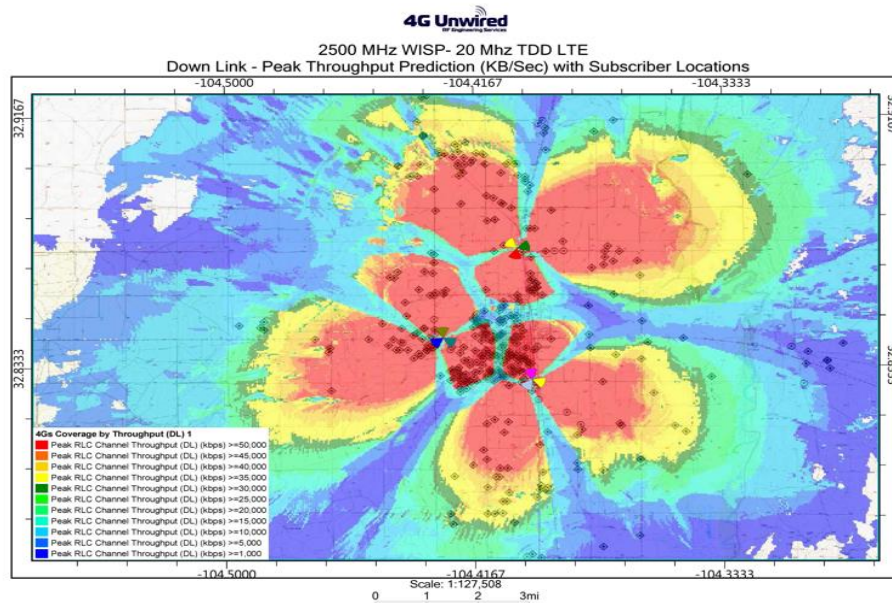
Verify at [coursera.org/verify/GWJG2WDNNGCZ](https://coursera.org/verify/GWJG2WDNNGCZ)  
Coursera has confirmed the identity of this individual and their participation in the course.

# Engineering Overview – CBRS SAS Certified

4G Unwired is an independent RF Engineering consulting firm that provides both Fixed Wireless and Mobile System Design in the US, Caribbean and Asia-Pacific regions.

Wireless carriers engage 4G Unwired to design, upgrade and improve the performance and profitability of their 5G/4G & 3G Small Cell and ODAS wireless networks.

Founded in 2005, 4G Unwired is an active member of the Competitive Carrier Association and is a Veteran Owned Small Business.

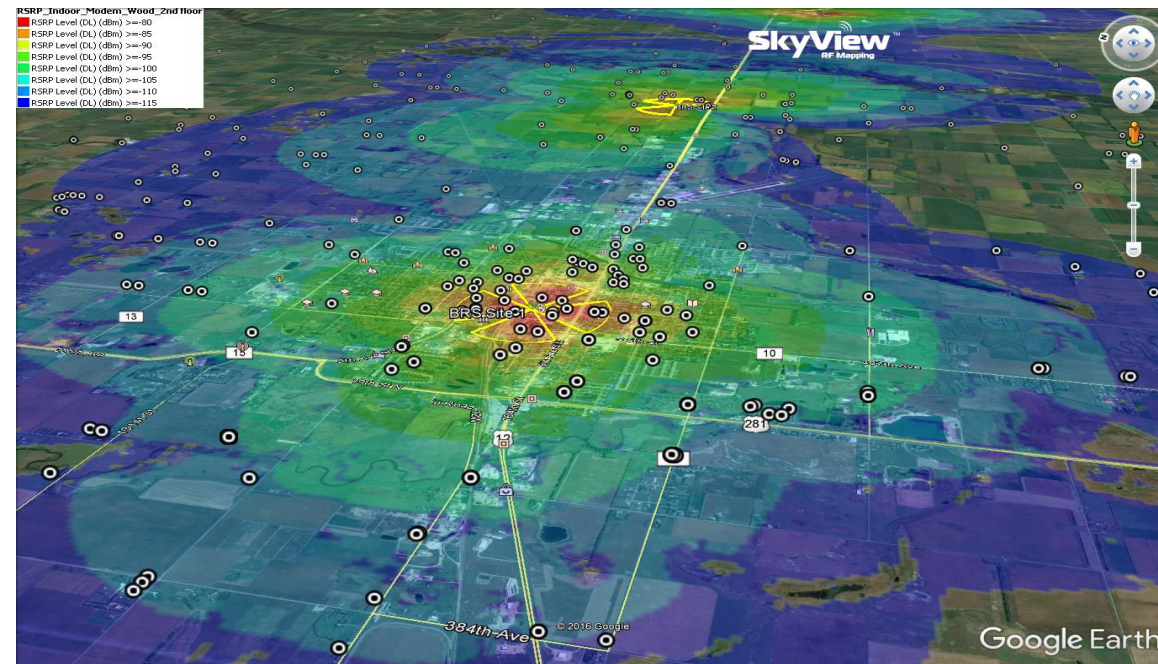




# Wireless Internet Services (WISP)

4G Unwired provides complete Fixed Wireless LTE RF design services. We can assist your team with spectrum management, network design, frequency planning, PCI planning, PRACH cell ranging, and optimization to ensure minimum interference and maximum throughputs for your customers. Shown below – LTE RSRP coverage over actual client subscribers locations.

*LTE RSRP Coverage Analysis*

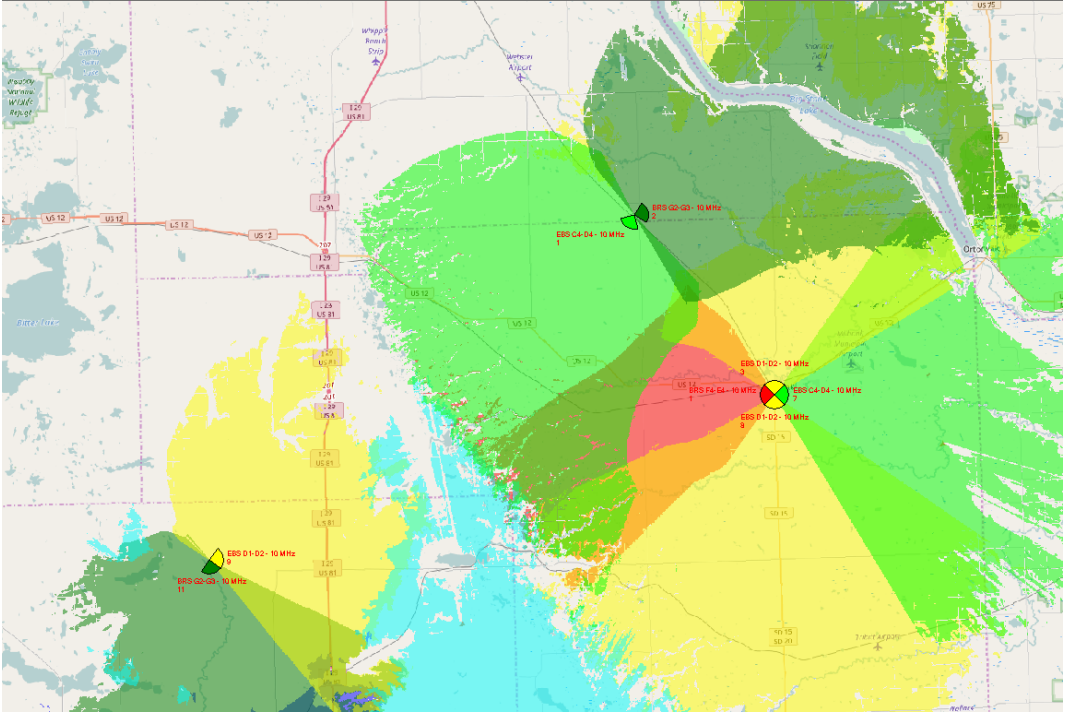


# Support Your Market Transition Plans

4G Unwired engineers are propagation planning experts and are familiar with the challenges facing Wireless Internet Service Providers. We can:

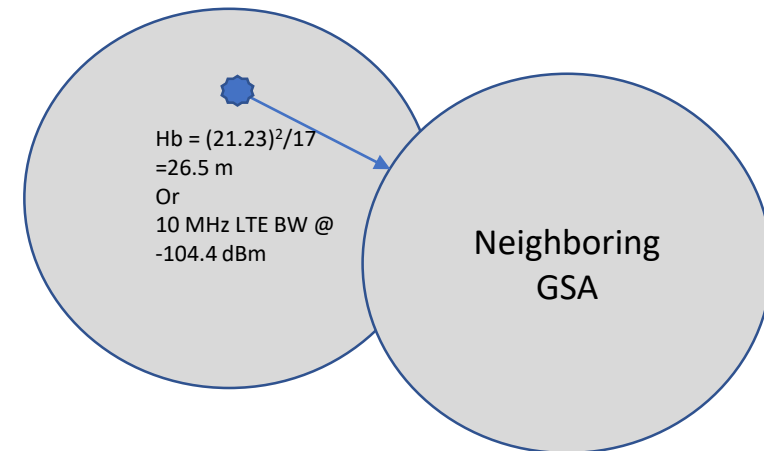
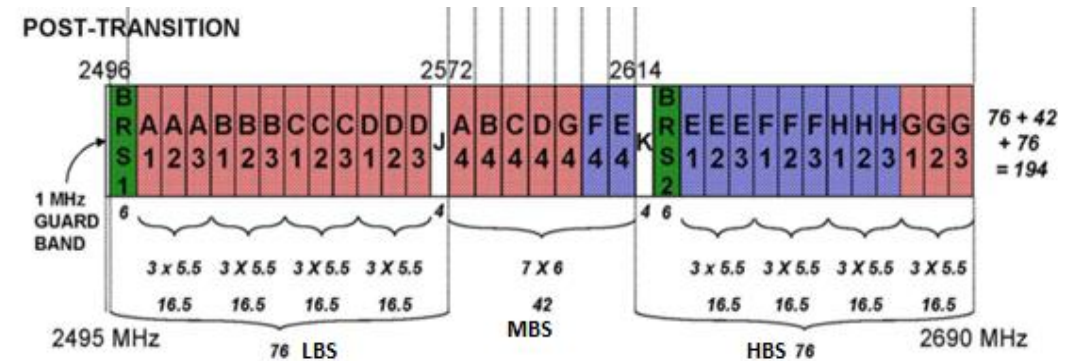
- Plan a transition from older technologies to LTE

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# Need Help with BRS – EBS Spectrum?

- 4G Unwired RF Engineers can assist you with FCC Part 90 BRS-EBS 2.5 GHz Band LTE Design
- 4G Unwired provides complete EBS – BRS FCC Engineering services:
  - FCC GSA Boundary Height Benchmarking Requirements
  - We provide FCC required power spectral density requirements
- 4G Unwired uses the Atoll propagation platform and GIS tools to ensure Quality of Service and FCC compliance



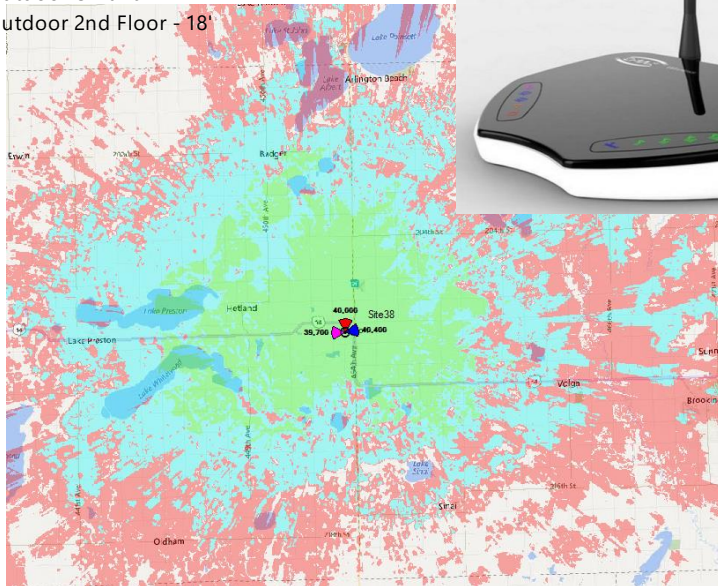


# Predictions based upon CPE Router Type

4G Unwired prepares a link budget to model each type of Router to ensure that Data Rates and Quality of Service are met as predicted in Atoll

## Coverage by Throughput (DL) 2

- Indoor Modem
- Outdoor Unit 10'
- Outdoor 2nd Floor - 18'

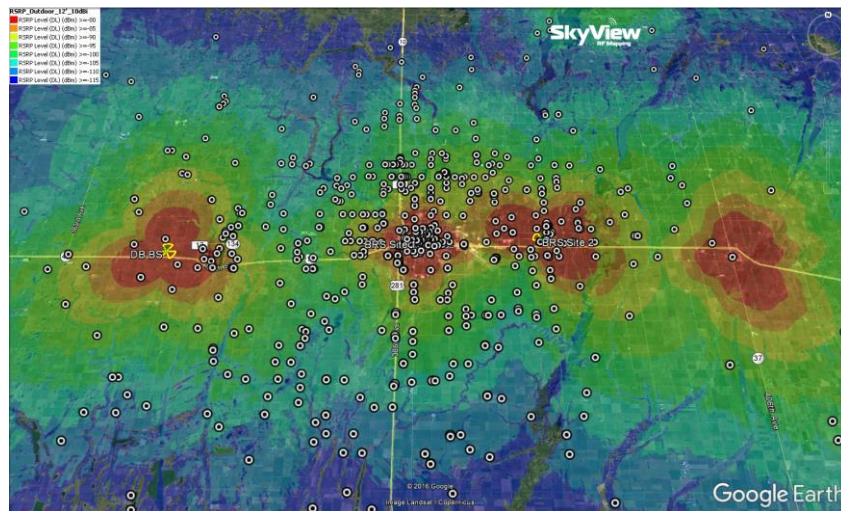


Standard Compliant	IEEE 802.16e-2005
Air Interface	Scalable OFDMA
Duplex Mode	TDD/5ms frame
Frequency Band	2.3-2.4GHz, 2.5-2.7GHz, 3.4-3.6GHz
Channel Bandwidth	5, 7, 8.75, 10MHz
Modulation	QPSK, 16QAM, 64QAM
MIMO	Matrix A (STC) & Matrix B
Beamforming	10 Beamforming
Transmitting Power	24+/-1dBm@16QAM, 3/4CTC
Receiving Sensitivity	-94dBm @ QPSK, 1/4 CTC
ND&S	Support
Antenna Type	Dual polarization internal patch antenna
Antenna Gain	12dBi for 2.3/2.5GHz 15dBi for 3.5GHz
Encryption	128 bit AES/CCM
Authentication	EAP-TLS (with optional X.509) EAP-TTLS-MSCHAPV2
QoS Mechanism	UGS, RT-VR, NRT-VR, ERT-VR, BE
Hand Over	Hard HO / Optimized Hard HO

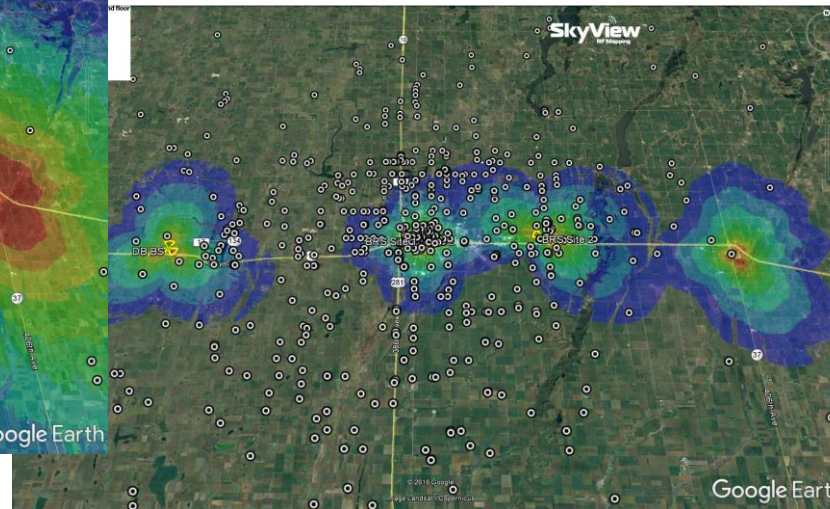


# Propagation Prediction Analysis

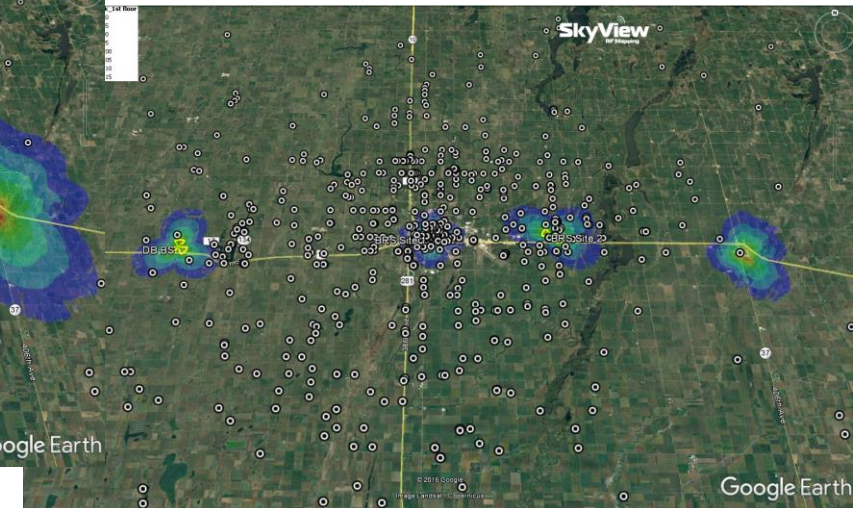
4G Unwired can model several types of LTE predictions, dependent on outdoor vs indoor CPE heights, equipment specifications and building types (wood, brick or reinforced concrete). 4G Unwired can adjust the propagation models for greater accuracy with client data, extremely useful for additional system expansion.



Outdoor CPE Coverage with unit at 12 ft.



Service for Indoor Modem on 2<sup>nd</sup> Floor of Light Structures

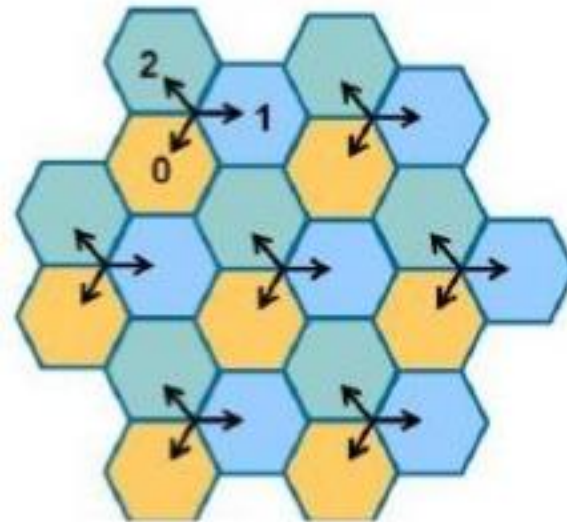


Indoor Modem RSRP on 1st Floor Brick or Concrete Structures



# 4G Unwired Provides LTE PCI Planning for Improved Network Performance

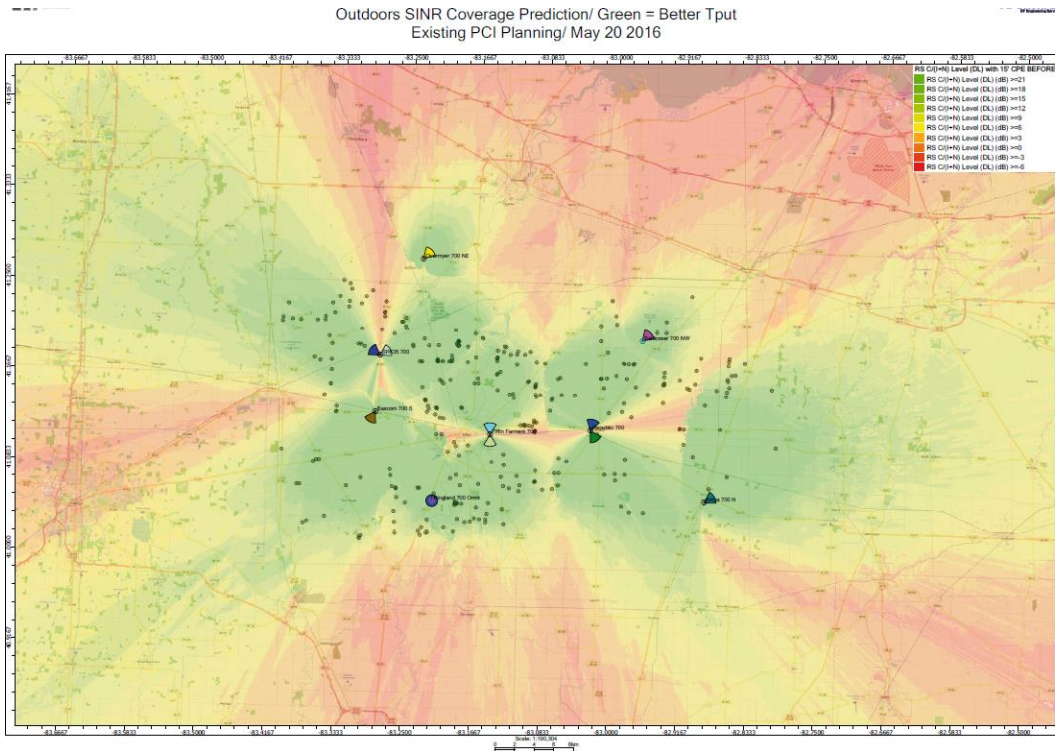
In LTE networks, **Physical Cell Identity** allocation (PCI) is crucial for both subscriber Quality of Service (QoS) and data throughputs. Correct PCI planning is an essential parameter in your network and is affected each time you add a new location. 4G Unwired engineers can provide fast and cost effective PCI plans once we have your network modeled in our propagation software.



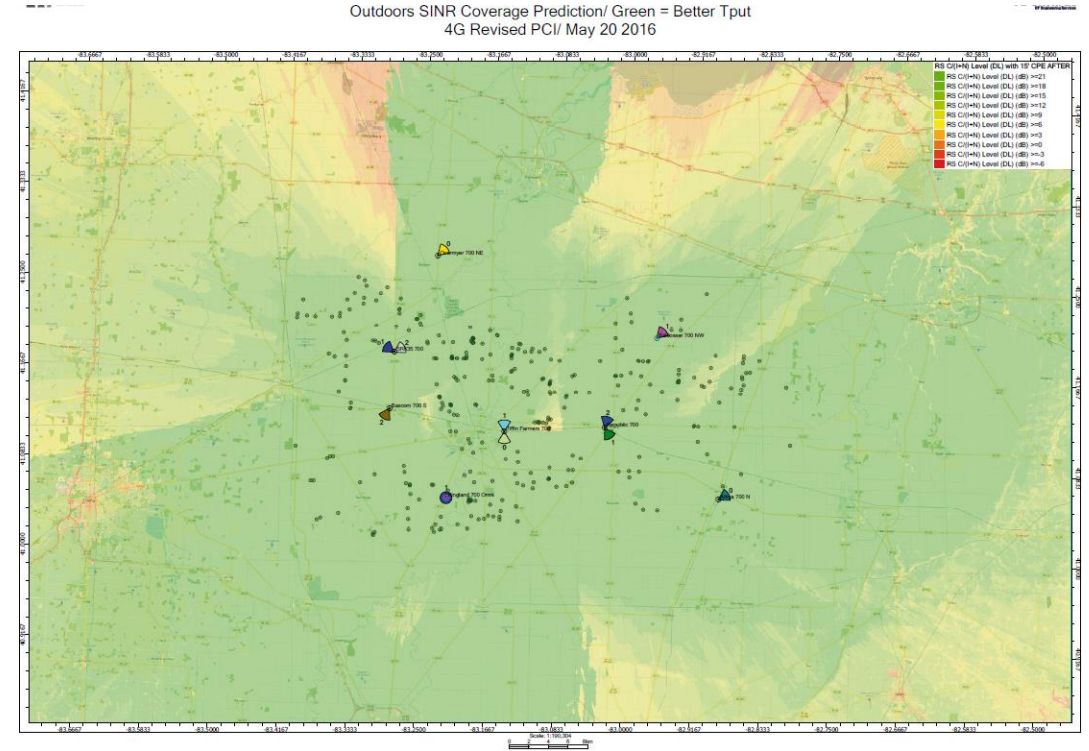


# Real Life Example

Shown below is WISP that had interference and throughput issues with their existing network. 4G provided a corrected PCI plan and significantly improved the network throughputs and coverage. **Red is bad** – **Green is Good!**



Given PCI Planning by Client  
Red shows interference and lower  
throughput

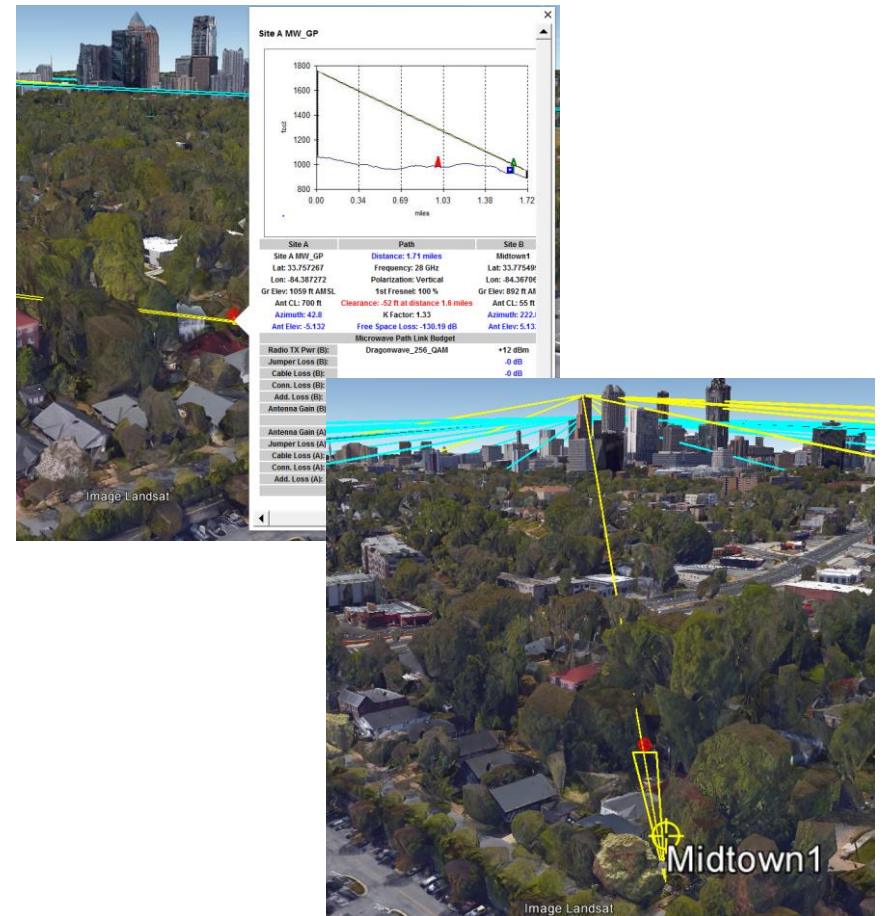
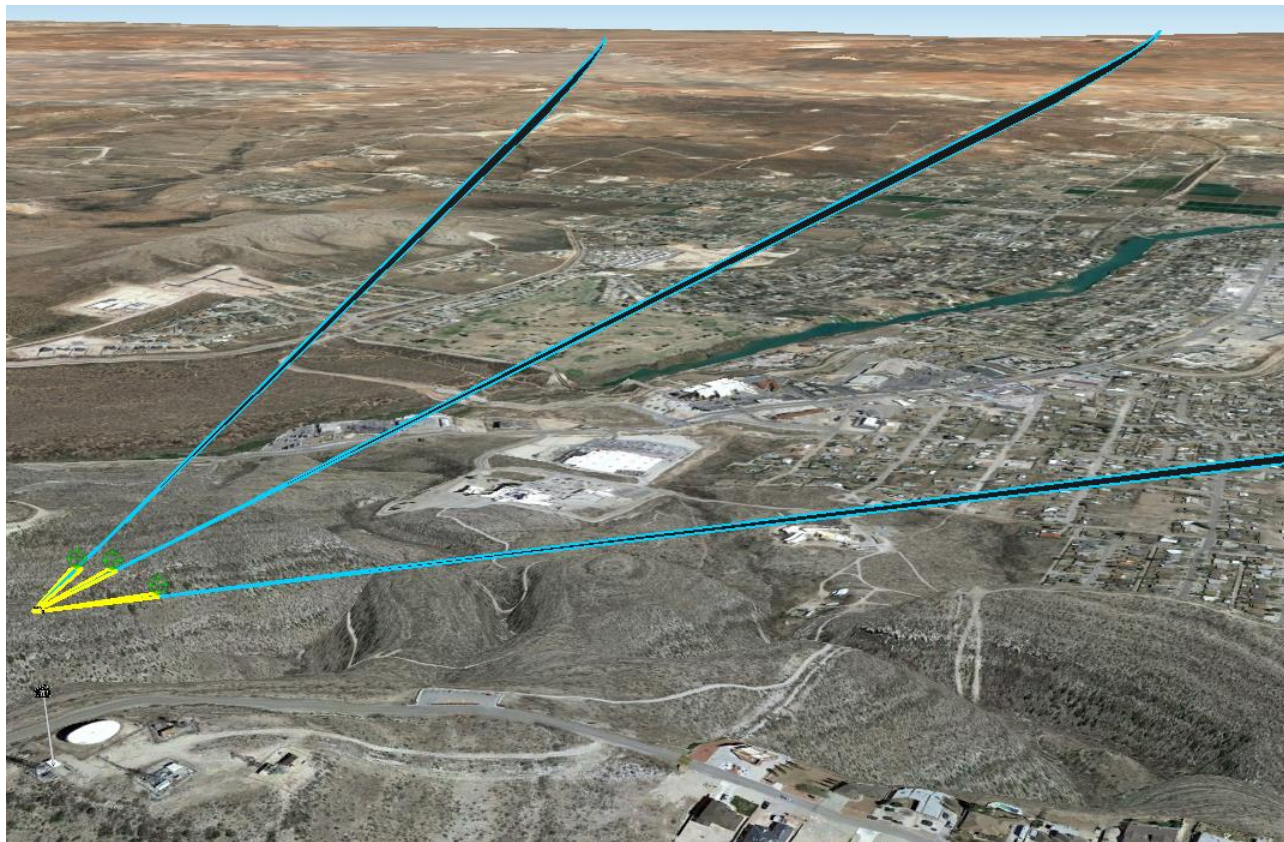


4G Revised PCI Planning  
Green shows improved data rate  
throughput



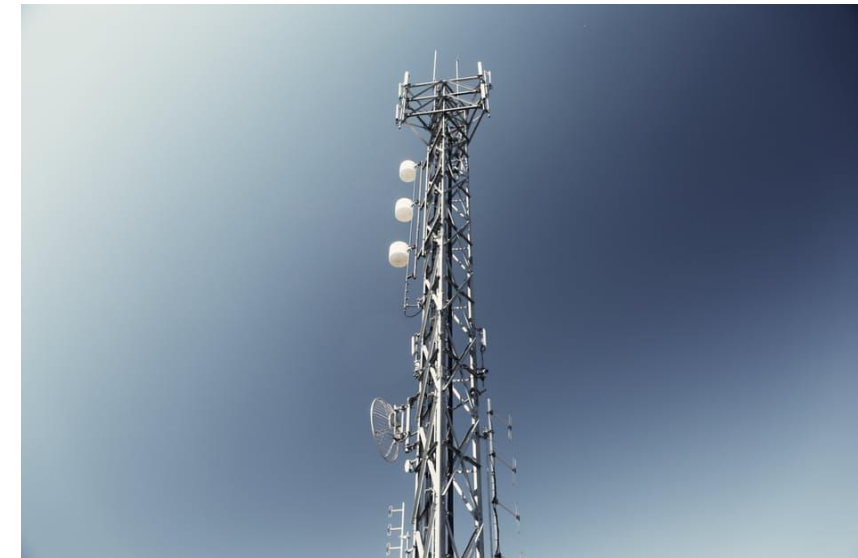
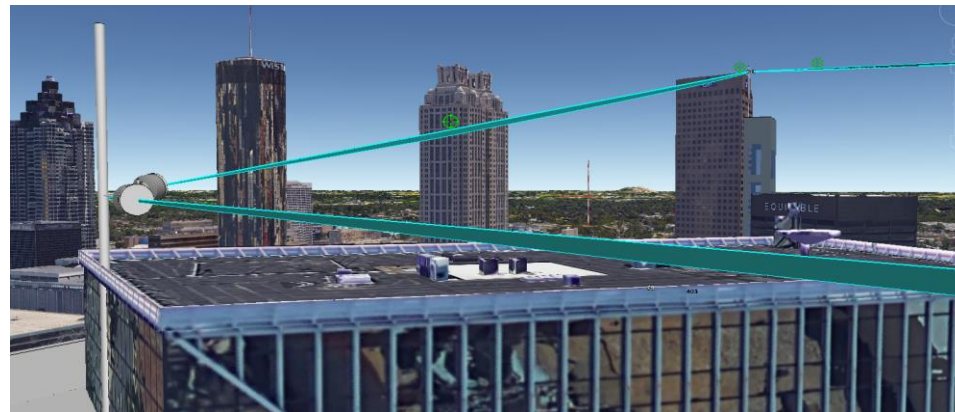
# Microwave Engineering Services

4G Unwired provides complete Microwave Network Engineering Services. We can also assist with equipment selection, reliability studies, path planning and design specifications with both Licensed or Unlicensed Radio equipment – all shown in Google Earth.



# Partnering with 4G Unwired

- 4G Unwired has the RF knowledge, tools and experience to assist your team
- Extensive LTE, CBRS, UMTS Design and Optimization Experience
- Experience with all major Vendor RAN systems
- Full Turnkey construction and Integration Services through our Partner Network





# *Your Vision. Our Design. Your Network. How can we help?*

**Scott Robinson**  
**President**  
**4G Unwired, Inc.**  
**1751 Sarno Rd, Suite 1**  
**Melbourne, FL 32935**  
**Phone: (321) 726-4183**  
**[www.4GUnwired.com](http://www.4GUnwired.com)**  
**[Scott.Robinson@4GUnwired.com](mailto:Scott.Robinson@4GUnwired.com)**



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