LTE Walk Test Measurements

Using Consultix WTX-610 ILLuminator & Test Phones

Ultimate wireless coverage indoors is becoming a fundamental requirement of inbuilding infrastructure whether it's WiFi, cellular, or Public safety networks.

In order to deploy a network effectively and economically achieving its QoS KPIs, network designers need to be equipped with tools that ensure high confidence level in their designs. This is most pronounced in 4G networks as the expected throughput and capacity requirements tend to be much higher.

CW Measurements and Walk-testing are key parts of site survey during the design phase to show the effect of construction materials and reveal complex propagation mechanisms. In many cases it's the preferable method to overcome uncertainties of prediction/planning tools and it also serves as the ultimate test during commissioning (commonly called DAS injection).

This application note explains how a typical walk-test is conducted in LTE using test phones together with an accurate and controlled test transmitter that's capable of LTE signal generation. The test transmitter used in this application note is Consultix multi-mode test transmitter "WTX-610 Illuminator".

This document is divided into the following sections:

- A brief about the setup: The WTX-610 ILLuminator and Drive Test/Walk Test phones
- A brief about Walk Testing & Propagation Measurements
- How to configure WTX-610 ILLuminator to generate an LTE signal
- How to configure a test phone with the ILLuminator to conduct a complete Modulated Walk Test

Introduction

Radio propagation in indoor environment differs greatly from the outdoor one, not just because of wall losses but due to many other factors; density of the subscribers, mobility of users in addition to the close proximity of reflecting structures (walls, floors …etc.) which introduce a different fading profile; all are resulting in a totally different RF behavior that varies greatly even from one place to another within the same building (if not within the same room).

Accurate base station site planning and optimization are big arms in fulfilling the network KPIs yet Radio design and simulation tools can't take _all_ real environment parameters and factors into consideration and that's where CW measurements & modulated Walk Test results come into play to help operators make sure to achieve their KPIs.

About WTX-610 ILLuminator

Consultix WTX-610 iLLuminator is the gold standard for test transmitters. Using modulated signals for testing is vital to ensure dominance, avoid pilot pollution and validate the carrier configuration prior to deployment.

Wideband operation up to 6 GHz allows the iLLuminator to address the network's future needs even for unlicensed bands for LTE-U and LAA or the CBRS Band. These features combined with the ultra-portable handheld form factor and innovative touch interface for maximum ease of use make the WTX-610 iLLuminator the ideal choice for inbuilding and small cell professionals everywhere.

The built-in wideband power amplifier extends the iLLuminator's capabilities to high power missions, whether for oDAS test and design or for performing outdoor CW model calibration.

WTX-610 ILLuminator is capable of generating a standard LTE carrier with the LTE 3GPP layers which makes it detectable on standard LTE Receivers, test phones as well as commercial LTE handsets allowing it to be a realistic transmitter for LTE Walk-testing, Model Tuning, coverage and interference studies.

Result Summary			LTE-FDD BTS		11/10/17	17:10
	Center:	2.6 GHz	Ref Level:	10.0 dBm	Sweep:	Cont
	Channel:	---	Ref Offset:	0.0 dB	Cell [Grp/ID]	Auto
	Band:	---	Att:	20.0 dB	Cyclic Prefix:	Auto
	Transd:	---	Preamp:	Off	Antenna:	SISO / Tx1
	Ch BW:	5 MHz (25 RB)			Subframes:	10

Global Results			SYNC OK	
RF Channel Power:	11.16 dBm	Cell Identity [Grp/ID]:	503 [167/2]	
Overall EVM:	8.25 %	Cyclic Prefix:	Normal	
Carrier Freq Error:	1.8367 kHz	Traffic Activity:	58.28 %	
Sync Signal Power:	-10.87 dBm			
OSTP:	11.23 dBm	IQ Offset:	-64.18 dB	

Allocation Summary					
	Power:	EVM:		Power:	EVM:
Ref Signal:	-11.11 dBm	6.47 %	PSYNC:	-10.81 dBm	9.28 %
QPSK:	-11.12 dBm	7.98 %	SSYNC:	-10.92 dBm	7.32 %
16 QAM:	--- dBm	--- %	PBCH:	-10.74 dBm	3.62 %
64 QAM:	--- dBm	--- %	PCFICH:	-11.36 dBm	32.00 %

| Save | Recall | Recall Screenshot | | | File Manager |

Figure 1, Consultix WTX-610 ILLuminator LTE Signal Analysis

Drive Test / Walk Test Phones

Operators need reliable information about network coverage and performance, this information is obtained through conducting Walk Tests to identify potential areas that need optimization using scanning receivers and test phones.

A Test Phone is a multi-functional smartphone set to measure the performance and quality parameters of wireless networks for optimization, benchmarking and troubleshooting purposes to evaluate and reflect the real subscriber experience QoS/QoE within a wireless network.

Walk Test Phones now include indoor measurement capabilities as depicted in (Figure 2) . For example, RF Engineers can use test phones to conduct a brief walk test campaign of installed inbuilding networks or to collect baseline measurements. The collected data can be used for design, optimization, benchmarking and troubleshooting purposes.
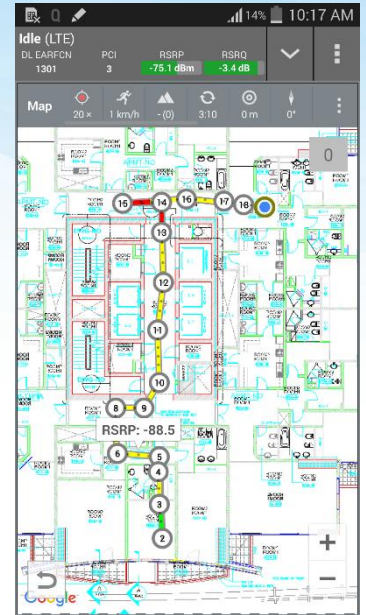
Figure 2, Walk Test Phone – Indoor Measurements

Walk Testing & Propagation Measurements

A test transmitter combined with a relevant receiver or scanner can be used to conduct a Walk Test. The test transmitter can be either a CW (Continuous Wave) transmitter or a modulated transmitter as follows:

A CW (Un-modulated) transmitter can be used as a signal generator to transmit a CW signal at a carrier frequency provided by the operator, the signal is to be received by an RF receiver or a scanner to measure the received CW signal level at different locations. This is in order to give a real picture of the actual path loss that impacts the signal propagation and to guarantee meeting the coverage KPIs during RF Model Calibration on design tools or during commissioning (DAS Injection).

However, in order to conduct optimum prediction, technology specific information about the signal is required (RSRP & RSRQ for example in LTE). This information is critically needed to predict the performance of the planned in-building network in terms of coverage, interference and data rate. In such case, a modulated test transmitter is needed, such as the Consultix WTX-610 iLLuminator.
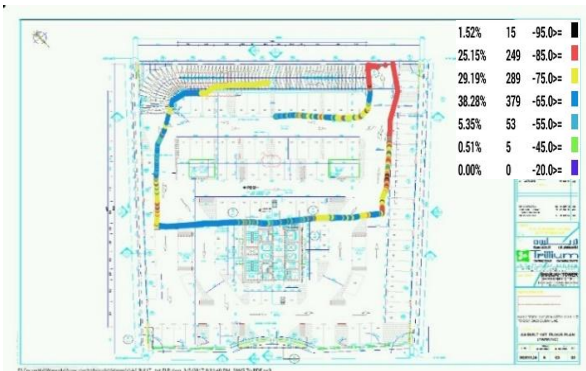
Figure 3, CW Walk Test

Figure 4, Modulated Walk Test
Done by WTX-610 ILLuminator @ EARFCN=1301 & PCI = 3

Procedures

This section contains steps for configuring WTX-610 ILLuminator to generate LTE signal as depicted in (Figure 5),

- In the "**Freq**." Textbox, type in the desired signal frequency = 1815.1 MHz

  (equivalent to 1301 EARFCN)

- In the "**Amp**." Textbox, type in the desired signal level = 0 dBm

- Set the operation mode to "**LTE**"

- In the "**Cell ID**" Textbox, type in Cell ID = 3

  (Cell ID ranges from 0 to 503)

- Set the Tx Port to be "**Low**" to select the low power port

- Press the "**RF** " button to start Transmission .
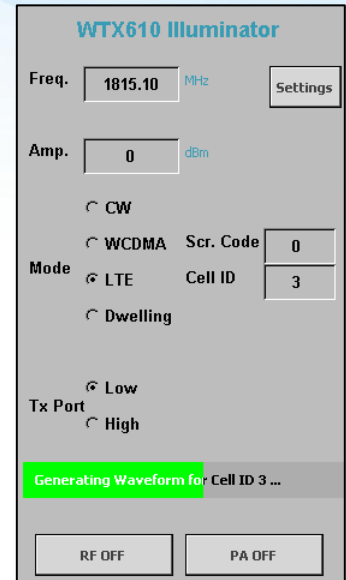

Figure 3, Illuminator Configurations

For a test phone, the following general configurations are required to conduct a complete Modulated Walk Test,

- Launch the application on your test phone

- Go to "**Settings**" and use "**Forcing**" feature as follows,

  - Required measurement technology to be "**LTE"** in our case

  - Required downlink measurement frequency "**EARFCN**"

  - Required measurement Cell ID "**PCI"**

- Go to "**LTE DL"** window and select the same **"DL EARFCN"** and **"PCI"** that you set in the iLLuminator.

- Now you can view the measured parameters of the iLLuminator's LTE signal such as RSSI, RSRP, RSRQ,....etc.

- Go to **"Map",** load your floor plan of measurement area and start Walk Testing as depicted in (Figure 6) below,
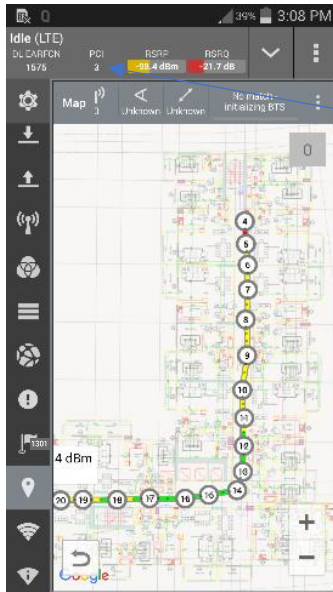
DL EARFCN = 1301

Cell ID = 3

Figure 4, Setting Test Phone to capture iLLuminator LTE Signal

WTX-610 iLLuminator Specifications

RF Characteristics	
RF Ports	Port 1 (Standard), Port 2 (Optional)
Frequency Band	200 MHz to 6 GHz
Internal Frequency Accuracy	1 ppm
Frequency Step	1 KHz
Output Power Level Steps	1 dB
Modulations	Continuous Wave (CW), LTE-FDD (optional), LTE-TDD (optional) and WCDMA (optional)
LTE Settings	Cell ID (Synchronization Reference Signal), and Bandwidth
LTE BW	5 MHz (10 MHz Optional)
WCDMA Settings	Scrambling Code
Port 1 Output Power (CW)	200 MHz to 4800 MHz: -10 dBm to 15 dBm 4.8 GHz to 6 GHz: -10 dBm to 10 dBm
Port 1 Output Power (Modulated)	400 MHz to 2700 MHz: -10 dBm to 15 dBm
Port 1 Level Accuracy	+/- 2 dB (Typ. 1 dB)
Port 1 RF Interface	50 Ohm SMA Female
Port 2 Frequency Range	350 to 2700 MHz
Port 2 Output Power (Optional Built-In Output Amplifier)	350 MHz to 2700 MHz: 40 dBm (10 Watt CW)
Port 2 Level Accuracy	+/- 2 dB (Typ. 1 dB)
Port 2 RF Interface	50 Ohm Type-N
Dwelling Mode (Optional)	Up to 8 Frequencies @ 0.25 ms hopping speed
Power Supply	
Input Power	24 VDC / 12 VDC (Without Amplifier)
Included AC/DC Adapter	110/220V AC, 50/60 Hz.
Physical Characteristics	
External Dimensions	L 220x W100 x H 62 mm
Weight	< 2 Kgm (5 lbs.) with Amplifier
Operating Temperature	-10 to +40 C
Interfaces	1 x Type-N Female, 1 x SMA Female, 1 x USB, and 1 DC Jack
Standard Package	Handheld CW Transmitter, AC/DC Adapter, Tri-band Antenna, Soft case and User Manual.

Table 1, WTX-610 iLLuminator Specifications