Agilent E7515A UXM Wireless Test Set

User's Guide

Agilent Technologies

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This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Manual Part Number

E7515-90001

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A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Electrical Rating

Input Voltage Range: 100/120/220/240 V_{AC}

Input Frequency Range: 50/60Hz, nominal

Input Power Rating: 1100 Watts Max

Mains supply voltage fluctuates up to +/- 10% of the nominal voltage.

WARNING	This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

WARNING	No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

WARNING	This instrument is heavy. Two people are required to lift this instrument.

WARNING	Please consult ergonomic guidelines regarding placement of the external keyboard when using it with the instrument. Using the keyboard in an uncomfortable or awkward environment could result in personal injury.

CAUTION	Before switching on this instrument, make sure: - the correct rating service breaker. - the supply voltage is in the specified range.

CAUTION	This instrument has auto-ranging line voltage input. Be sure the supply voltage is within the specified range and voltage fluctuations do not to exceed 10 percent of the nominal supply voltage..

CAUTION	The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION	This product is designed for use in Installation Category II and Pollution Degree 2 environment.

NOTE	Use Agilent supplied power cord or one with same or better electrical rating.

Electrical Safety Compliance

SAFETY

Complies with European Low Voltage Directive 20006/95/EC

- IEC/EN 61010-1, 3rd Edition
- Canada: CAN/CSA C22.2 No. 61010-1-12
- USA: UL std no. 61010-1, 3rd Edition

Acoustic statement (European Machinery Directive 2002/42/EC, 1.7.4.2u)

Acoustic noise emission	Geraeuschemission
LpA <70 dB	LpA <70 dB
Operator position	Am Arbeitsplatz
Normal operation mode	Normaler Betrieb
Per ISO 7779	Nach DIN 45635 t.19

EMI and EMC Compliance

EMC

Complies with European EMC Directive 2004/108EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AX/NZS CISPR 11
- ICES/NMB-001

  This ISM device complies with Canadian ICES-001
  Cet appareil ISM est conforme a la norme NMB-001 du Canada.

- South Korean Class A EMC declaration: This equipment is Class Asuitable for professional use and is for use in electromagnetic environments outside of the home.

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Where to Find the Latest Information

Agilent will periodically update product documentation. For the latest information about this wireless test set, including software upgrades, operating and application information, and product and accessory information, see the following URL: www.agilent.com/find/UXM

Is your product software up-to-date?

Agilent will periodically release software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Agilent Technical Support website at

www.agilent.com/find/softwaremanager

Table of Contents

1 Introduction

Welcome to the ***User's Guide*** for the Agilent E7515A UXM Wireless Test Set (UXM). The purpose of this guide is to provide you the knowledge you need to operate your new test set and where you can go to get additional help information. It also provides basic steps to set-up and test end-to-end throughput measurements and carrier aggregation.

Agilent E7515A UXM Overview

The UXM is a highly-integrated signaling test set created for functional and RF design validation in the 4G era and beyond. It provides the integrated capabilities you need to test the newest designs, delivering LTE-Advanced category 6 now and handling more complex requirements later.

Figure 1-1 Agilent E7515A UXM Wireless Test Set

General Capabilities of the Agilent E7515A UXM

- Stable, bidirectional data throughput at 300 Mbps downlink (DL) / 50 Mbps uplink (UL)
- Category 4/6 support with two independent 100 MHz RF transceivers enabling multiple cells, carrier aggregation, up to 4x2 MIMO, and integrated fading
- Receiver test capabilities including flexible channel definitions and closed-loop testing, and trusted X-Series measurement applications for transmitter testing
- Frequency Division Duplex (FDD) and Time Division Duplex (TDD) options

UXM Software Application License Options

Agilent E7530A LTE/LTE-A Test Application (TA) Software License

This software application license enables the test application version of the LTE/LTE-Advanced software. The TA was created to meet the needs of RF design validation, and includes RF measurement capability and basic base station emulation functionality. Options are available to enable FDD, TDD, 2 carrier downlink carrier aggregation and 4x2 downlink MIMO. You must purchase either the E7530A TA or the E7630A LA license described below.

Agilent E7630A LTE/LTE-A Lab Application (LA) Software License

This software application license enables the lab application version of the LTE/LTE-Advanced software. The LA is targeted at overall device design validation, and includes the RF measurement capability of the E7530A TA, plus IP data-based functionality such as end-to-end IP data throughput, advanced network emulation and functional test capabilities. Options are available to enable FDD and TDD, and each LA version license adds new capabilities, building on the previous version. You must purchase either the E7630A LA or the E7530A TA described above.

Latest documentation

For the latest documentation and software updates for the above products, please go to www.agilent.com/find/uxm.

About the E7530A/E7630A LTE/LTE-A Test/Lab Application

Agilent E7530A/E7630A LTE/LTE-A Test/Lab Application (TA/LA) enables LTE and LTE-Advanced user equipment design validation.

The application runs on an embedded Windows controller present in the UXM. It uses the provided touch-screen based interface, integrated fading, network emulation and measurement capabilities present in the test set to provide you with a simple to use, bench-top design verification tool.

The software application provides two different operation modes:

- Signaling based mode: In this operation mode, the TA/LA is capable of emulating a single cell LTE and LTE-Advanced network (or dual cell network if you purchased the E7515A-RB1/BB1 as well as the -RA1/BA1). This operation mode enables you to recreate test environments similar to the real-life conditions the UE will encounter during its operation on an actual network including fading and MIMO variations.
  In the signaling operation mode, you are also capable of configuring several communication parameters, ranging from the different modulation and coding schemes, to the size of the bandwidth allocations for both UL and DL, as well as other additional parameters.
  If you have purchased the option -AFP for your TA or FDD version A.02 of the LA , then, you can also configure the DL Carrier Components (CC) and other related Carrier Aggregation requirements. For more information on Carrier Aggregation, visit the 3GPP website's description.
- Non-signaling based mode: In this operation mode, you can configure the test set to generate a compliant broadcast signal, and start the transmission of PDCCH channel with allocations for the UE, without the need to complete an ATTACH procedure with the UXM.

2 Using this Document

UXM Display nomenclature

When referencing selections in the graphical user interface of the UXM display, the text is always in bold font. When referencing a string of optional selections, each selection is separated by a comma. For example, to turn the Cell On, it would be written as: "Select **Connect**, **Cell ON**.".

3 UXM TA/LA Display

The TA/LA software is an embedded application designed to control the UXM touch-screen user interface. The following figures show the different application areas highlighted:

Parameter Configuration Display

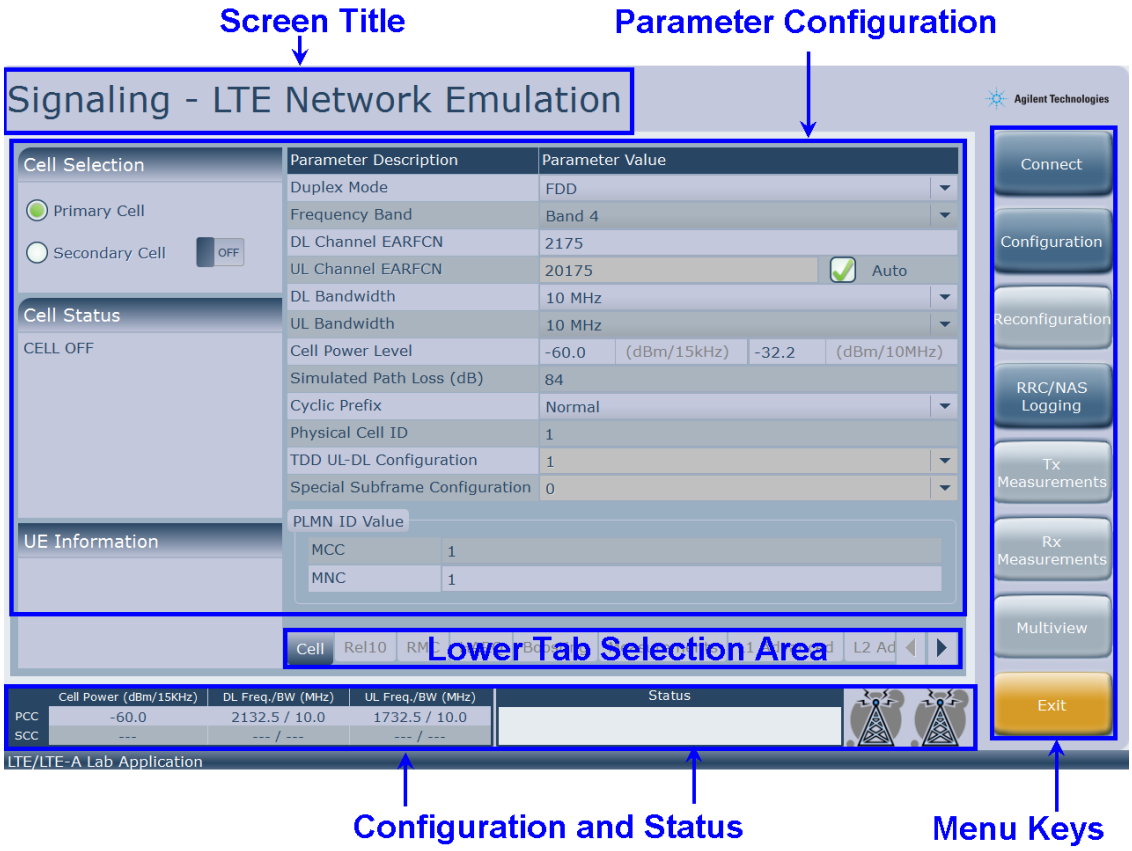


Figure 3-1: Parameter Configuration View

Screen Title: This area indicates the purpose of the screen displayed.

Parameter Configuration: This area enables you to configure the different parameters available to you depending upon the other selections made using the lower tab area or the menu key area.

Menu keys: This is a variable area that enables you to navigate through the different configuration and measurement screens in the TA/LA software.

Configuration and Status: This summary area provides information about the following (areas from left to right):

- Cell Power, UL and DL EARFCN and BW
- Equipment status
- Communication status

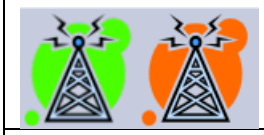
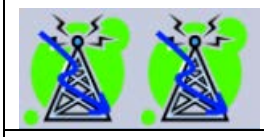
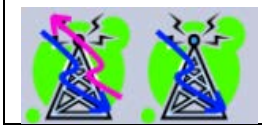
Tower Icon	Tower State
	Cell OFF
	PCC active, SCC inactive
	PCC/SCC active, no DL/UL allocations
	PCC/SCC active, DL allocations only
	PCC/SCC active, UL allocations only
	PCC/SCC active, both UL/DL allocations

Figure 3-2: Tower Icon Communication Status

Transmitter Measurements Display

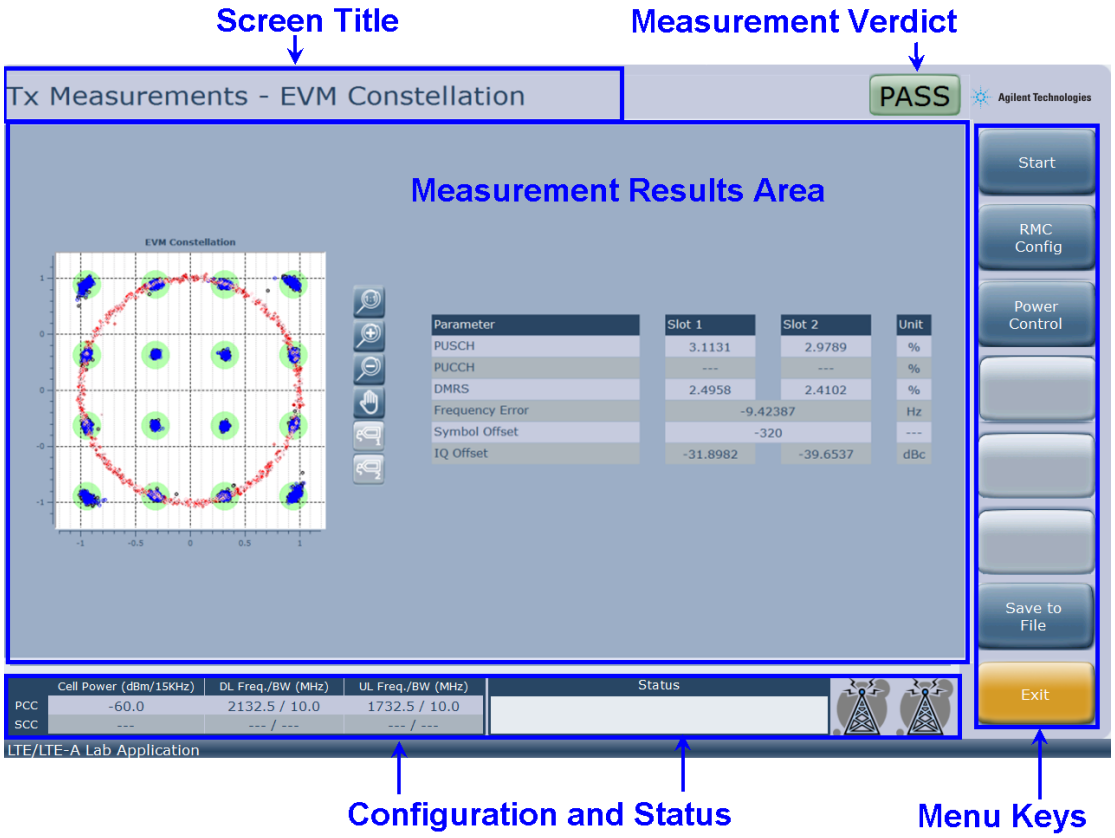


Figure 3-3: Transmitter Measurements View

Screen Title: This area indicates the purpose of the screen displayed.

Measurement Verdict: This indicates the current measurement verdict when checked against the current measurement limits.

Measurement Results Area: This is where the measurement results are displayed.

Menu keys: This is a variable area that enables you to navigate through the different configuration and measurement screens in the TA/LA software.

Configuration and Status: This summary area provides information about the following (areas from left to right):

- Cell Power, UL and DL EARFCN and BW
- Equipment status
- Communication status

Receiver Measurements Display

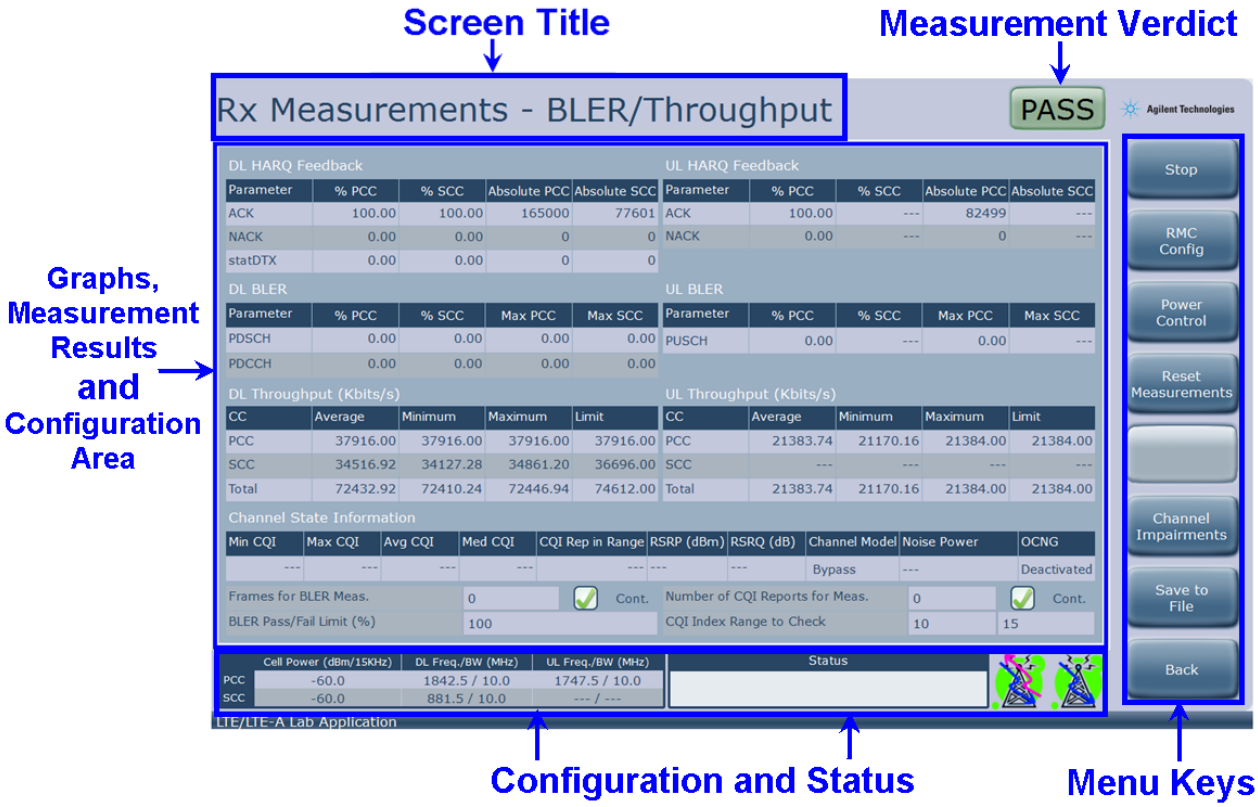


Figure 3-4: Receiver Measurements View

Screen Title: This area indicates the purpose of the screen displayed.

Measurement Verdict: This indicates the current measurement verdict when checked against the current measurement limits.

Menu keys: This is a variable area that enables you to navigate through the different configuration and measurement screens in the TA/LA software.

Configuration and Status: This summary area provides information about the following (areas from left to right):

- Cell Power, UL and DL EARFCN and BW
- Equipment status
- Communication status

Graphs, Measurement Results, and Configuration Parameters Area: This area displays the measurement results.

RRC/NAS Logging screen layout

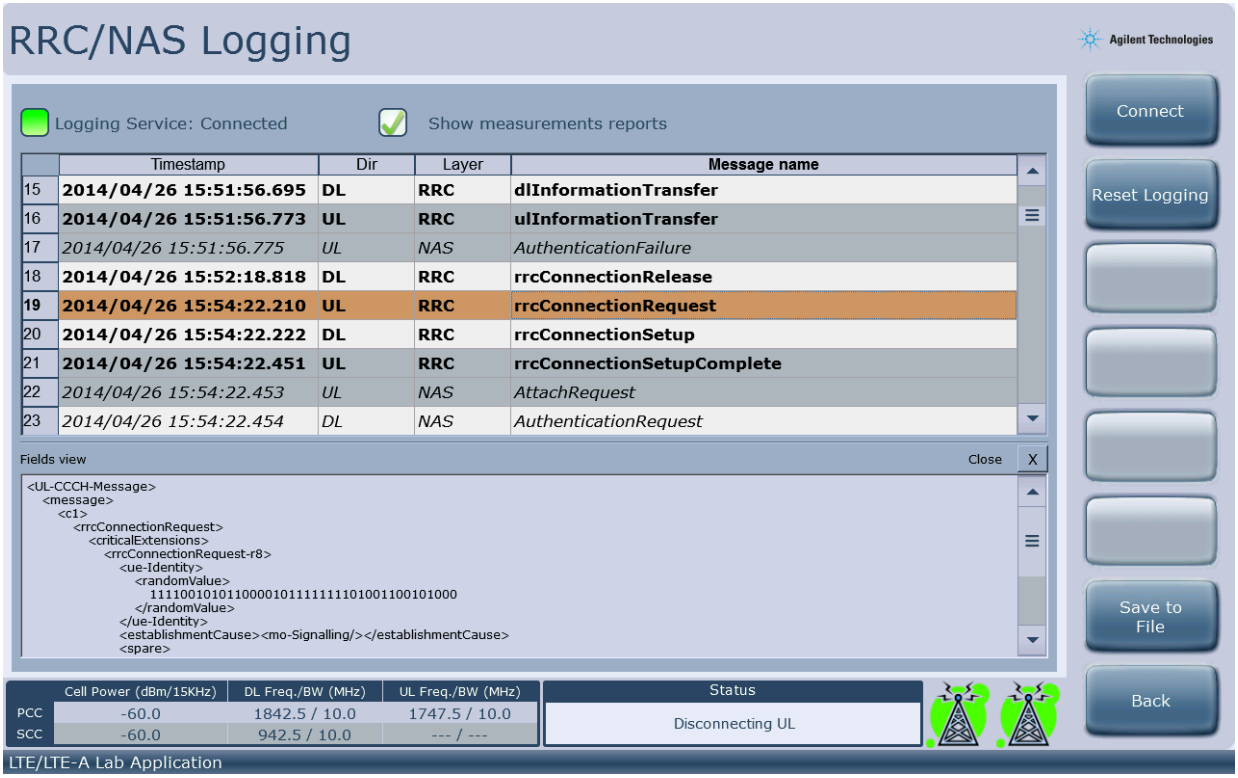


Figure 3-5: RRC/NAS Logging screen layout

- The numbered messages in the top section of the above graphic are displayed whenever you select the **RRC/NAS Logging** menu key from the right-hand menu.
- The detailed view of the fields for each message is displayed as shown (in the lower section of the window) when you select one of the messages from the list above.

4 Agilent LTE/LTE-Advanced TA/LA Operation

When operating the TA/LA in the signaling based mode, the UXM emulates a single cell, LTE network.

You are able to control the communication state between the network emulation and the UE. Additionally, you are able to trigger transitions between the different signaling states using the touchscreen display.

You are able to configure several parameters of the network emulation, allowing recreation of multiple testing scenarios and enabling real-life conditions to be presented to the UE during testing.

The following sections provide a complete listing of all the parameters than can be configured in this operation mode.

These parameters are organized in different groups, in order to ease the operation of the system.

Furthermore, transition between the different signaling states and configuration of these parameters is not only possible through the TA/LA software user interface, but also through a SCPI command interface.

The description and complete reference of the TA/LA SCPI command interface is provided in the *Agilent UXM Programmer's Reference*.

Application start-up and shutdown

Once the UXM has booted up, the system is ready to start the TA/LA. You can access the TA/LA software application from the windows desktop or listed under ***All Programs*** from with windows ***Start*** menu. Refer to the *Agilent UXM Getting Started Guide* for detailed information regarding turning on the UXM and launching the TA/LA.

In order to close the TA/LA, it is recommended that you stop MAC Padding in order for you to attain the ***CellOFF*** state. Select any of the tabs from the lower horizontal scroll bar and then select **Exit** from the bottom menu key. When asked to confirm the action of closing the application, select **Yes**.

Connection control capabilities implemented in the TA/LA Software Application

The states described below are referenced in this document when describing the various menu options. The diagram below helps you understand these different signaling state transitions.

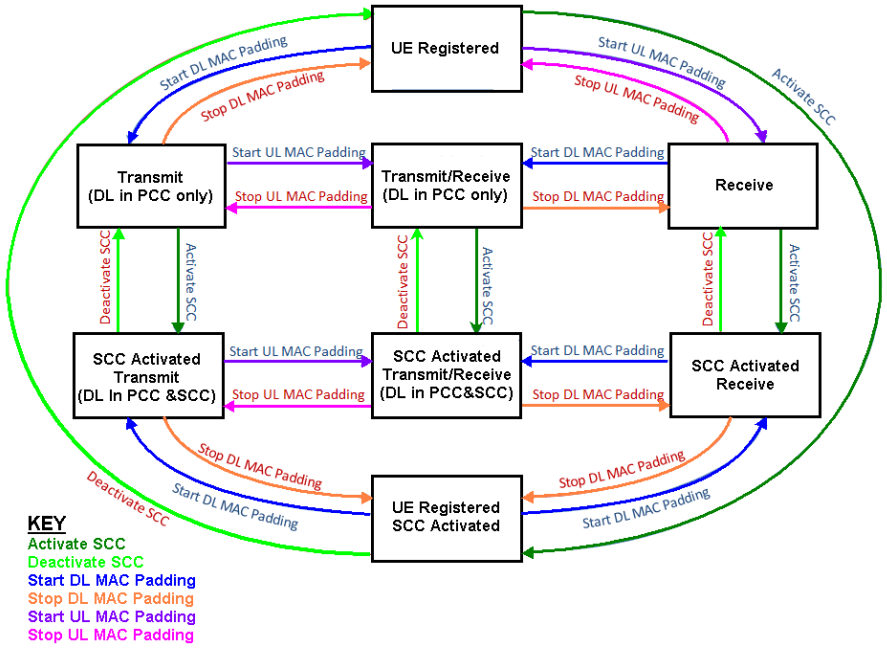


Figure 4-1: Signaling state transitions diagram for the LTE/LTE-A network emulation

UERegistered state

You do not need to perform any specific operation to bring the system from the *CellActive* state to the *UERegistered* state. The attach process is initiated by the UE.

Transition from *CellActive* state to *UERegistered* state requires the UE to decode the broadcast channel and performs the registration procedure with the emulated network.

All of the above is valid when the TA/LA is operating in its signaling-enabled mode. When in non-signaling operation mode, this state is automatically reached without any actual UE registration procedure being involved.

Once the previous procedure has completed, both the LTE network emulation and the UE will be on the *UERegistered* state. In this state the UE or the network emulation can at any time perform the required signaling to initiate a user data communication.

Additionally, if you select **Connect**, **Cell OFF** in the *UERegistered* state, the network emulation stops the network emulation and disables the RF output in the UXM. This occurs without regard to a successful detach procedure.

Transmit/Receive states

Once set in the *UERegistered* state, the LTE network emulation can be triggered to start MAC padding transmission with the UE, independently for the DL and UL directions.

In order to do so, select **Connect**, **Start DL MAC Padding**, or **Connect**, **Start UL MAC Padding** when the TA/LA is in the *UERegistered* state.

In terms of the DL direction, selecting **Connect**, **Start DL MAC Padding** triggers the network emulation to start transmission of a PDSCH channel allocated to the UE (signaled accordingly on the PDCCH). You can choose the scheduling configuration parameters via the RMC configuration tab.

In terms of the UL direction, selecting **Connect**, **Start UL MAC Padding** triggers the network emulation to start transmission of a PDCCH channel with a control region specific to the UE on which UL resources will be allocated to the UE.

Once set into the *Transmit* state, *Receive* state or *Transmit / Receive* state, the LTE network emulation can be triggered to stop MAC padding transmission, independently for the DL and UL directions.

In order to do so, you must select **Connect**, **Stop DL MAC Padding**, or **Connect, Stop UL MAC Padding**, when the TA/LA is in any connected state.

In terms of the DL direction, selecting **Connect**, **Stop DL MAC Padding** triggers the network emulation to stop transmission of the PDSCH channel allocated to the UE (signaled accordingly on the PDCCH). For the UL direction, selecting **Connect**, **Stop UL MAC Padding** has a similar effect on the UL direction.

CellOFF state

Upon start up, the TA/LA is in a state in which no signal is being transmitted through the RF connections in the UXM.

This state is called the *CellOFF* state.

CellActive state

Once all the parameters are set, the user can trigger the TA/LA to start the LTE/LTE-A network emulation.

This is achieved by selecting **Connect**, **Cell ON** from the menu keys on the right-hand side of the display. This forces the start of the network emulation state, and the activation of the RF transceivers. In this state, the TA/LA is transmitting a complete LTE/LTE-A compliant broadcast.

Transition to CellActive state

Once the transition is complete, the TA/LA is in the *CellActive* state as defined above. The menu key-path **Connect**, **Cell ON** changes to **Connect**, **Cell OFF**, enabling you to switch off the network emulation capabilities in the TA/LA and return to the state *CellOFF*.

When the TA/LA is working in its signaling-enabled mode, in the *CellActive* state the system is ready to accept the attach request from the UE.

When the non-signaling-enabled mode is used, the *CellActive* state is just a transitional state to the UERegistered state, which is automatically reached without requiring the actual registration to be performed.

SCC Activated states

If carrier aggregation was activated, once the UE finishes its registration to the network the TA/LA automatically activates the RF transceivers for the secondary cell (SCC) and performs the RRC reconfiguration procedure to send SCC information to the UE.

All of the above is valid when the TA/LA is operating in its signaling-enabled mode. When in non-signaling operation mode, SCC transceivers are automatically enabled once the *UERegistered* state is automatically reached through menu key-path **Connect**, **Cell ON,** as explained above.

Once the SCC is ON, you will be able to trigger SCC activation through **Connect**, **Activate SCC** key-path. Once the SCC is activated, DL transmission is performed in both PCC and SCC whenever the network emulator is in Transmit or Transmit/Receive states. The menu key-path **Connect**, **Activate SCC** changes then to **Connect**, **Deactivate SCC**, enabling you to deactivate the SCC cell. When SCC is deactivated, DL transmission is again performed in PCC only when the network emulator is in Transmit or Transmit/Receive states.

Cell parameters tab

This configuration parameters group contains the most commonly modified cell parameters.

Changing the parameters on this screen (with the exception of the cell power level)

- must be performed prior to the initialization of the network emulation (while the network emulation is in the *CellOFF* state).
- requires the network emulation in the TA/LA to be restarted.

The following figure shows the signaling parameters configuration screen in the TA/LA:

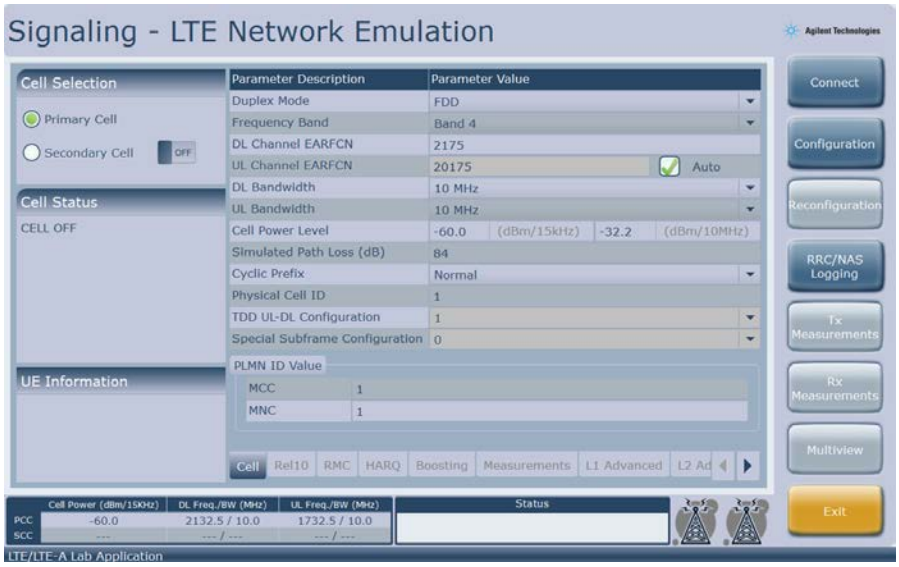


Figure 4-2: Cell parameters configuration tab view.

Duplex mode

This parameter enables you to specify the type of LTE network to be emulated by the signaling mode in the TA/LA.

The possible options, as defined in 3GPP TS 36.101, are:

- FDD duplex mode
- TDD duplex mode

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state.

In the TA/LA, the network duplex mode is selected through a selection list in the **Cell** tab present in the main configuration screen.

Frequency band

This parameter enables you to specify which frequency band is to be used by the LTE network emulation in the TA/LA.

The possible options, as defined in 3GPP TS 36.101, are listed in the following table. Note that additional bands can be introduced in the future as they are introduced in 3GPP specifications.

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F_{UL_low} – F_{UL_high}	F_{DL_low} –F_{DL_high}	
1	1920 MHz–1980 MHz	2110 MHz–2170 MHz	FDD
2	1850 MHz–1910 MHz	1930 MHz–1990 MHz	FDD
3	1710 MHz–1785 MHz	1805 MHz–1880 MHz	FDD
4	1710 MHz–1755 MHz	2110 MHz–2155 MHz	FDD
5	824 MHz–849 MHz	869 MHz–894MHz	FDD
6	830 MHz–840 MHz	875 MHz–885 MHz	FDD
7	2500 MHz–2570 MHz	2620 MHz–2690 MHz	FDD
8	880 MHz–915 MHz	925 MHz–960 MHz	FDD
9	1749.9 MHz–1784.9 MHz	1844.9 MHz–1879.9 MHz	FDD
10	1710 MHz–1770 MHz	2110 MHz–2170 MHz	FDD
11	1427.9 MHz–1447.9 MHz	1475.9 MHz–1495.9 MHz	FDD
12	699 MHz–716 MHz	729 MHz–746 MHz	FDD
13	777 MHz–787 MHz	746 MHz–756 MHz	FDD
14	788 MHz–798 MHz	758 MHz–768 MHz	FDD
...	...	...	...
17	704 MHz–716 MHz	734 MHz–746 MHz	FDD
18	815 MHz–830 MHz	860 MHz–875 MHz	FDD
19	830 MHz–845 MHz	875 MHz–890 MHz	FDD
20	832 MHz–862 MHz	791 MHz–821 MHz	FDD
21	1447.9 MHz–1462.9 MHz	1495.9 MHz–1510.9 MHz	FDD
...	...	...	...
23	2000 MHz – 2020 MHz	2180 MHz – 2200 MHz	FDD
24	1626.5 MHz – 1660.5 MHz	1525 MHz – 1559 MHz	FDD
25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
26	814 MHz – 849 MHz	859 MHz – 894 MHz	FDD
27	807 MHz – 824 MHz	851 MHz – 869 MHz	FDD
28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
29[1]	N/A	716 MHz -728 MHz	FDD
...	...	...	...
33	1900 MHz–1920 MHz	1900 MHz–1920 MHz	TDD
34	2010 MHz–2025 MHz	2010 MHz–2025 MHz	TDD
35	1850 MHz–1910 MHz	1850 MHz–1910 MHz	TDD

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F_{UL_low} – F_{UL_high}	F_{DL_low} –F_{DL_high}	
36	1930 MHz–1990 MHz	1930 MHz–1990 MHz	TDD
37	1910 MHz–1930 MHz	1910 MHz–1930 MHz	TDD
38	2570 MHz–2620 MHz	2570 MHz–2620 MHz	TDD
39	1880 MHz–1920 MHz	1880 MHz–1920 MHz	TDD
40	2300 MHz–2400 MHz	2300 MHz–2400 MHz	TDD
41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
44	703 MHz – 803 MHz	703 MHz – 803 MHz	TDD
Note 1: Band 29 is only available in the Secondary Cell when Carrier Aggregation is used.			

Table 4-1: Supported FDD/TDD frequency bands

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state.

The network operating frequency band is selected through a selection list in the **Cell** tab present in the main configuration screen.

However, since the selection of the operating frequency band also depends on the configured network duplex mode, the selection list in the TA/LA only displays those options applicable to the currently configured duplex mode.

UL and DL EARFCNs

These parameters allow the user to specify which EARFCNs are to be used by the LTE network emulation in the TA/LA, both in the DL and UL directions.

The possible options, as defined in 3GPP TS 36.101, are listed in the following table.

E-UTRA Operating Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs-DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs-UL}$	Range of N_{UL}
1	2110	0	0 – 599	1920	18000	18000 – 18599
2	1930	600	600 - 1199	1850	18600	18600 – 19199
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
4	2110	1950	1950 – 2399	1710	19950	19950 – 20399
5	869	2400	2400 – 2649	824	20400	20400 – 20649
6	875	2650	2650 – 2749	830	20650	20650 – 20749
7	2620	2750	2750 – 3449	2500	20750	20750 – 21449
8	925	3450	3450 – 3799	880	21450	21450 – 21799
9	1844.9	3800	3800 – 4149	1749.9	21800	21800 – 22149
10	2110	4150	4150 – 4749	1710	22150	22150 – 22749
11	1475.9	4750	4750 – 4949	1427.9	22750	22750 – 22949
12	729	5010	5010 - 5179	699	23010	23010 - 23179
13	746	5180	5180 – 5279	777	23180	23180 – 23279
14	758	5280	5280 – 5379	788	23280	23280 – 23379
...						
17	734	5730	5730 – 5849	704	23730	23730 - 23849
18	860	5850	5850 – 5999	815	23850	23850 – 23999
19	875	6000	6000 – 6149	830	24000	24000 – 24149
20	791	6150	6150 – 6449	832	24150	24150 – 24449
21	1495.9	6450	7050 – 7199	1447.9	24450	25050 – 25199
...						
23	2180	7500	7500 – 7699	2000	25500	25500 – 25699
24	1525	7700	7700 – 8039	1626.5	25700	25700 – 26039
25	1930	8040	8040 - 8689	1850	26040	26040 – 26689
26	859	8690	8690 – 9039	814	26690	26690 – 27039
27	852	9040	9040 - 9219	806	27040	27040 - 27219
28	758	9210	9210 - 9659	703	27210	271210 - 27209
29	716	9660	9660-9769	N/A	N/A	N/A
...						
33	1900	36000	36000 – 36199	1900	36000	36000 – 36199
34	2010	36200	36200 – 36349	2010	36200	36200 – 36349

E-UTRA Operating Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs-DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs-UL}$	Range of N_{UL}
35	1850	36350	36350 – 36949	1850	36350	36350 – 36949
36	1930	36950	36950 – 37549	1930	36950	36950 – 37549
37	1910	37550	37550 – 37749	1910	37550	37550 – 37749
38	2570	37750	37750 – 38249	2570	37750	37750 – 38249
39	1880	38250	38250 - 38649	1880	38250	38250 - 38649
40	2300	38650	38650 - 39649	2300	38650	38650 - 39649
41	2496	39650	39650 – 41589	2496	39650	39650 - 41589
44	703	45590	45590 - 46589	703	45590	45590 - 46589

NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge are not used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge are not used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.

Table 3-4-2. TA/LA supported EARFCN ranges.

This parameter can be changed when the TA/LA is in the *CellOFF, Transmit*, *Receive, Transmit/Receive* or *UERegistered* states.

In the TA/LA, the DL and UL channel EARFCNs are selected through a text field in the **Cell** tab present in the main configuration screen. Validation of the entered values is performed by the application to prevent erroneous configuration of the system due to input errors.

Additionally, you can link the value for the UL EARFCN to the one entered for DL EARFCN by ticking on the "Auto" checkbox next to the UL EARFCN text field. In this mode, the UL EARFCN is entered automatically by the TA/LA based on the value entered for the DL EARFCN and the frequency band parameters.

UL and DL channel bandwidths

These parameters enable you to specify which bandwidths are used by the LTE network emulation in the TA/LA, both in the DL and UL directions.

The possible options, as defined in 3GPP TS 36.101, are listed in the following table. Note that limitations exist in the 3GPP specification regarding the usable channel bandwidths in specific frequency bands.

E-UTRA band / channel bandwidth						
E-UTRA Band	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
1			Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes[1]	Yes[1]
3	Yes	Yes	Yes	Yes	Yes[1]	Yes[1]
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes[1]		
6			Yes	Yes[1]		
7			Yes	Yes	Yes	Yes[1]
8	Yes	Yes	Yes	Yes[1]		
9			Yes	Yes	Yes[1]	Yes[1]
10			Yes	Yes	Yes	Yes
11			Yes	Yes[1]		
12	Yes	Yes	Yes[1]	Yes[1]		
13			Yes[1]	Yes[1]		
14			Yes[1]	Yes[1]		
...						
17			Yes[1]	Yes[1]		
18			Yes	Yes[1]	Yes[1]	
19			Yes	Yes[1]	Yes[1]	
20			Yes	Yes[1]	Yes[1]	Yes[1]
21			Yes	Yes[1]	Yes[1]	
...						
23	Yes	Yes	Yes	Yes		
24			Yes	Yes		
25	Yes	Yes	Yes	Yes	Yes[1]	Yes[1]
26	Yes	Yes	Yes	Yes	Yes	Yes
27	Yes	Yes	Yes	Yes	Yes	Yes
28		Yes	Yes	Yes	Yes	Yes
...						
33			Yes	Yes	Yes	Yes
34			Yes	Yes	Yes	
35	Yes	Yes	Yes	Yes	Yes	Yes
36	Yes	Yes	Yes	Yes	Yes	Yes

E-UTRA band / channel bandwidth						
E-UTRA Band	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
37			Yes	Yes	Yes	Yes
38			Yes	Yes	Yes	Yes
39			Yes	Yes	Yes	Yes
40			Yes	Yes	Yes	Yes
41			Yes	Yes	Yes	Yes
44		Yes	Yes	Yes	Yes	Yes

NOTES:

1. A bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (Clause 7.3) is allowed.
2. TA/LA may support frequency bands which have not yet been fully standardized at the 3GPP level. These bands are supported without bandwidth restrictions. You are responsible for ensuring that the correct channel bandwidths are configured.

Table 4-3: TA/LA supported system bandwidths configurations

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the DL and UL channel bandwidths are selected through a selection list in the **Cell** tab present in the main configuration screen.

You must ensure that the configured DL and UL bandwidth is configured according to the above table. The behavior of the TA/LA is unspecified for non-3GPP specified frequency band – channel bandwidths combinations.

Cell power level

This parameter enables you to configure the TA/LA cell transmission power level.

The cell power level is provided both as the level of the cell reference signals, given in dBm/15 kHz units, and as the total cell power assuming transmission on all RBs, in dBm/BW(MHz) units.

This parameter can be changed when the TA/LA is in the *Transmit*, *Receive* or *Transmit/Receive* states.

In the TA/LA, this parameter is entered in either of both text fields (cell reference signals power or total cell power), providing validation on the input data. The parameter is available in the main configuration screen, under the **Cell** tab for initial configuration, and by selecting the **Power Control** menu key available whenever you are accessing the measurement screens.

Simulated Path Loss

This parameter enables you to modify the difference between the currently configured cell power level and the parameter "ReferenceSignalPower" transmitted to the UE as part of the common radio resource configuration block within the SIB2 broadcast message.

Effectively, this enables you to configure the RF path loss that the UE will perceive during the connection, since the ReferenceSignalPower parameter provides indication of the power level of the signals

transmitted by the eNodeB at its transmitter antenna, and the cell power level provides indication of the power level of the signals actually received at the UE antenna connector.

Therefore this parameter provides a direct way to verify UEs open loop power control mechanism.

Since this parameter affects the contents of broadcast messages transmitted by the TA/LA, this parameter can only be changed when the TA/LA is in the ***CellOFF*** state. Therefore, once this parameter is set, further changes require tearing down all active connections with the UE, and re-execution of the attach process with the network (when in signaling-enabled mode), irrespective of the changes introduced to the cell power level parameter during an active call.

This parameter is entered in a text field. The TA/LA provides validation on the input data. It is available in the main configuration screen, under the **Cell** tab.

Cyclic Prefix

This parameter enables you to specify the size of the cyclic prefix to be used by the LTE network emulation in the TA/LA.

The two possible options are:

- Normal cyclic prefix
- Extended cyclic prefix

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state.

In the TA/LA, the cyclic prefix size is selected through a selection list in the **Cell** configuration tab present in the main configuration screen.

Cell ID value

This parameter enables you to configure the TA/LA emulated LTE network PHY cell ID value.

According to the corresponding specifications, this parameter can have any value within the 0 to 503 range, both inclusive.

This parameter can be changed when the TA/LA is in the *Transmit*, *Receive, Transmit/Receive, UERegistered, or CellOFF* state. Therefore, further changes of this parameter require tearing down all active connections with the UE, and the re-execution of the attach process with the network (when in signaling-enabled mode).

This parameter is entered in a text field. The TA/LA provides validation on the input data. The parameter is available in the main configuration screen, under the **Cell** tab.

TDD Frame Configuration

When configured to operate in TDD mode, this parameter enables defining the frame configuration to be used by the TA/LA.

According to 3GPP specifications, there are 7 different TDD frame configurations (indexed between 0 and 6), defining 7 different combinations of UL and DL sub-frame sets. The following table provides details about the different configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Sub-frame number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 4-4: TDD UL-DL frame configurations

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state. Therefore, further changes of this parameter require tearing down all active connections with the UE, and the re-execution of the attach process with the network (when in signaling-enabled mode).

In the TA/LA, this parameter is entered drop down list, providing validation of the input data. The parameter is available in the main configuration screen, under the **Cell** tab.

NOTE	TDD frame configuration 0 is not supported in the current version of the TA/LA and will be introduced in future releases.

TDD Special Sub-frame Configuration

When configured to operate in TDD mode, this parameter allows defining the special sub-frame configuration to be used by the TA/LA.

According to 3GPP specifications, there are 9 different special sub-frame configurations that define different durations for the DwPTS and UpPTS fields within the special sub-frame. Furthermore, this configuration also depends on the current selection of the Cyclic Prefix duration parameter. The following table provides details about the different possibilities for configuration of this parameter.

Special sub-frame configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			-	-	-
8	$24144 \cdot T_s$			-	-	-

Table 4-5: TDD special sub-frame configuration

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state. Therefore, further changes of this parameter require tearing down all active connections with the UE, and the re-execution of the attach process with the network (when in signaling-enabled mode).

In the TA/LA, this parameter is entered drop down list, providing validation of the input data. The parameter is available in the main configuration screen, under the **Cell** tab.

PLMN ID parameter

This parameter enables you to enter the PLMN ID that is transmitted by the TA/LA in the SIB1 broadcast message. A match between this parameter and the corresponding parameter stored in the SIM card used in the UE is normally needed in order for the UE to "camp" on the TA/LA simulated cell.

This parameter is composed of two different fields:

- MNC (Mobile Network Code)
  Composed of two numeric digits. Default value set to "01".
- MCC (Mobile Country Code)
  Composed of three numeric digits. Default value set to "001".

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state.

In the TA/LA, the PLMN ID configuration is entered using two different text fields: one for the MNC and another one for the MCC. These text fields are located in the **Cell** parameters tab.

RMC parameters tab

This configuration parameters group contains the configuration parameters for the Reference Measurement Channel to use upon establishment of the DL and/or UL connections.

The parameters on this tab are only available prior to the initialization of the network emulation (while the network emulation is in the *CellOFF* state). However, you can access them while the connection is established from the corresponding **RMC config** menu key within the measurements display.

The following figure shows the signaling parameters configuration screen in the TA/LA:

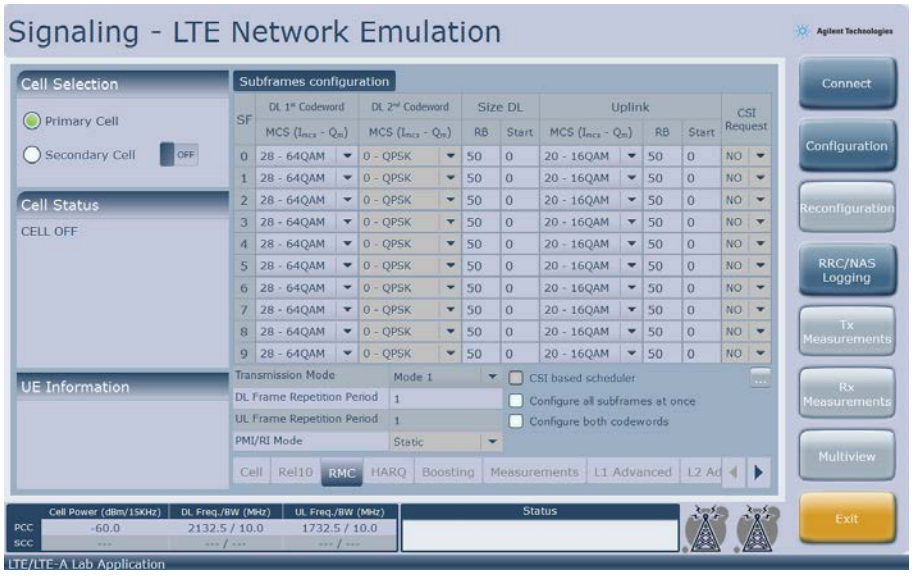


Figure 4-3: RMC parameters configuration tab view

RMC configuration basics

The TA/LA enables you to define the allocation size, offset, modulation and coding scheme to be used in each and every sub-frame within a complete frame.

These parameters are defined by means of a table in which each row represents a different sub-frame, and each column represents a different RMC parameter.

Additionally, there are some parameters that apply to all the sub-frames configured (for example: transmission mode).

Although the allocation in the TA/LA is defined in terms of number of Physical Resource Blocks (PRBs) and I_{MCS} parameters, you can obtain the currently configured Transport Block Size (TBS) by tapping on the sub-frame index column, on top of the corresponding row. The TBS is provided for both UL and DL as shown in the following image.

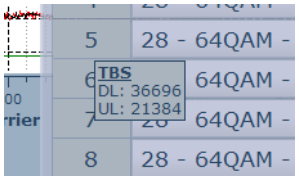


Figure 4-4: Subframe *TBS* indication in RMC configuration dialog

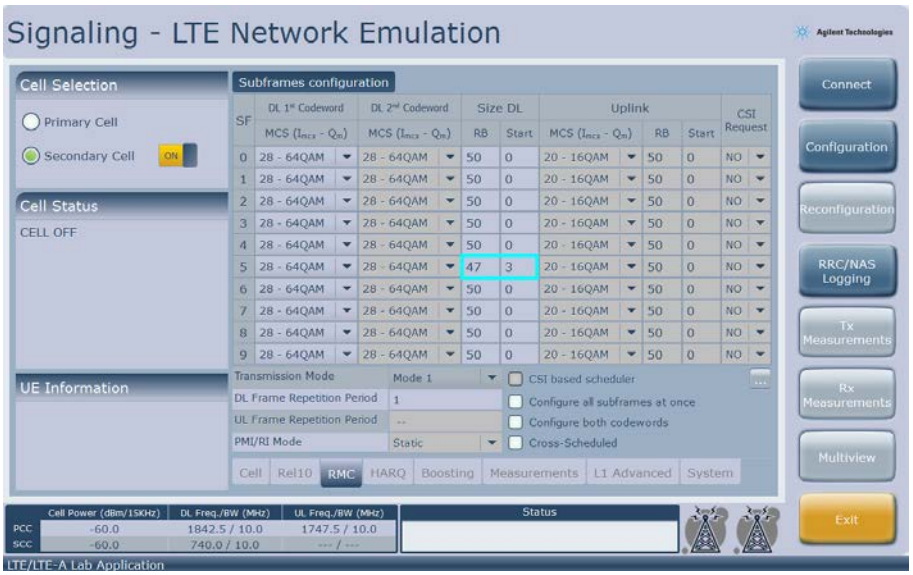


Figure 4-5: Example - optimizing throughput by subframe 5 allocation

To obtain maximum throughput, it is recommended that you set all subframes to have full allocation except subframe 5 which should have an allocation offset of at least 2 RBs. Otherwise, SIBs transmission, which takes place in those first 2 RBs of subframe 5 for certain frames, would overlap with data allocation, and the latest one would be dropped, significantly reducing the total throughput achieved.

Refer to the section entitled, *End to End (E2E) Throughput Measurement* on page 93 for an example of this configuration. If you are testing Carrier Aggregation, this setting is recommended for both PCC and SCC.

NOTE	You can also access these RMC configuration parameters by selecting **RMC Config** from the key menu that is available when you are performing Tx or Rx measurements. Whereas the **RMC** tab menu is only available when the TA/LA is in the *CellOff* state.

DL allocation: start offset

PDSCH allocations signaled by the TA/LA to the UE are specified in terms of a RB offset and an allocation size, in number of PRBs.

For single antenna operation, or for multiple antenna operation using transmission mode 2 or 6, resource allocation type 2 is used to signal bandwidth resources to the UE.

When in multiple antenna operation with transmission mode 3, 4, 7 or 8, resource allocation type 0 is used to signal bandwidth resources to the UE.

In both cases, the TA/LA will translate from the offset/allocation size to the respective underlying signaling formats.

This parameter enables you to configure the starting PRB index of the allocation signaled to the UE for the PDSCH.

Its minimum value is 0 and represents the index of the left-most (lowest frequency) PRB to be assigned to the UE.

Its maximum value is dependent on the channel bandwidth configuration used during the measurements and is provided in the following table:

Channel bandwidth BWChannel [MHz]	1.4	3	5	10	15	20
Maximum DL start offset	5	14	24	49	74	99

Table 4-6: TA/LA maximum supported allocation offset for DL

This parameter is entered in a text field. The TA/LA provides validation on the input data. It can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, this parameter can be changed in the **RMC Config** menu key only as the **RMC** tab is not available.

NOTE	The **RMC** tab is only available when the TA/LA is in the *CellOFF* state, however you can always modify these parameters using the **RMC Config** menu key which exists in the right-hand key menu after you have selected either Tx or Rx measurements.

DL allocation: number of PRBs

PDSCH allocations signaled by the TA/LA to the UE can be either contiguous or non-contiguous depending on the DCI format to be used.

For single antenna operation, or for multiple antenna operation using transmission mode 2 or 6, resource allocation type 2 is used to signal bandwidth resources to the UE.

When in multiple antenna operation with transmission mode 3, 4, 7 or 8, resource allocation type 0 is used to signal bandwidth resources to the UE.

In both cases, the TA/LA will translate from the offset/allocation size to the respective underlying signaling formats.

This parameter enables you to configure the amount of PRBs in the allocation signaled to the UE for the PDSCH.

Its minimum value is 1. Its maximum value is dependent of the channel bandwidth configuration used during the measurements and on the value of the DL allocation starting offset parameter. This prevents signal allocations bigger than that which the actual channel bandwidth allows.

This parameter is entered in a text field. The TA/LA provides validation on the input data. It can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, this parameter can be changed in the **RMC Config** menu key only as the **RMC** tab is not available.

NOTE	The **RMC** tab is only available when the TA/LA is in the *CellOFF* state, however you can always modify these parameters using the **RMC Config** menu key which exists in the right-hand key menu after you have selected either Tx or Rx measurements.

DL allocation: non-contiguous PRBs

When in multiple antenna operation with transmission modes 3, 4, 7 and 8, you can select the RBs to be transmitted in a non-contiguous manner by the use of a graphical grid where the transmission of each Resource Block Group (RBG) can be enabled or disabled in a per subframe basis.

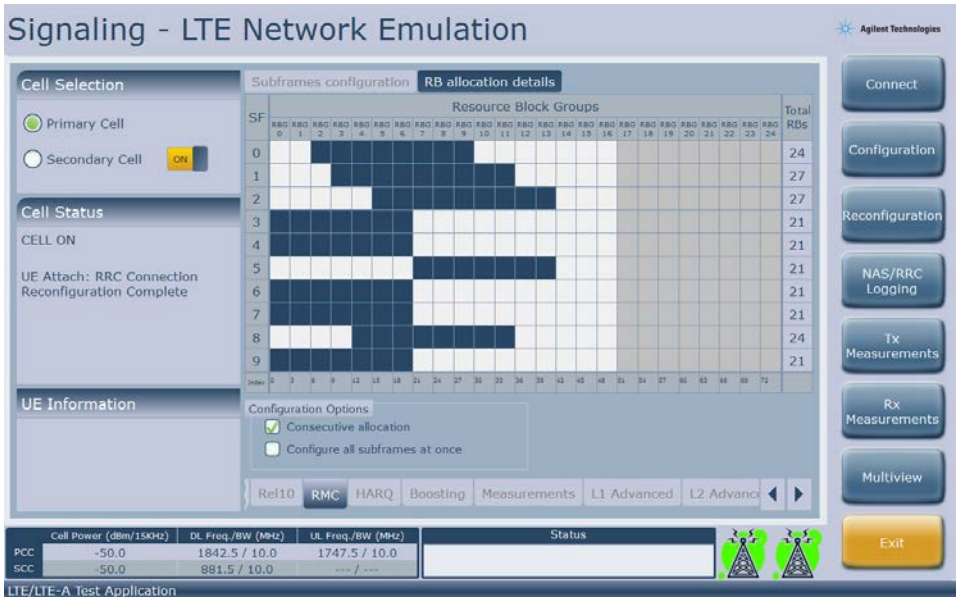


Figure 4-6: Non-contiguous subframe allocation

DL allocation: modulation and coding scheme (I_{MCS})

You can specify the modulation and target coding scheme to be used for transmission of the PDSCH allocations transmitted to the UE, by selecting the I_{MCS} to be used.

The allowed values for this parameter are according to 3GPP TS 36.213, but are repeated here for convenience:

MCS Index I_{MCS}	Modulation Order Q_m	TBS Index I_{TBS}
0	QPSK	0
1	QPSK	1
2	QPSK	2
3	QPSK	3
4	QPSK	4
5	QPSK	5
6	QPSK	6
7	QPSK	7
8	QPSK	8
9	QPSK	9
10	16-QAM	9
11	16-QAM	10
12	16-QAM	11
13	16-QAM	12
14	16-QAM	13
15	16-QAM	14
16	16-QAM	15
17	64-QAM	15
18	64-QAM	16
19	64-QAM	17
20	64-QAM	18
21	64-QAM	19
22	64-QAM	20
23	64-QAM	21
24	64-QAM	22
25	64-QAM	23
26	64-QAM	24
27	64-QAM	25
28	64-QAM	26
29	QPSK	reserved
30	16-QAM	
31	64-QAM	

Table 4-7: TA/LA supported modulation and target coding scheme configurations

This parameter can be changed when the TA/LA is in the *Transmit*, *Receive, Transmit/Receive* or *UERegistered* states.

It is entered by a selection list. It can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens.

NOTE	The **RMC** tab is only available when the TA/LA is in the *CellOFF* state, however you can always modify these parameters using the **RMC Config** menu key which exists in the right-hand key menu after you have selected either Tx or Rx measurements.

DL allocation: frame repetition period

You can configure the frame repetition period for the configured RMC in the DL direction.

The minimum value for this parameter is 1, representing a transmission on the configured DL allocations on every frame.

This parameter is entered in a text field. The TA/LA provides validation on the input data. It can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, this parameter can be changed in the **RMC Config** menu key only as the **RMC** tab is not available.

DL allocation: transmission mode

This parameter enables you to configure the TA/LA to use one of the multiple transmission modes available for PDSCH transmission.

Possible values for this parameter will depend on the currently selected antennae configuration. Transmission modes 1, 2, 3, 4, 7 (SISO), 7 (MIMO) and 8 are supported and available in the TA/LA.

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, this parameter is entered in a selection list, providing all available values for a given antennae configuration. The parameter is available in the main configuration screen, under the **RMC** tab.

UL allocation: start offset

This parameter enables you to configure the starting PRB index of the allocation signaled to the UE for the PUSCH.

DCI Format 0 is used by the TA/LA to signal bandwidth resources to the UE.

Its minimum value is 0 and represents the index of the left-most (lowest frequency) PRB to be assigned to the UE.

Its maximum value is dependent on the channel bandwidth configuration used during the measurements and is provided in the following table:

Channel bandwidth $BW_{Channel}$ [MHz]	1.4	3	5	10	15	20
Maximum UL start offset	5	14	24	49	74	99

Table 4-8: TA/LA maximum supported allocation offset for UL

This parameter can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, the **RMC** tab is not available.

UL allocation: number of PRBs

This parameter enables you to configure the amount of PRBs in the allocation signaled to the UE for the PUSCH.

DCI Format 0 is used by the TA/LA to signal bandwidth resources to the UE.

In order to fulfill the requirements of 3GPP 36.211, in terms of the size of the UL allocations signaled to a LTE UE, only the following set of values for indicating the size of the allocation are allowed:

N_{RB_PUSCH}			
1	12	32	72
2	15	36	75
3	16	40	80
4	18	45	81
5	20	48	90
6	24	50	96
8	25	54	100
9	27	60	
10	30	64	

Table 4-9: TA/LA supported allocation sizes for UL

In case you enter an UL allocation size different to the set of values provided in the table above, the TA/LA will indicate this situation by highlighting the value in red. You need to correct the incorrect parameter value in order to proceed with the configuration.

This parameter can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit*, *Receive, Transmit/Receive* or *UERegistered* states, the **RMC** tab is not available.

UL allocation: modulation and coding scheme (I_{MCS})

You can specify the modulation and target coding scheme to be used for transmission of the PUSCH allocations transmitted to the UE, by selecting the I_{MCS} to be used.

The allowed values for this parameter are according to 3GPP TS 36.213, but are repeated here for convenience:

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}
0	QPSK	0
1	QPSK	1
2	QPSK	2
3	QPSK	3
4	QPSK	4
5	QPSK	5
6	QPSK	6
7	QPSK	7
8	QPSK	8
9	QPSK	9
10	QPSK	10
11	16-QAM	10
12	16-QAM	11
13	16-QAM	12
14	16-QAM	13
15	16-QAM	14
16	16-QAM	15
17	16-QAM	16
18	16-QAM	17
19	16-QAM	18
20	16-QAM	19
21	64-QAM	19
22	64-QAM	20
23	64-QAM	21
24	64-QAM	22
25	64-QAM	23
26	64-QAM	24
27	64-QAM	25
28	64-QAM	26
29	reserved	
30		
31		

Table 4-10: TA/LA supported modulation and target coding scheme configurations, UL case

This parameter can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, the **RMC** tab is not available.

UL allocation: frame repetition period

You can configure the frame repetition period for the configured RMC in the UL direction.

The minimum value for this parameter is 1, representing a transmission on the configured UL allocation on every frame.

This parameter can be changed in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, the **RMC** tab is not available.

CSI based scheduler

Selecting the CSI based scheduler box enables you to let the network emulator automatically adapt the DL transmission according to CSI reports received from the UE. That adaptation is performed at two levels:

- **DL IMCS level**: Once CSI based scheduler is enabled, if you select **CQI Based** in the **MCS** selection list for any of the subframes, you enable the LTE network emulator to automatically select the IMCS for DL allocations in those subframes according to the CQI reported by the UE. You can also define the coding scheme you wish to apply to each reported CQI value, rather than use those defined by the 3GPP standards, by using the menu available when selecting ....

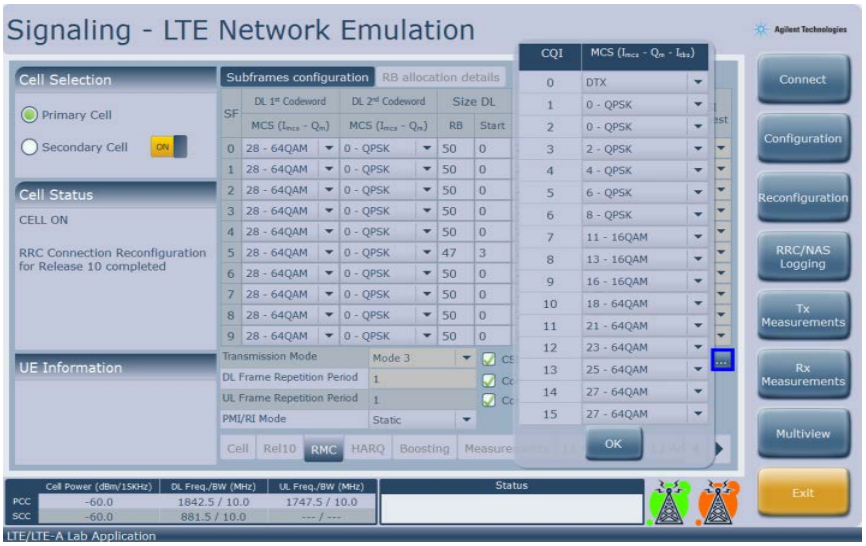


Figure 4-7: Define Coding Scheme for each reported CQI value

- **PMI/RI level**: You can enable the LTE network emulator automatically adapt Precoding Matrix and number of codewords according to PMI and RI reports received from the UE. Three options are available, depending on Transmission Mode used:
  - Static: both Precoding Matrix and number of codewords are static, so no adaptation is performed.
  - Adaptive: both Precoding Matrix and number of codewords (when applicable for transmission mode used) are automatically adapted according to reports.
  - Random: Precoding Matrix is randomly selected by the network emulator. No adaptation is performed for the number of codewords

This parameter is selected or de-selected and is available in both the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens when the TA/LA is in the *CellOFF* state.

When the TA/LA is in the *Transmit, Receive, Transmit/Receive* or *UERegistered* states, the **RMC** tab is not available.

Configuration of this parameter is only available when **Periodic CSI Reporting Configuration** or **Aperiodic CSI Reporting Configuration** is enabled in the **Measurements** tab.

CSI Request

You can configure whether the channel state information is included in the UL transmission or not in this column.

This parameter can be changed when the TA/LA is in the *Transmit*, *Receive* or *Transmit/Receive* states. However, configuration of this parameter is only available when **CSI aperiodic report** is enabled in the **Measurements** tab.

In the TA/LA, this parameter is set as **NO** or **Srv** for each subframe and is available in the main configuration screen, under the **RMC** tab, for initial configuration, and in the **RMC Config** menu key accessible from within all the measurement screens.

HARQ parameters tab

This configuration tab contains a series of parameters that enables modification of the TA/LA HARQ operation during testing, both for DL and UL directions.

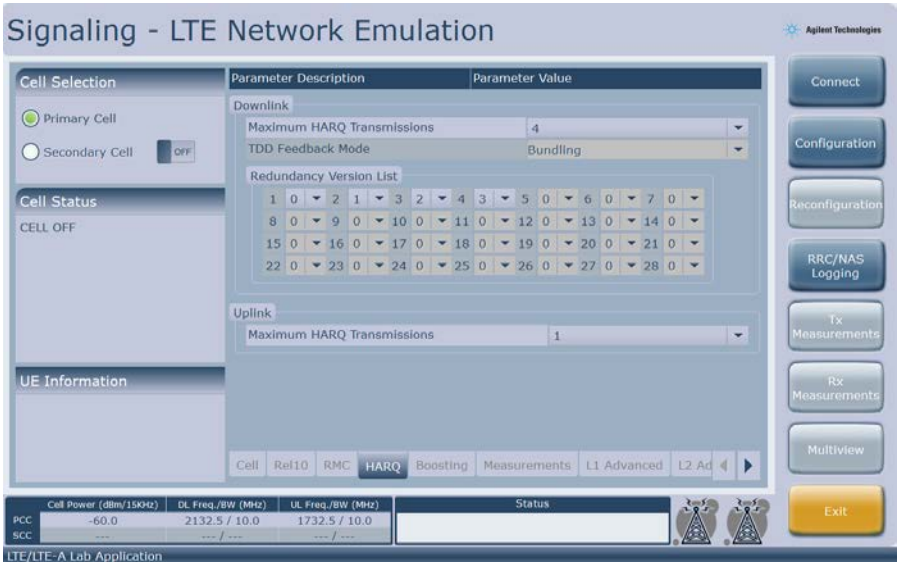


Figure 4-8: HARQ parameters configuration tab view.

Maximum number of DL HARQ transmissions

This parameter enables you to specify the maximum number of DL HARQ transmissions that the network emulation in the TA/LA performs before signaling a transmission error to the upper layers.

Specifying a value of 1 for this parameter effectively disables DL HARQ operation, since it prevents DL retransmissions from happening.

In the TA/LA, this parameter is entered using a text field in the **HARQ** parameters tab as well as during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

TDD feedback mode

This parameter enables you to select the type of feedback mode that will be used for HARQ when in TDD operation (frame type 2).

The TA/LA allows operation in bundling and multiplexing modes.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, this parameter is modified using a combo-box control in the **HARQ** parameters tab.

DL HARQ redundancy version list

This parameter enables you to specify the list of redundancy versions that the TA/LA uses on DL transmissions.

The TA/LA allows modification of this parameter when in *CellOFF* state. You can also enter values during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

In the TA/LA, the redundancy version list is entered by using a combo-box for each of the possible transmission attempts, with a maximum of 28. The TA/LA prevents you from configuring the redundancy version for transmission attempts beyond the maximum number of configured HARQ transmissions.

NOTE	The default DL HARQ sequence (0,1,2,3) aligns with section 8 of 3GPP TS 36.521-1 in table 8.2.1-1. However, if you wish to use 64 QAM, you may need to change the sequence to 0,0,1,2 in order to align with this table. If you are performing tests defined in section 7 of 3GPP TS 36.521-1, which are receiver tests, not performance tests, you will want to set the number of transmissions to 1. (The default for this setting is 4.)

Maximum number of UL HARQ transmissions

This parameter enables you to specify the maximum number of UL HARQ transmissions that the network emulation in the TA/LA performs before signaling a transmission error to upper layers.

Specifying a value of 1 for this parameter effectively disables UL HARQ operation, since it prevents UL retransmissions from happening.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, this parameter is entered using a text field in the **HARQ** parameters tab, as well as during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

L1 Advanced parameters tab

The **L1 Advanced** parameters configuration tab enables you to configure L1 parameters that are normally not modified during the measurement process itself, but that may be required in order to achieve a successful connection with the UE, or in order to test scenarios with specific configurations.

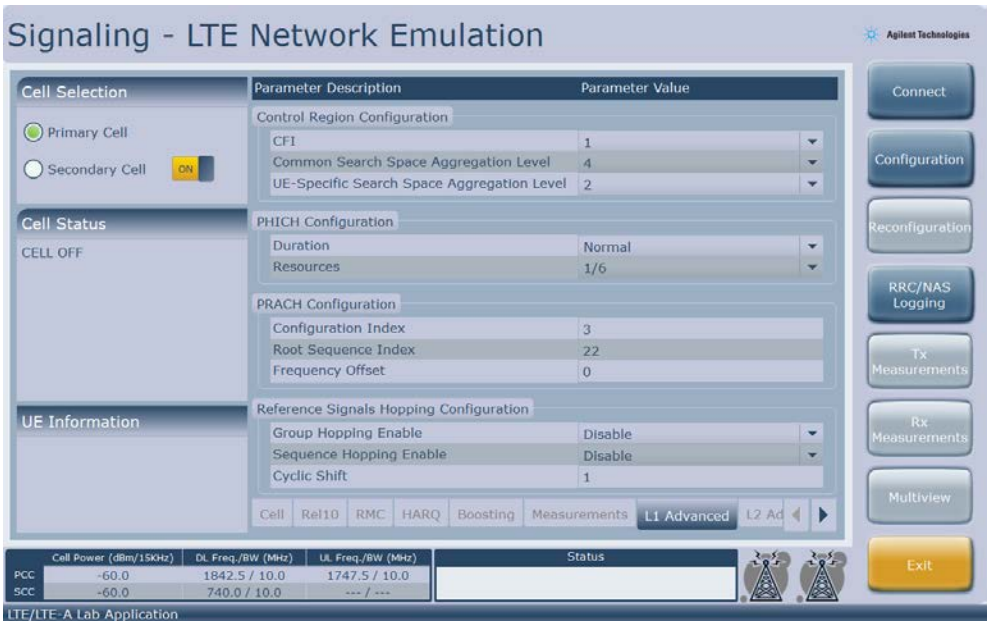


Figure 4-9: *L1 Advanced* parameters configuration tab view.

Control region configuration – number of symbols

This parameter enables you to configure the numbers of symbols that are used for the control region in the LTE network emulation. The selection is signaled on the PCFICH channel.

The possible values for this parameter are defined in 3GPP TS 36.211. They are repeated in the table below for convenience:

Sub-frame	**Number of OFDM symbols for PDCCH when** $N_{RB}^{DL} > 10$	**Number of OFDM symbols for PDCCH when** $N_{RB}^{DL} \leq 10$
Sub-frame 1 and 6 for frame structure type 2	1, 2	2*
Sub-frames on a carrier not supporting PDSCH	0	0
Non-MBSFN sub-frames (except sub-frame 6 for frame structure type 2) configured with positioning reference signals	1, 2, 3	2*, 3*
All other cases	1, 2, 3	2*, 3*, 4*
(*) CFI value you entered in the **L1 Advanced** tab screen is the number represented in the table minus one.		

Table 4-11: TA/LA supported CFI configurations

Users must exercise caution when modifying this parameter, as incorrect configuration may cause the system not to have enough CCE resources to transmit the required PDCCH signaling to the UE.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the L1 Advanced parameters configuration tab, as well as during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

Control region configuration – common search space aggregation level

This parameter enables you to specify the transmission format (PDCCH aggregation level) of the common search space, as specified in 3GPP TS 36.213. The table with the different possible values is repeated below for convenience:

Search space $S_k^{(L)}$			Number of PDCCH candidates $M^{(L)}$
Type	**Aggregation level** L	**Size [in CCEs]**	
Common	4	16	4
	8	16	2

Table 4-12: TA/LA supported common space aggregation level configurations

Notice that the only values allowed for the aggregation level are 4 and 8.

You must exercise caution when modifying this parameter, as an incorrect configuration may cause the system to not have enough CCE resources to transmit the required PDCCH signaling to the UE.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L1 Advanced** parameters configuration tab, as well as during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

Control region configuration – UE-specific search space aggregation level

This parameter enables you to specify the transmission format (PDCCH aggregation level) of the UE-specific search space, as specified in 3GPP TS 36.213. The table with the different possible values is repeated below for convenience:

Search space $S_k^{(L)}$			Number of PDCCH candidates $M^{(L)}$
Type	**Aggregation level** L	**Size [in CCEs]**	
UE-specific	1	6	6
	2	12	6
	4	8	2
	8	16	2

Table 4-13: TA/LA supported UE specific aggregation level configurations

You must exercise caution when modifying this parameter, as an incorrect configuration may cause the system to not have enough CCE resources to transmit the required PDCCH signaling to the UE.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L1 Advanced** parameters configuration tab, as well as during transmission by selecting, **Reconfiguration**, **L1 Reconfiguration**. Refer to *L1 Reconfiguration* on page 69 for more information.

PHICH configuration – duration

You can configure the LTE network emulation in the system to use different PHICH duration values by modifying this parameter.

Allowed values for this parameter are given in 3GPP TS 36.211. The following table summarized the defined values:

PHICH duration	Non-MBSFN sub-frames		MBSFN sub-frames on a carrier supporting PDSCH
	Sub-frames 1 and 6 in case of frame structure type 2	All other cases	
Normal	1	1	1
Extended	2	3	2

Table 4-14: PHICH configuration parameters

This parameter value is also transmitted by the LTE network emulator in the broadcast information contained in the MIB.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the L1 Advanced configuration parameters tab.

PHICH configuration – resources

You can configure the LTE network emulation in the system to use different PHICH N_g values by modifying this parameter.

Allowed values for this parameter are given in 3GPP TS 36.211. For convenience, they are repeated here:

$$N_g \in \{1/6, 1/2, 1, 2\}$$

This parameter value is also transmitted by the LTE network emulator in the broadcast information contained in the MIB.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L1 Advanced** parameters tab.

PRACH configuration – configuration index

This parameter provides the following set of values for PRACH configuration: the preamble format parameter, the sub-frame number parameter and the even/any sub-frame requirement.

See tables 5.7.1-2 and 5.7.1-3 within 3GPP TS 36.211 for obtaining the actual values.

Allowed values for this parameter are positive integers between 0 and 63, both inclusive, but excluding values 30, 46, 60, 61 and 62, when using FDD. When using TDD, the allowed values for this parameter are the positive integers between 0 and 57, both inclusive.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is provided to the TA/LA by means of a text field within the **L1 Advanced** parameters configuration tab.

PRACH configuration – root sequence index

See 3GPP TS 36.211, tables 5.7.2-4 and 5.7.2-5 in order to obtain the relationship between the root sequence index parameter and the physical root sequence index.

Once the physical root sequence index is obtained, it is used to derive the actual preamble sequence to be transmitted on the PRACH resources.

Allowed values for this parameter are positive integers between 0 and 837, both inclusive, for preamble formats 0 to 3. In the case where preamble format 4 is selected (available only for TDD operation), allowed values are positive integers between 0 and 137, both inclusive.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is provided to the TA/LA by means of a text field, within the **L1 Advanced** parameters configuration tab.

PRACH configuration – frequency offset

See 3GPP TS 36.211 for details and definition of this parameter.

This parameter specifies the first PRB that has been allocated for a given RACH opportunity. It fulfills the following relationship:

$$0 \le n_{\mathrm{PRBoffset}}^{\mathrm{RA}} \le N_{\mathrm{RB}}^{\mathrm{UL}} - 6$$

Allowed values for this parameter are all positive integers fulfilling the previous relationship.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is provided to the TA/LA by means of a text field within the **L1 Advanced** configuration tab.

Reference signals hopping configuration – group hopping enable

This parameter enables or disables the group hopping pattern used to derive the sequence-group number. This group hopping pattern is used for both PUSCH and PUCCH demodulation reference signal generation. This parameter is defined in 3GPP TS 36.211.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

The parameter is configured by means of a selection list within the **L1 Advanced** parameters tab and the possible values are enabled or disabled.

Reference signals hopping configuration – sequence hopping enable

This parameter enables or disables the sequence-shift pattern used to derive the sequence-group number. This sequence-shift pattern is used for both PUSCH and PUCCH demodulation reference signal generation, although the actual sequence used varies for each channel. This parameter is described in 3GPP TS 36.211.

For PUSCH, the sequence-shift pattern is derived both from the cell ID parameter and from the parameter defined in Cyclic Prefix on page 30.

For PUCCH, the sequence-shift pattern is derived solely from the cell ID parameter.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configured by means of a selection list within the **L1 Advanced** configuration parameters and the possible values are enabled or disabled.

Reference signals hopping configuration – cyclic shift

This parameter provides the sequence cyclic shift as the index into the table presented in 3GPP TS 36.211.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

Possible values range from 0 to 7, both inclusive. The parameter can be entered into the TA/LA in a selection list within the **L1 Advanced** configuration parameters tab.

L2 Advanced parameters tab

The **L2 Advanced** parameters configuration tab enables you to configure L2 parameters that are normally not modified during the measurement process itself, but that may be required in order to achieve a successful connection with the UE, or in order to test scenarios with specific configurations.

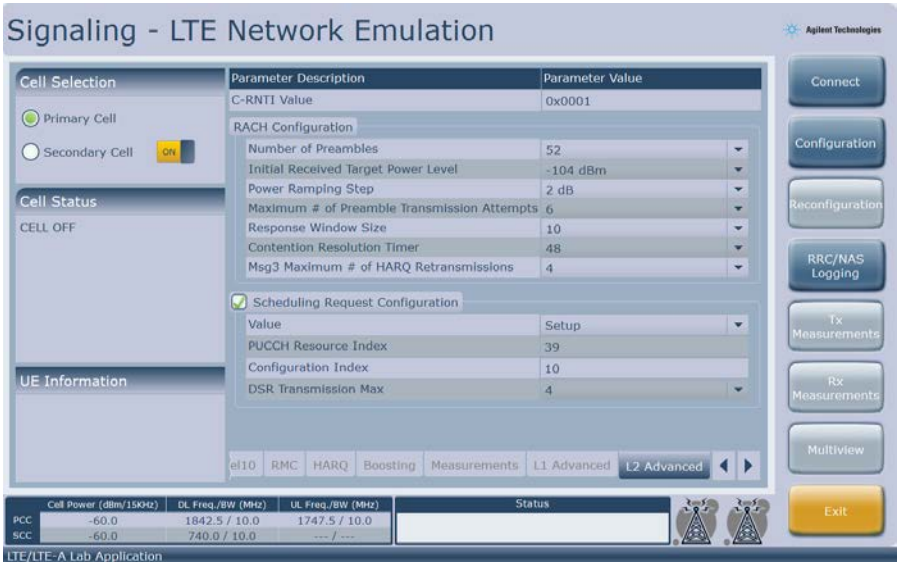


Figure 4-10: L2 Advanced parameters configuration tab view

C-RNTI configuration

This parameter enables you to configure the C-RNTI value that is used for scrambling the data sent/received from the UE.

This parameter is described in 3GPP TS 36.211 (several sections). Possible values for this parameter are given in 3GPP TS 36.321.

For convenience, the following table provides the allowed values:

Value (hexa-decimal)	RNTI
0000	N/A
0001-003C	RA-RNTI, C-RNTI, Semi-Persistent Scheduling C-RNTI, Temporary C-RNTI, TPC-PUCCH-RNTI and TPC-PUSCH-RNTI (see note)
003D-FFF3	C-RNTI, Semi-Persistent Scheduling C-RNTI, Temporary C-RNTI, TPC-PUCCH-RNTI and TPC-PUSCH-RNTI
FFF4-FFFC	Reserved for future use
FFFD	M-RNTI
FFFE	P-RNTI
FFFF	SI-RNTI
NOTE: The values corresponding to the RA-RNTI values of a cell's PRACH configuration are not used in the cell for any other RNTI (C-RNTI, Semi-Persistent Scheduling C-RNTI, Temporary C-RNTI, TPCPUCCH-RNTI or TPC-PUSCH-RNTI).	

Table 4-15: Allowed RNTI values

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a text field in the **L2 Advanced** configuration parameters tab. This text field provides data validation capabilities to avoid wrong configurations of the system due to incorrect input.

RACH configuration – number of preambles

This parameter enables you to configure the number of non-dedicated random access preambles available for use during the random access procedure.

It is defined in 3GPP TS 36.331, as one field in the RACH-ConfigCommon information element.

Allowed values for this parameter are:

4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – initial received target power level

This parameter enables you to configure the initially expected power (as received by the network emulator) of the preambles transmitted by the UE during the random access procedure, without considering preamble format associated corrections.

It is defined in 3GPP TS 36.331, as one field in the RACH-ConfigCommon information element.

Allowed values for this parameter are:

dBm-120, dBm-118, dBm-116, dBm-114, dBm-112, dBm-110, dBm-108, dBm-106, dBm-104, dBm-102, dBm-100, dBm-98, dBm-96, dBm-94, dBm-92, dBm-90

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – power ramping step

This parameter enables you to specify the power ramping step that the UE should apply when transmitting successive random access preambles.

The parameter is defined in 3GPP TS 36.321, as part of the RACH-ConfigCommon information element.

Allowed values for this parameter are:

dB0, dB2, dB4, dB6

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – maximum number of preamble transmission attempts

This parameter enables you to specify the maximum number of repetitions that the UE should attempt the random access procedure in case it does not receive a response from the network emulator.

The parameter is defined in 3GPP TS 36.321, as part of the RACH-ConfigCommon information element.

Allowed values for this parameter are:

n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – response window size

This parameter enables you to specify the size of the preamble response window size to by signaled by the TA/LA network emulation to the UE. According to 3GPP TS 36.321, the preamble response window starts in the sub-frame in which the preamble transmission ends plus three sub-frames, and has a length (in number of sub-frames) indicated by this parameter.

The parameter is defined in 3GPP TS 36.321, as part of the RACH-ConfigCommon information element.

Allowed values for this parameter are:

sf2, sf3, sf4, sf5, sf6, sf7, sf8, sf10

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – contention resolution timer

This parameter enables you to configure the value of the contention resolution timer used in the random access procedure after the transmission of Message3.

The parameter is defined in 3GPP TS 36.321, as part of the RACH-ConfigCommon information element.

Allowed values for this parameter are:

sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

RACH configuration – Msg3 maximum number of HARQ retransmissions

This parameter enables you to configure the maximum allowed amount of retransmission of Message3 during the random access procedure.

The parameter is defined in 3GPP TS 36.321, as part of the RACH-ConfigCommon information element.

Allowed values for this parameter are positive integers between 1 and 8, both inclusive.

This parameter is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **L2 Advanced** configuration parameters tab.

Scheduling request configuration – enable

This parameter enables you to configure whether the SchedulingRequestConfig IE, contained within the PhysicalConfigDedicated IE enclosed within RadioResourceConfigDedicated IE, is transmitted as part of the RRCConnectionSetup, RRCConnectionReconfiguration and RRCConnectionReestablishment messages or not.

If it is not transmitted, the UE is assumed to use 3GPP defined default configuration.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a check box in the **L2 Advanced** configuration parameters tab.

Scheduling request configuration – value

This parameter enables you to configure the value of the SchedulingRequestConfig IE contained within the PhysicaConfigDedicated IE enclosed within RadioResourceConfigDedicated IE, transmitted as part of the RRCConnectionSetup, RRCConnectionReconfiguration and RRCConnectionReestablishment messages.

This parameter can only have two different values:

- **Release**: when release value is set, the IE is transmitted empty, in which case the UE uses the default scheduling request configuration. When the release value is configured, the remaining scheduling request configuration parameters are disabled in the TA/LA.
- **Setup**: when setup value is set, the IE is transmitted containing the complete set of scheduling request configuration parameters. When the setup value is configured, you need to configure the scheduling request parameters in the TA/LA .

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a combo box in the **L2 Advanced** configuration parameters tab.

Scheduling request configuration – PUCCH resource index

This parameter enables you to configure the PUCCH resource that the UE uses in order to transmit Scheduling Requests to the SS.

This parameter is part of the SchedulingRequestConfig IE contained within the PhysicalConfigDedicated IE enclosed within RadioResourceConfigDedicated IE, transmitted as part of the RRCConnectionSetup, RRCConnectionReconfiguration and RRCConnectionReestablishment messages.

The allowed range for this parameter depends on the actual system bandwidth configured in the emulated LTE cell. The TA/LA does not perform validation of the entered value. You need to exercise caution to avoid incorrect configurations to be entered.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a text field in the **L2 Advanced** configuration parameters tab.

Scheduling request configuration – configuration index

This parameter enables you to specify the Scheduling Requests configuration index that the UE uses. As defined by 3GPP TS 36.213, this actually enables you to configure the actual scheduling requests periodicity and sub-frame offset.

This parameter is part of the SchedulingRequestConfig IE contained within the PhysicalConfigDedicated IE enclosed within RadioResourceConfigDedicated IE, transmitted as part of the RRCConnectionSetup, RRCConnectionReconfiguration and RRCConnectionReestablishment messages.

The allowed range for this parameter is defined in table 10.1-5, within 3GPP TS 36.213.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through combo box in the **L2 Advanced** configuration parameters tab.

Scheduling request configuration – DSR transmission max

This parameter enables you to specify the maximum number of Scheduling Requests transmissions that a compliant UE should attempt before attempting a Random Access procedure to request resources to the eNodeB.

This parameter is part of the SchedulingRequestConfig IE contained within the PhysicalConfigDedicated IE enclosed within RadioResourceConfigDedicated IE, transmitted as part of the RRCConnectionSetup, RRCConnectionReconfiguration and RRCConnectionReestablishment messages.

Allowed values for this parameter are given by the following list:

n4, n8, n16, n32, n64

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through combo box in the **L2 Advanced** configuration parameters tab.

Boosting parameters tab

The Boosting parameters configuration tab enables you to set the power boosting applied to the PDSCH, Sync signals, and the Other channels separately.

p-a is one of the parameters that controls the power boosting applied to the PDSCH. It is signaled in the RRC Connection Setup message.
p-b is one of the parameters that controls the power boosting applied to the PDSCH. It is signaled in the System Information Block 2 message.

See 3GPP TS 36.213 section 5.2 for details of how the values of p-a (and p-b) determine how much boosting is applied to the PDSCH.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

Measurements parameters tab

The tab enables you to configure parameters related to the how measurement reports are transmitted by the UE. These parameters are normally not modified during the measurement process itself, so they must be configured when the TA/LA is in the *CellOFF* state. They may be required to perform specific measurements over the UE.

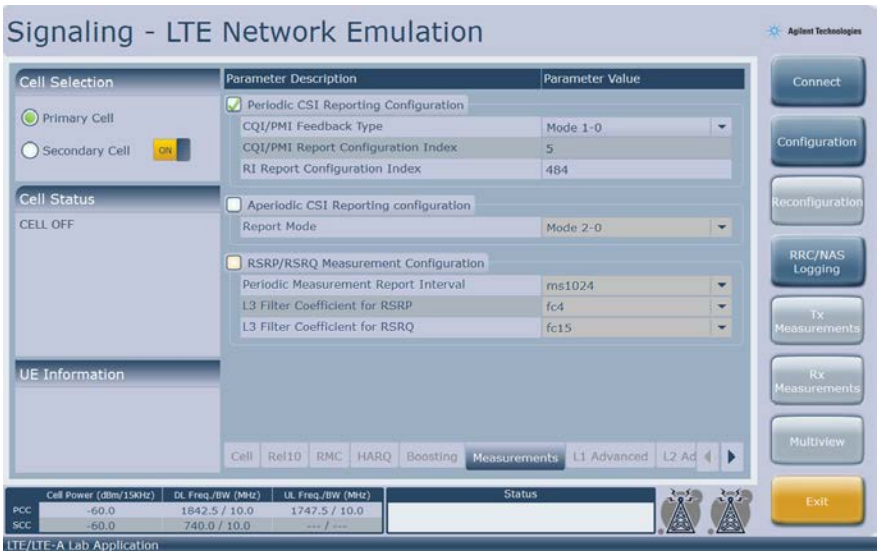


Figure 4-11: Measurements parameters configuration tab view

Periodic CQI reporting configuration – enable

You can enable/disable the CQI/PMI reporting in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a check-box that allows you to enable or disable the CQI/PMI/RI reporting.

Periodic CQI reporting configuration – mode

You can configure the CQI periodic reporting mode. This parameter is described in 3GPP TS 36.213. The following table provides a simplified view of the different reporting modes (CQI/PMI/RI) over PUCCH that you can configure the UE to use:

		PMI Feedback Type	
		No PMI	Single PMI
PUCCH CQI Feedback Type	Wideband (wideband CQI)	Mode 1-0	Mode 1-1
	UE Selected (subband CQI)	Mode 2-0	Mode 2-1

Table 4-16: CQI reporting modes

The allowed values for this parameter are dependent on the currently configure transmission mode. The following table summarizes the available options:

Transmission mode	Periodic CQI reporting configuration mode
1	Modes 1-0, 2-0
2	Modes 1-0, 2-0
3	Modes 1-0, 2-0
4	Modes 1-1, 2-1
6	Modes 1-1, 2-1
7	Modes 1-0, 2-0
8	Modes 1-1, 2-1

Table 4-17: Relationship between transmission modes and CQI reporting mode

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **Measurements** configuration parameters tab.

Periodic CQI reporting configuration – CQI/PMI reporting configuration index

You can configure the CQI/PMI reporting configuration index in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a text field which allows you to enter values between 0 and 1023 for the CQI/PMI reporting configuration index parameter.

Periodic CQI reporting configuration – RI reporting configuration index

You can configure the RI reporting configuration index in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a text field which enables you to enter values between 0 and 1023 for the RI reporting configuration index parameter.

Aperiodic CSI reporting

You can configure the CQI periodic reporting mode. This parameter is described in 3GPP TS 36.213. The following table provides a simplified view of the different reporting modes (CQI/PMI/RI) over PUSCH that you can configure the UE to use:

		PMI Feedback Type		
		No PMI	Single PMI	Multiple PMI
PUSCH CQI Feedback Type	Wideband (wideband CQI)			Mode 1-2
	UE Selected (subband CQI)	Mode 2-0		Mode 2-2
	Higher Layer-configured (subband CQI)	Mode 3-0	Mode 3-1	

Table 4-18: CQI and PMI Feedback Types for PUSCH CSI reporting Modes

The allowed values for this parameter are dependent on the currently configure transmission mode. The following table summarizes the available options:

Transmission mode	Periodic CQI reporting configuration mode
1	Modes 2-0, 3-0
2	Modes 2-0, 3-0
3	Modes 2-0, 3-0
4	Modes 1-2, 2-2, 3-1
6	Modes 1-2, 2-2, 3-1
7	Modes 2-0, 3-0
8	Modes 2-0, 3-0

Table 4-19: Relationship between transmission modes and aperiodic CQI reporting mode

This setting can only be modified when the TA/LA is in the *CellOFF* state.

If this selection is made in the **Measurements** tab, it enables you to set the **CSI Request** state (**NO** or **Srv** (server) for each subframe which is located on the **RMC** tab. See *CSI Request* on page 42 for more information.

Periodic RSRP/RSRQ reporting configuration – enable

You can configure the RSRP/RSRQ reporting in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a check-box which allows you to enable or disable the periodic RSRP/RSRQ reporting.

Periodic RSRP/RSRQ reporting configuration – Reporting interval

You can configure the RSRP/RSRQ reporting interval period in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a selection list in the TA/LA which enables you to select the interval period to be configured to the UE among the following values:

120 ms	240 ms	480 ms	640 ms	1024 ms	2048 ms	5120 ms
10240 ms	1 minute	6 minutes	12 minutes	30 minutes	60 minutes	---

Periodic RSRP/RSRQ reporting configuration – L3 filtering coefficient for RSRP reports

You can configure the RSRP reporting L3 filtering coefficient in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a selection list in the TA/LA which allows you to select the L3 filtering coefficient to be configured to the UE among the following values:

fc0	fc1	fc2	fc3	fc4	fc5	fc6	fc7
fc8	fc9	fc11	fc13	fc15	fc17	fc19	---

Periodic RSRP/RSRQ reporting configuration – L3 filtering coefficient for RSRQ reports

You can configure the RSRQ reporting L3 filtering coefficient in the UE.

This setting can only be modified when the TA/LA is in the *CellOFF* state.

This is achieved through a selection list in the TA/LA, enabling you to select the L3 filtering coefficient to be configured to the UE among the following values:

fc0	fc1	fc2	fc3	fc4	fc5	fc6	fc7
fc8	fc9	fc11	fc13	fc15	fc17	fc19	---

RRC/NAS parameters tab

The **RRC/NAS** parameters configuration tab enables you to configure L3 parameters that are normally not modified during the measurement process itself, but that may be required in order to achieve a successful connection with the UE, or in order to test scenarios with specific configurations.

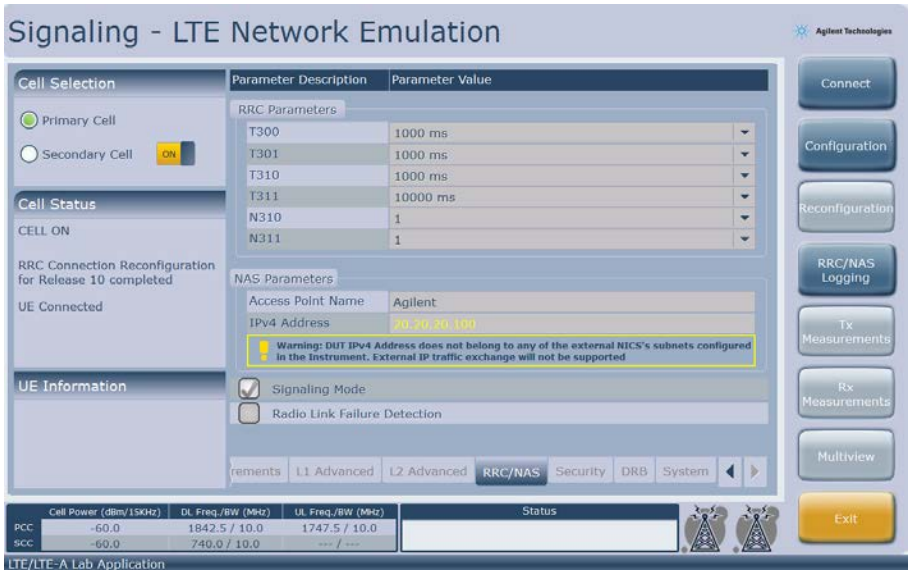


Figure 4-12: RRC/NAS parameters configuration tab view.

Timers and constants configuration – T300 value

T300 timer enables the UE to detect a timeout in the RRC connection establishment procedure.

The UE starts T300 timer upon transmission of the RRCConnectionRequest message to the TA/LA network emulation. Timer is stopped by the UE upon reception of the RRCConnectionSetup or RRCConnectionReject messages from the network emulation.

If timer expires before reception of any of the mentioned messages, the UE resets MAC layer and re-establishes the RLC connection for all RBs that are established, as well as informing the upper layers that the RRC connection could not be established.

This parameter can be configured to have any of the following values:

ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000

It is provided to the UE as part of the SIB2 broadcast message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Timers and constants configuration – T301 value

T301 timer enables the UE to detect a timeout in the RRC connection reestablishment procedure.

UE shall start T301 timer upon transmission of the RRCConnectionReestablishmentRequest message to the LTE network emulation. Timer is stopped by the UE upon reception of the RRCConnectionReestablishment or RRCConnectionReestablishmentReject messages from the network emulation.

If the timer expires before the reception of any of the mentioned messages, the UE returns to the RRC_Idle state by execution of the procedure described in 3GPP TS 36.331.

This parameter can be configured to have any of the following values:

ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000

It is provided to the UE as part of the SIB2 broadcast message or as an information element within the RRCConnectionSetup message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Timers and constants configuration – T310 value

Timeout of this timer indicates to the UE that there is a radio link failure.

This timer is started by the UE upon reception of N310 consecutive out-of-sync indications from the PHY layer, and it is stopped upon reception of N311 consecutive in-sync indications from the PHY layer, upon triggering the HO procedure or upon triggering the connection reestablishment procedure.

Upon expiry of T310 timer, if AS security is enabled, UE enters RRC_Idle state according to the procedure described in 3GPP TS 36.331. However, if security is not enabled, the UE attempts the connection reestablishment, according to the procedure described in 3GPP TS 36.331.

This parameter can be configured to have any of the following values:

ms0, ms50, ms100, ms200, ms500, ms1000, ms2000

It is provided to the UE as part of the SIB2 broadcast message or as an information element within the RRCConnectionSetup message.

This parameter can be changed when the TA/LA is in the ***CellOFF*** state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Timers and constants configuration – T311 value

T311 timer is started by the UE upon initiating the RRC connection reestablishment procedure. Timer is stopped upon selection of a suitable EUTRA cell or a cell using another RAT.

Upon expiry, UE enters the RRC_Idle state, following the procedure described in 3GPP TS 36.331.

This parameter can be configured to have any of the following values:

ms1000, ms3000, ms5000, ms10000, ms15000, ms20000, ms30000

It is provided to the UE as part of the SIB2 broadcast message or as an information element within the RRCConnectionSetup message.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Timers and constants configuration – N310 value

This counter is used by the UE to determine there is a radio link failure.

T310 timer, explained above, is started by the UE upon reception of N310 consecutive out-of-sync indications from the PHY layer.

This parameter can be configured to have any of the following values:

n1, n2, n3, n4, n6, n8, n10, n20

It is provided to the UE as part of the SIB2 broadcast message or as an information element within the RRCConnectionSetup message.

This parameter can be changed when the TA/LA is in the ***CellOFF*** state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Timers and constants configuration – N311 value

This counter is used by the UE to determine there is a radio link failure.

T310 timer, explained above, is stopped upon reception of N311 consecutive in-sync indications from the PHY layer.

This parameter can be configured to have any of the following values:

n1, n2, n3, n4, n5, n6, n8, n10

It is provided to the UE as part of the SIB2 broadcast message or as an information element within the RRCConnectionSetup message.

This parameter can be changed when the TA/LA is in the ***CellOFF*** state.

This parameter is configurable through a selection list in the **RRC/NAS** configuration parameters tab.

Access Point Name configuration

During the last phases of the attach procedure, the eNodeB provides the UE with the Access Point Name (APN) to be used for PDN access.

The TA/LA enables you to configure the actual APN that is signaled to the UE during the attach procedure. This parameter is to be configured as a text string.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through text field in the **RRC/NAS** configuration parameters tab.

IP address configuration

During the last phases of the attach procedure, the eNodeB provides the UE with the actual IP address to be used for PDN access.

The TA/LA enables you to configure the actual IP address that is signaled to the UE during the attach procedure. This parameter is to be configured as a text string.

This parameter can be changed when the TA/LA is in the *CellOFF* state.

This parameter is configurable through a text field in the **RRC/NAS** configuration parameters tab.

NOTE: The warning message shown below warns that you could potentially have problems with traffic routing when you are performing external IP throughput measurements. See End to End (E2E) Throughput Measurement on page 93 for more information.

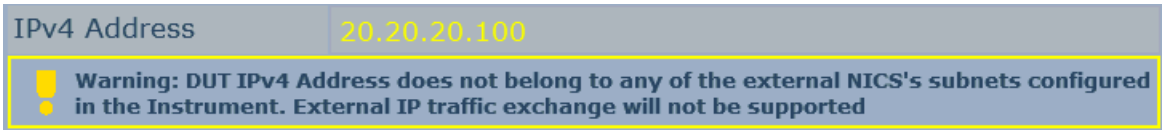


Figure 4-13: IP configuration warning message

Signaling / non-signaling enable control

This parameter allows you to enable or disable signaling capabilities in the TA/LA.

In the signaling-based operation mode, the UE must always perform a successful attach in order for the TA/LA to be able to allocate bandwidth resources to it and perform transmitter and receiver measurements. This means that the system will never transmit a PDCCH containing DCIs intended for the UE until the attach procedure has completed successfully. The corresponding menu selections: **Connect**, **Start DL MAC Padding** and **Connect**, **Start UL MAC Padding** are disabled until then.

However, the TA/LA is capable of operating in a non-signaling mode as well. In this mode, you can enable transmission of the PDCCHs allocating bandwidth to the UE even when the attach procedure has not taken place.

This parameter can only be changed when the TA/LA is in the ***CellOFF*** state.

In the TA/LA, the signaling/non-signaling configuration is enabled or disabled through a checkbox, located in the **RRC/NAS** parameters configuration tab.

Radio Link Failure detection enable control

This parameter allows you to enable or disable the Radio Link Failure detection capabilities in the TA/LA.

When enabled, the TA/LA notifies you of the occurrence of a situation in which it can be assumed that the link with the UE has been lost.

To that effect, a pop-up appears in the screen notifying you of the situation and requesting input to proceed with the operation. The pop-up allows you to ignore the situation (by selecting the **Ignore** button) or reset the cell to manually re-establish the connection with the UE (by selecting, **OK**).

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the Radio Link Failure detection is enabled or disabled through a checkbox, located in the **RRC/NAS** parameters configuration tab.

Security parameters tab

The **Security** parameters configuration tab enables you to configure security related parameters that may be required in order to achieve a successful connection with the UE, or in order to test scenarios with specific configurations.

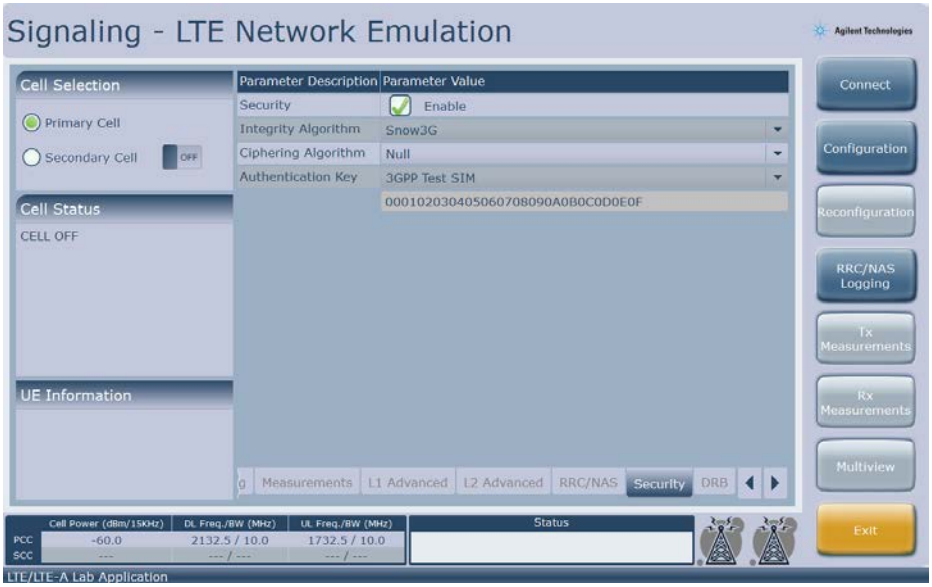


Figure 4-14. "Security" parameters configuration tab view.

Security enable control

This parameter allows you to enable or disable the security procedures during the attach process.

Disabling this control allows you to completely bypass L2/L3 security procedures.

Enabling this control enables a complete attach procedure, including authentication and security procedures, but requires the UE to use a TA/LA compatible SIM card with the security configuration used.

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the use of security procedures during connection setup is enabled or disabled through a checkbox, located in the **Security** parameters configuration tab.

Integrity algorithm configuration

This parameter enables you to select which integrity algorithm is used in the security procedures during the attach process and afterwards.

The current selection of security algorithms supported by the TA/LA is: Null and Snow3G.

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the integrity configuration is configured through a selection list, located in the **Security** parameters configuration tab.

Ciphering algorithm configuration

This parameter enables you to select which ciphering algorithm is used in the security procedures during the attach process and afterwards.

The current selection of security algorithms supported by the TA/LA is: Null.

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the ciphering configuration is configured through a selection list, located in the **Security** parameters configuration tab.

Authentication key configuration

This parameter enables you to configure the authentication key stored in the SIM card and used to derive the different security related keys initialized during the attach procedure between the UE and the eNodeB. This authentication key must be known in the eNodeB in order to successfully complete the security related procedures.

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the authentication key is configured through a text field, located in the **Security** parameters configuration tab. Default 3GPP and Agilent authentication keys can be automatically configured using a selection list.

DRB parameters tab

The **DRB** parameters configuration tab enables you to configure the dedicated radio bearers of the TA/LA.

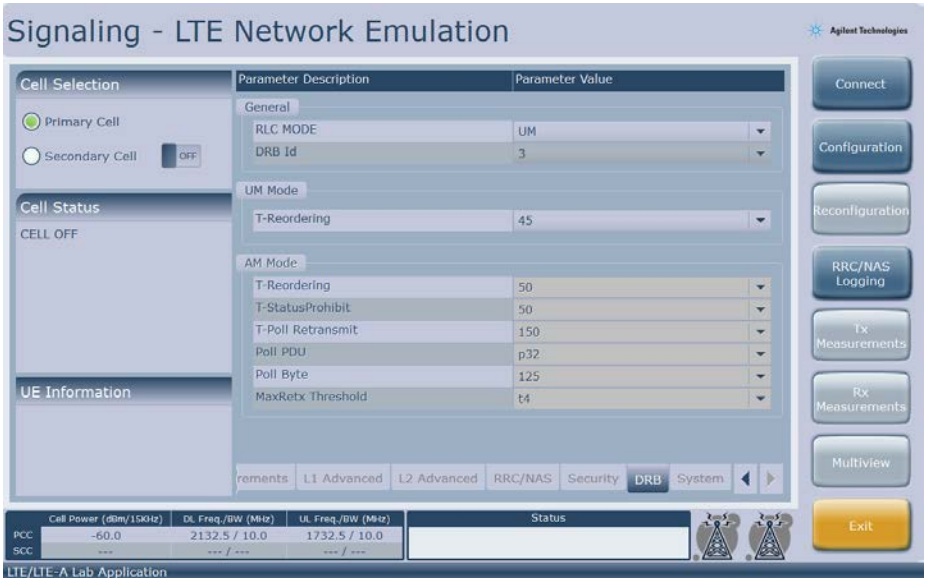


Figure 4-15: DRB parameters configuration tab view

General

RLC Mode

This setting enables you to specify the RLC mode as either Unacknowledged Mode (UM) or Acknowledged Mode (AM).

DRB Id

This setting enables you to specify the dedicated radio bearer Id (DRB Id). The values available are from 1 - 32.

UM Mode

T-Reordering

This parameter enables you to specify the T-Reordering value:

- For values between 0 and 100, the selections available increment by 5.
- For values between 100 and 200, the selections available increment by 10.

AM Mode

This parameter enables you to specify the following parameters:

T-Reordering

This parameter enables you to specify the T-Reordering value:

- For values between 0 and 100, the selections available increment by 5.
- For values between 100 and 200, the selections available increment by 10.

T-StatusProhibit

This parameter enables you to specify the T-StatusProhibit value:

- For values between 0 and 250, the selections available increment by 5.
- For values between 250 and 500, the selections available increment by 50.

T-Poll Retransmit

This parameter enables you to specify the T-Poll Retransmit value:

- For values between 0 and 250, the selections available increment by 5.
- For values between 250 and 500, the selections available increment by 50.

Poll PDU

This parameter enables you to specify the Poll PDU value. The available options are: p4, p8, p16, p32, p64, p128, p256, and pInfinity.

Poll Byte

This parameter enables you to specify the Poll Byte value:

- For values between 0 and 125, the selections available increment by 25.
- For values greater than 125, the selections available are: 250, 375, 500, 750, 1000, 1250, 1500, 2000, 3000, and Infinity.

MaxRetx THreshold

This parameter enables you to specify the Maximum Retransmit threshold value. The available options are: t1, t2, t3, t4, t6, t8, t16, 32.

System parameters tab

The **System** parameters configuration tab enables you to configure basic configuration parameters of the TA/LA, that never change during the test session, like the number of antennae to use, or the RF connector configuration in the test system.

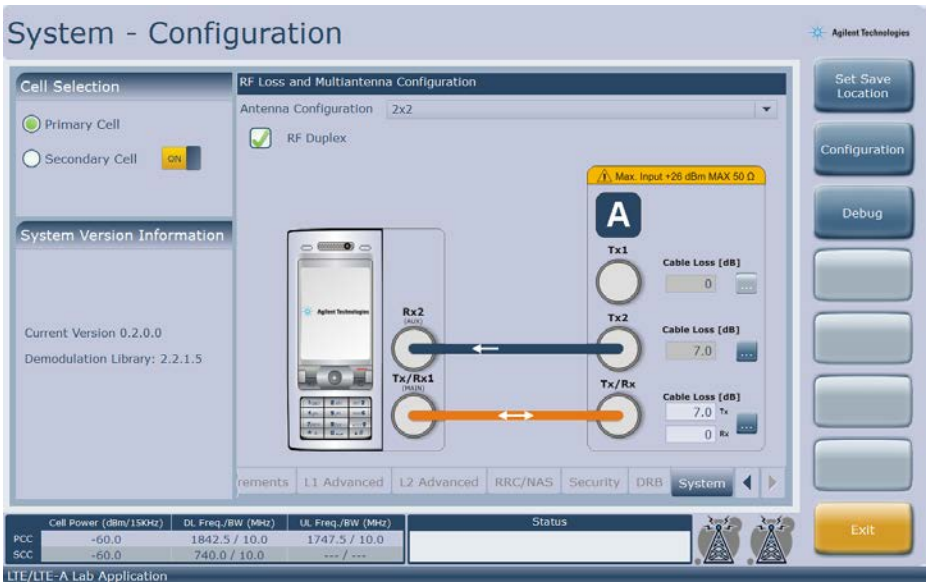


Figure 4-16: System parameters configuration tab view

Antennae configuration

This parameter enables you to specify the antennae configuration used by the LTE network emulation in the TA/LA.

The possible options are listed:

- 1x1 (SISO operation)
- 1x2 (SIMO operation)
- 2x2 (MIMO operation)
- 4x2 (MIMO operation)

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the antennae configuration is selected through a selection list in the **System** parameters configuration tab present in the main configuration screen.

RF duplex mode

This parameter enables you to select whether or not the RF connectors on the UXM front-panel splits the Rx and Tx signal paths into different connectors, or if they use the same one.

The default value for this parameter is the combined Tx and Rx signal paths. (The box is selected.)

This parameter can only be changed when the TA/LA is in the *CellOFF* state.

In the TA/LA, the RF duplex configuration is enabled or disabled through a checkbox, present in the **System** parameters configuration tab.

RF cable loss compensation controls

The TA/LA enables you to introduce RF cable loss information in order to allow the system to compensate for the losses introduced by these cables both when setting DL signal power levels and when performing UL signal measurements.

This information can be introduced independently for each of the currently configured RF connectors in the UXM. The set of connectors used depends on the configured multiple antenna selection:

Multiple antenna configuration	RF duplex configuration	Used RF connectors
SISO 1x1	Enabled	Tx/Rx1 (DL/UL)
SISO 1x1	Disabled	Tx/Rx1 (UL), Tx1 (DL)
SIMO 1x2	Enabled	Tx/Rx1 (DL/UL), Tx2 (DL)
SIMO 1x2	Disabled	Tx/Rx1 (UL), Tx1 (DL), Tx2 (DL)
MIMO 2x2	Enabled	Tx/Rx1 (DL/UL), Tx2 (DL)
MIMO 2x2	Disabled	Tx/Rx1 (UL), Tx1 (DL), Tx2 (DL)
MIMO 4x2	Enabled	Tx/Rx1 (DL/UL), Tx2 (DL)
MIMO 4x2	Disabled	Tx/Rx1 (UL), Tx1 (DL), Tx2 (DL)

Table 4-20: Cable loss compensation for the different RF combiner configurations

The RF cable loss information can be provided in two different ways:

- Specifying the specific correction value that the system applies to each RF connector;
- Specifying a set of attenuation/frequency pairs and letting the system interpolate the correction value automatically.

When directly specifying the correction value to be applied for both DL power adjustment and UL measurements corrections, you need to enter the correction value in the text field located next to each of the UXM RF connectors in the **System** tab. See the figure below.

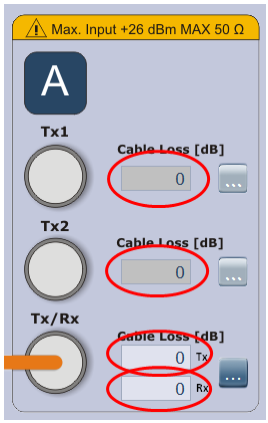


Figure 4-17: Connector cable loss compensation configuration detail

Alternately, you can define lists of frequency/attenuation pairs, representing the frequency response for the RF cable used on a given UXM RF connector. The following figure shows the dialog used for data entry.

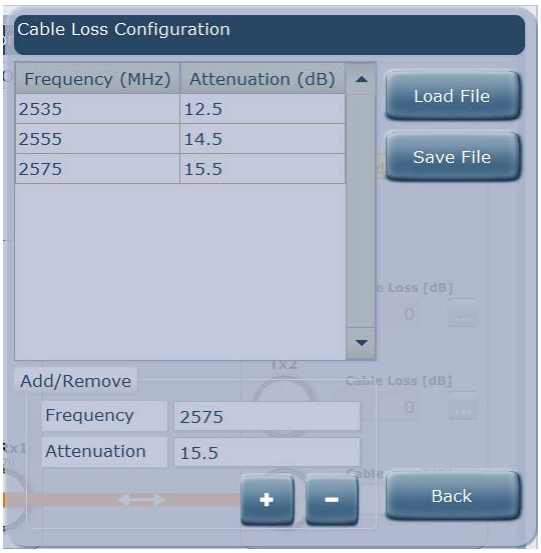


Figure 4-18: Connector cable loss information table detail

You can add frequency/attenuation pairs to the list by simply entering the desired frequency and attenuation values in the corresponding text fields and clicking on the "+" button.

Removal of a list entry involves clicking on the list entry to be removed, then clicking on the "-" button.

Furthermore, lists can be saved to a file (in order, for example, to allow definition of RF cable compensation information databases) and retrieved, by using the "Save File" and "Load File" respectively.

When using frequency/attenuation pairs list for RF cable loss compensation, the system automatically interpolates the values from the lists you provided based on the currently used DL and UL EARFCNs. The actual compensation value applied at any moment is displayed in the text field associated to each UXM RF connector in Figure 4-14.

However, the system only interpolates RF cable loss correction values if the frequency associated to the currently used DL/UL EARFCNs falls within the range of frequencies you entered in the RF cable frequency response dialog. Otherwise, the UXM uses a default correction value (0 dB). You are then responsible for updating the RF cable frequency response list accordingly or directly specifying the required correction value.

NOTE: The path loss setting value is retained through a power cycle of the UXM.

Configuration Menu Key

The **Configuration** menu key enables you to store and retrieve TA/LA configurations, allowing them to create a library of test scenarios and improving the overall system usability.

Figure 4-19: Configuration *Set Save Location* option

Selecting the **Set Save Location** menu key, enables you to specify the path to which the saved configuration files are stored to / retrieved from. The location is always the same each time you wish to save/recall a configuration until you change it.

Figure 4-20: Configurations management detail

Selecting the **Load Configuration** menu key opens a **Load File** dialog enabling you to select the saved configuration file to restore. By default, saved configuration files are stored in the directory(s) as shown below:

- If you log in as *Administrator*:
  D:\Users\Administrator\AppData\Roaming\Agilent\LTE_LTE-A Application\
  <App version number>\Measurements
- If you log in as *Instrument*:
  D:\Users\Instrument\AppData\Roaming\Agilent\LTE_LTE-A Application\
  <App version number>\Measurements

Selecting the **Save Configuration** menu key opens a **Save File** dialog enabling you to specify name and location in which to save the current system configuration. By default, saved configuration files are stored in the directory(s) as shown above.

Selecting the **Preset** button sets the configuration parameters in all the tabs to their default values.

Reconfiguration Menu Key

The **Reconfiguration** menu key enables you to reconfigure some cell parameters while being in the UE-registered, Transmit, Receive and Transmit/Receive states.

Blind HO

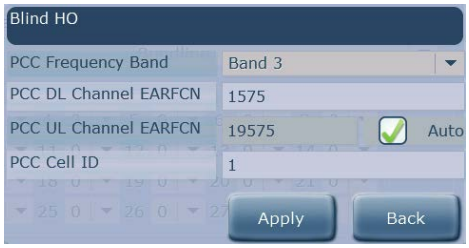


Figure 4-21: Blind Hand-over menu

This menu enables you to specify the PCC DL/UL channel EARFCN, and Cell ID during a measurement.

SCC Reconfiguration

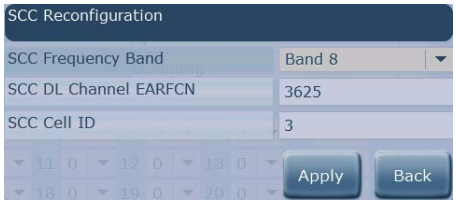


Figure 4-22: SCC Reconfiguration Menu

This menu enables you to change the SCC DL channel EARFCN, and Cell ID during in a measurement.

L1 Reconfiguration

This menu enables you to configure PCC and SCC HARQ related parameters during a measurement.

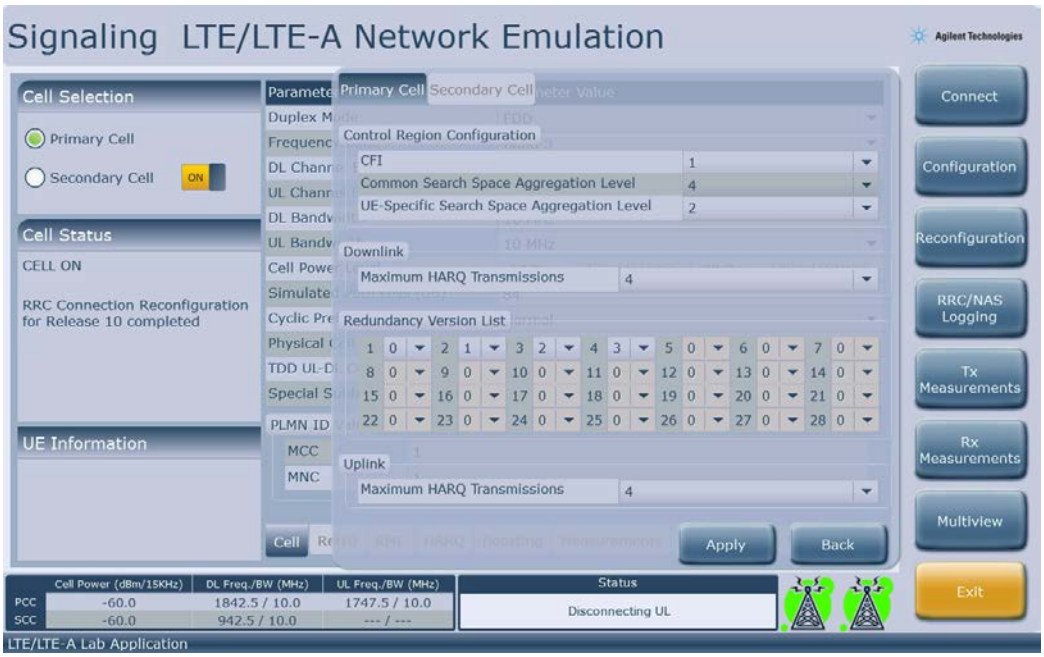


Figure 4-23: L1 Reconfiguration Menu

The **Control Region Configuration** includes settings for **CFI**, **Common Search Space Aggregation Level** and the **UE - Specific Search Space Aggregation Level**. These settings are explained in detail in the L1 Configuration menu descriptions on page 43.

You are also able to modify the UL and DL maximum HARQ transmissions, as well as the redundancy version list for both PCC and SCC. Refer to the *HARQ parameters tab* description on page 42 for more information on modifying these parameters.

5 Transmitter Measurements

Overview

The TA/LA implements an LTE UL signal analyzer, allowing LTE UE transmitter characterization.

The integrated signal analyzer provides you with a complete set of time, spectrum and modulation measurements, all of them based on the 3GPP TS 36.521-1 set of RF conformance test requirements.

The following sections provide details of each of the implemented transmitter measurements.

Common measurement support functionalities

The TA/LA provides you with several different transmitter measurements. Common to these measurements, you have these useful capabilities:

- RMC configuration
- Power Control
- Save to File
- Zoom and marker configuration

RMC configuration

At any moment during active measurements, you can reconfigure the main set of parameters defining the Reference Measurement Channel used thorough the measurement process.

Access this view by selecting the **RMC Config** menu key on the right size of the screen. The following dialog appears:

Figure 5-1: Reference Measurement Channel dynamic reconfiguration dialog

Details about the different parameters configuration have already been explained in previous the chapter.

Power Control

The TA/LA commands the UE to modify its current transmission power through the use of TPC commands. You control this by setting the UL power level for the UE using the menu shown below.

Figure 5-2: DL and UL Power Control menu options

Possible values for this parameter are:

- Set to maximum output power
- Set to minimum output power
- Set to specific output power level

The TA/LA issues TPC commands to the UE to command its transmission power to the specified value.

Setting the UE to maximum/minimum output power makes the LTE network emulation continuously send the UE up/down TPC commands, respectively. Specifying a value for the target UE output power level makes the LTE network emulation enter an adjustment process in which up/down TPC commands are sent to the UE, based on the UE output channel level measurements performed by the TA/LA automatically, until the desired UE output power level is adjusted.

This parameter can be changed when the TA/LA is in the *Transmit*, *Receive* or *Transmit/Receive* states.

Selection of the maximum and minimum UE transmission power levels is done through the provided controls in the **Power Control** menu key.

Figure 5-3: Dynamic DL/UL power control dialog

The changes are effective after you select **Set Max**, **Set Min,** and **Set**.

Also, you may specify a new value for the DL cell power level at any time. In order to do so it is necessary to input the desired cell power level in the corresponding field and select **Set**.

Save to File

Anytime during the measurement process, you can perform a capture of the measurement results, together with trace data (in CSV format), by selecting the **Save to file** menu key in the right side of the TA/LA.

Pressing this menu key triggers the generation of two text files in the application install directory:

- **Measurements results summary**: This text file contains two sections. The first section provides the complete configuration used by the TA/LA during the measurement process, while the second provides a summary of the measurement results.
- **Trace data**: For those measurements which include a graphical representation of the measurement results, a file is also generated containing the graph data in CSV format.

The result files are named according to the actual measurement for which they were created. The name also includes an automatically increasing numeric index allowing several of these files to be generated without overwriting previous captures.

Zoom and marker configuration

You can customize the way graphical measurement data is presented.

You can zoom in and out, focus on a specific area, pan the graph view and set markers providing measurement data about the specific point in the graph. You can also revert to the default configuration, automatically.

This functionality is accessed from the menu of icons located on the right-hand side of the screen.

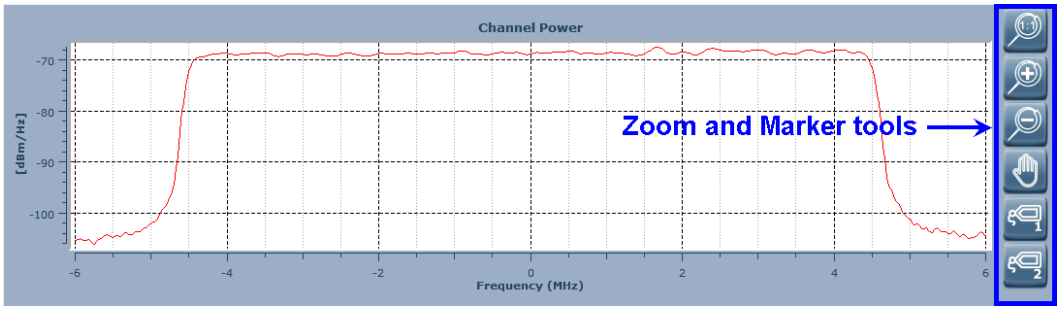


Figure 5-4: Zoom and Marker tools

Channel Power measurement

This RF measurement provides the total output power of the UE transmitter calculated as per 3GPP TS 36.521-1, provided that the configuration of the RMC is done according to the corresponding 3GPP TS 36.508 clause.

Depending on the UE configured output power, you will obtain a measurement of the following:

- transmitter maximum output power
- transmitter minimum power
- transmitter power based on a level you specify

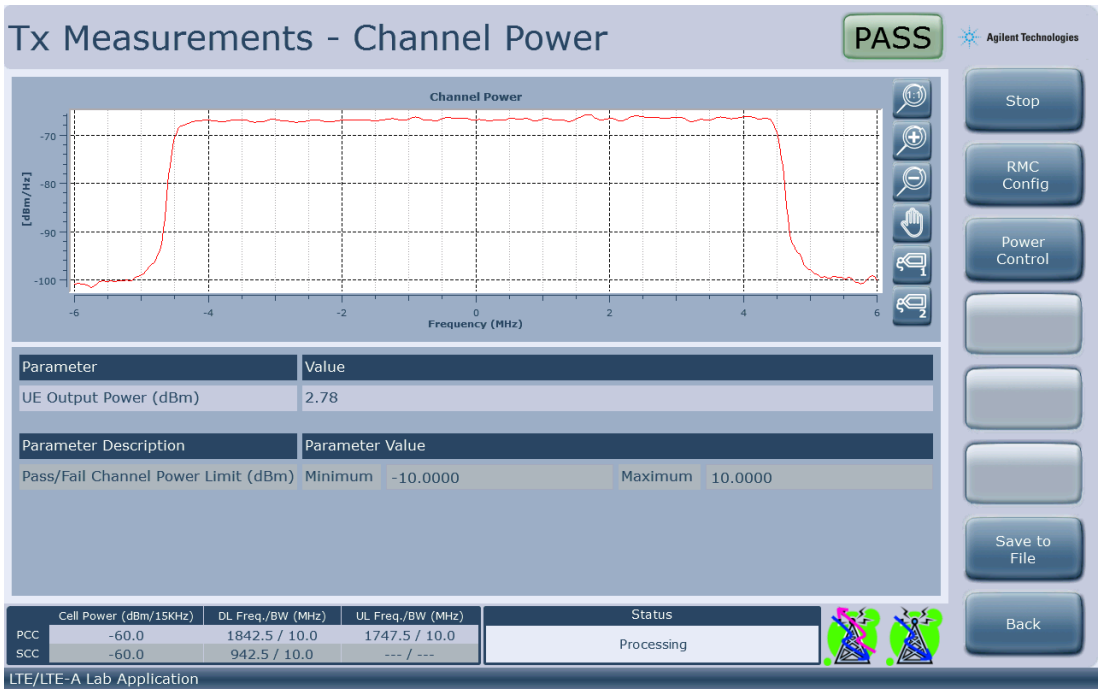


Figure 5-5: Channel Power measurement display view

When you select **Tx Measurements**, **Channel Power**, the display on the TA/LA is displayed as shown above.

The graph in the above screen provides the measured mean power versus frequency, in a bandwidth centered in the selected UL EARFCN. You can use the marker functionality to display specific point frequencies and power axis values.

The table right below the graph provides you with the actual figure for the calculated total output power, according to 3GPP TS 36.521-1, section 6.2 requirements.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits.

Spectral Flatness measurement

The spectral flatness is a measure of the relative power variation across the subcarriers of the RBs allocated in the UL.

This measurement is performed according to 3GPP TS 36.521-1 procedure, defined in section 6.5.2.4.

Figure 5-6: Spectral flatness measurement display view

When you select **Tx Measurements**, **Spectral Flatness**, the display on the TA/LA is displayed as shown above.

The graph above provides the relative carrier power variation across the allocated UL blocks. As with previous measurements, you can use the marker functionality to obtain frequency/level of a specific point in the graph.

The table right below the graph provides you with the actual figure for the calculated carrier level absolute difference according to 3GPP TS 36.521-1 requirements.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits.

EVM constellation measurement

The EVM constellation measurement provides you with a measure of the difference between an ideally modulated reference waveform and the actual measured waveform.

The purpose of the measurement is to verify the UE transmitter modulation quality.

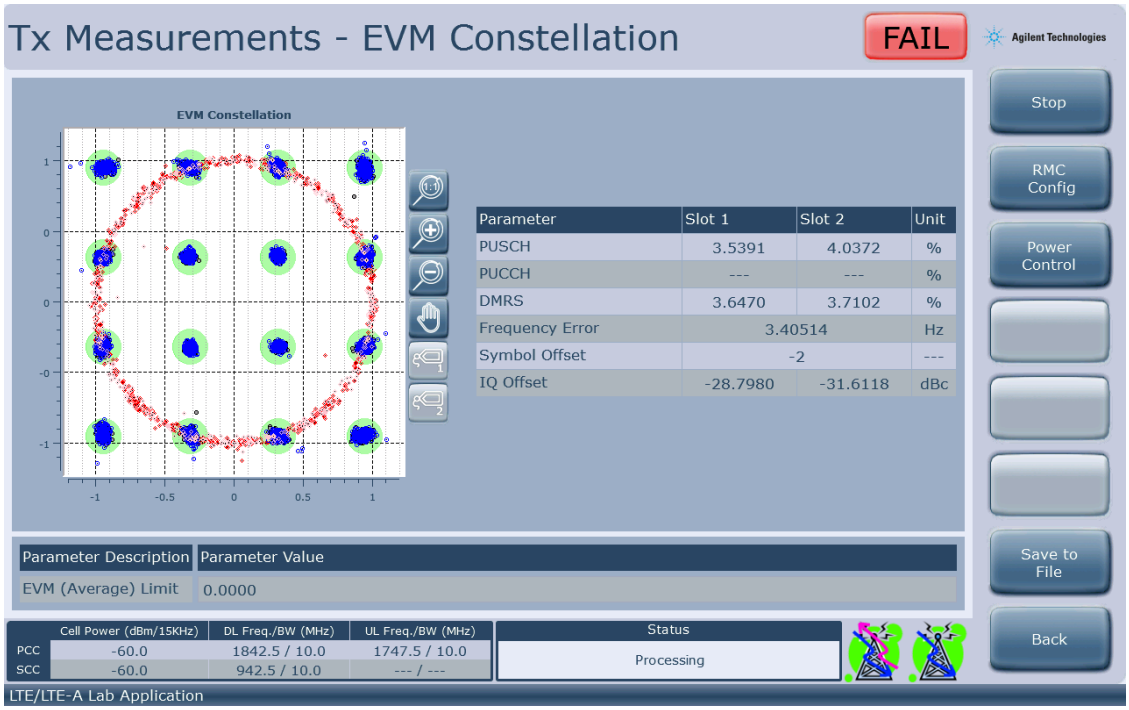


Figure 5-7: Constellation measurement display view

When you select **Tx Measurements, EVM Constellation**, the view in the figure above is shown.

The graph above provides the EVM constellation display for the selected UL channel (PUSCH, PUCCH). The display provides both data (black and blue points, depending on which slot they were transmitted) and reference pilots (red points) information. Indication is also provided in the graph regarding the actual pass/fail criteria limit value selected by the user (green areas around the ideal constellation points).

Along with the EVM constellation graph, a summary table is displayed, containing several modulation quality related measurement results.

This table provides measurement results obtained following the requirements of TS 36.521-1.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits.

EVM versus symbol measurement

The EVM versus symbol measurement provides you with a measure of the evolution of the modulation quality of the UE across the different SC-FDMA symbols of a slot.

The measurement provides information about the average EVM measured for each and every symbol, including both data and reference signals.

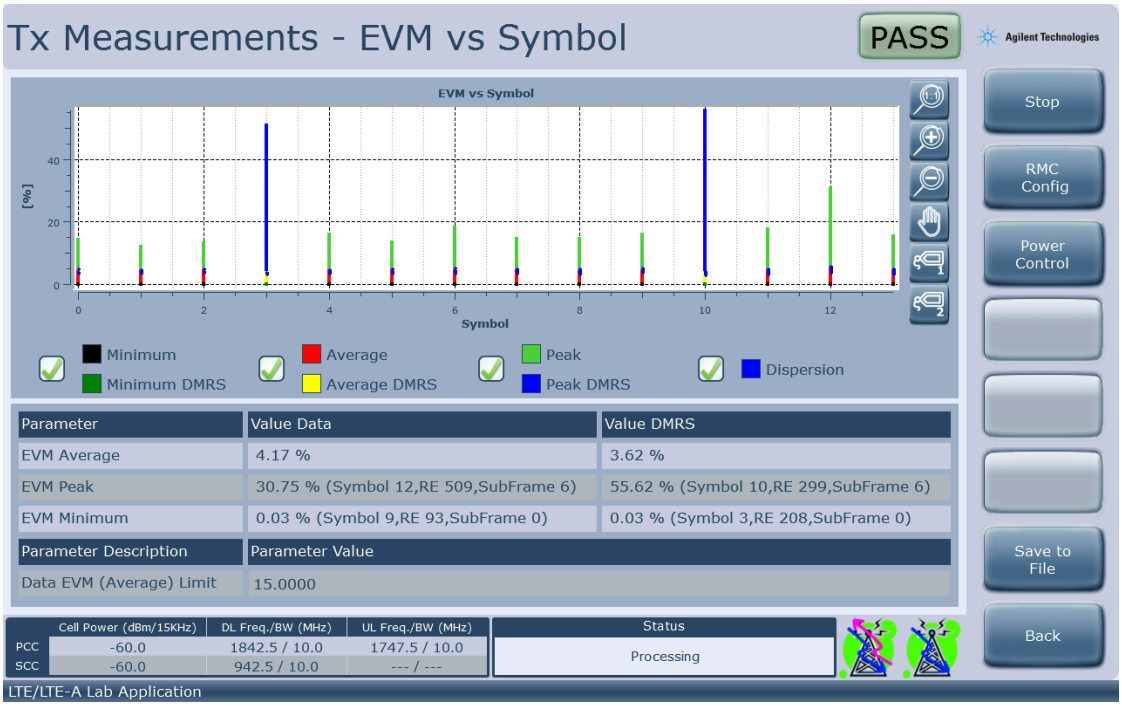


Figure 5-8: EVM vs symbol measurement view

When you select **Tx Measurements**, **EVM vs Symbol**, the view in the figure above is shown.

The graph above provides the EVM versus time display for the UL channel, presenting the information you select about the PUSCH and PUCCH channels. The display provides information for both data symbols (red points) and reference symbols (green points).

Along with the EVM versus time graph, a summary table is displayed, containing a summary of the EVM measurement results. You can use the marker functionality to obtain symbol index/EVM level of a specific point in the graph.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits.

EVM versus carrier measurement

The EVM versus carrier measurement provides you with a measure of the evolution of the modulation quality of the UE across the set of allocated carriers.

The measurement provides information about the average EVM measured for each and every allocated carrier.

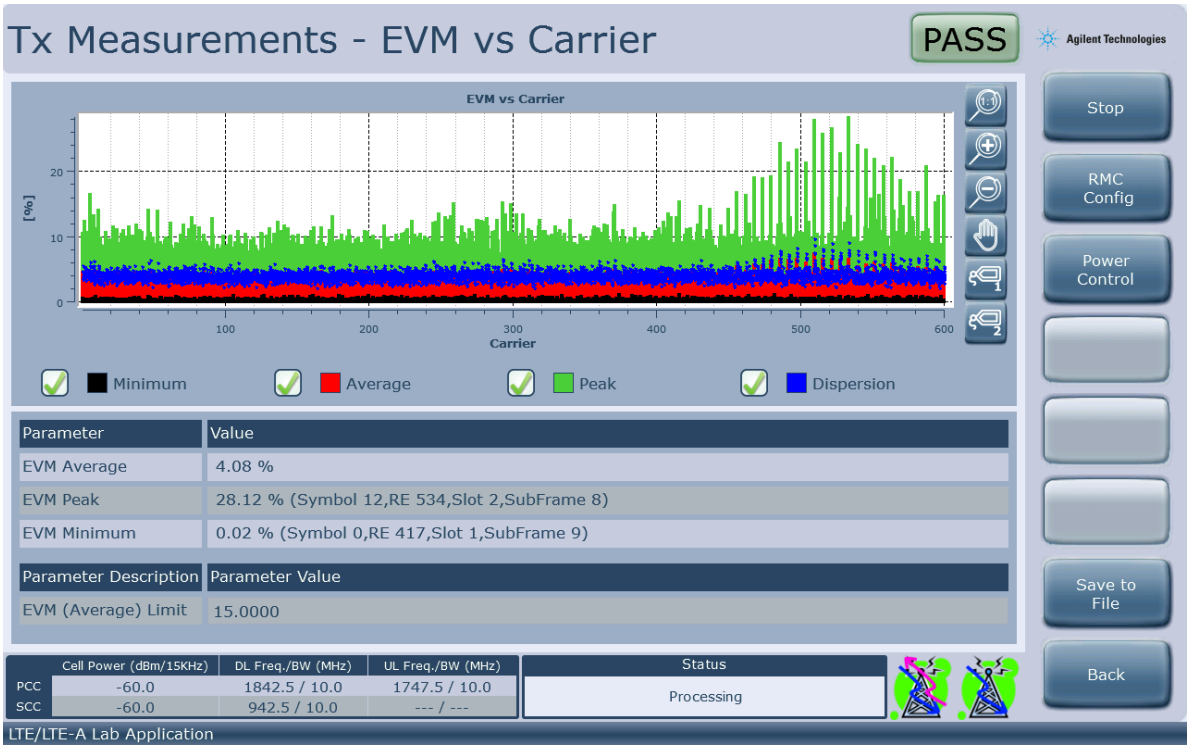


Figure 5-9: EVM vs carrier measurement view

When you select **Tx Measurements, EVM vs Carrier**, the view in the figure above is shown.

The graph above provides the EVM versus frequency display for the allocated UL channel.

Along with the EVM versus frequency graph, a summary table is displayed, containing a summary of the EVM measurement results. You can use the marker functionality to obtain carrier index/EVM level of a specific point in the graph.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits.

Occupied bandwidth measurement

The occupied bandwidth measurement provides you with a measure of the bandwidth that the UE transmitter uses when in operation.

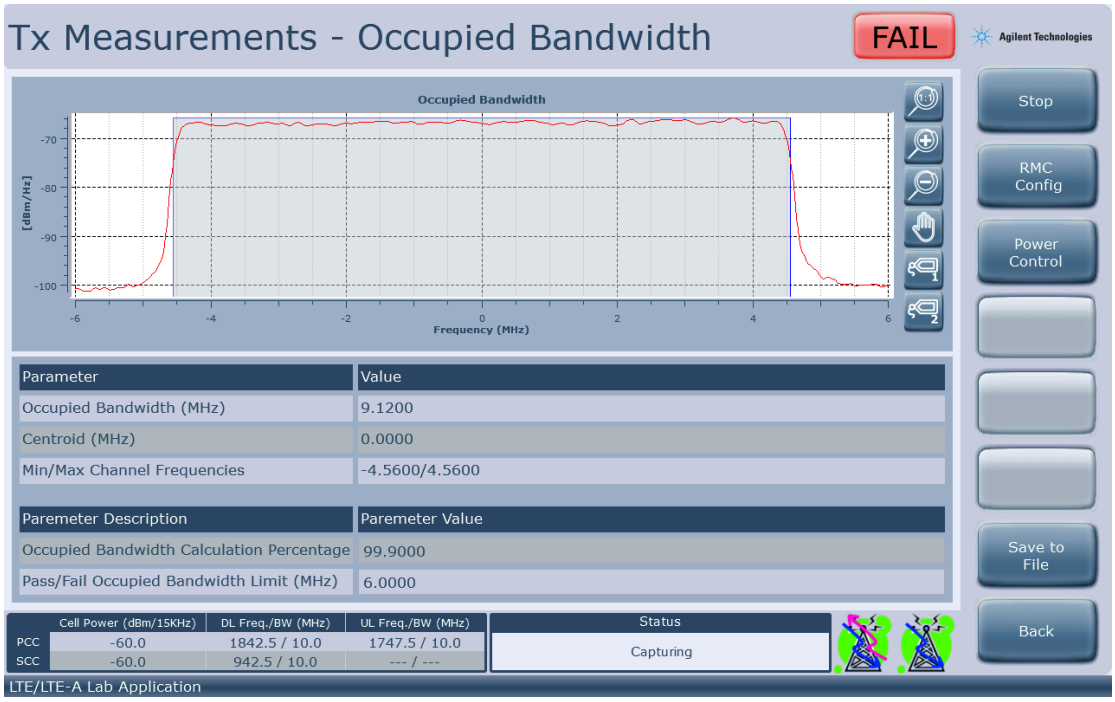


Figure 5-10: Occupied bandwidth measurement view

When you select **Tx Measurements, Occupied bandwidth**, the view in the figure above is shown.

The graph above provides the occupied bandwidth for the allocated UL channel.

Along with the occupied bandwidth graph, a summary table is displayed, containing a summary of the measurement results (occupied bandwidth, channel centroid and min/max channel frequencies). As with previous measurements, you can use the marker functionality to obtain offset frequency/power level of a specific point in the graph.

The lower table enables you to input the measurement pass/fail verdict assignation criteria limits, as well as the occupied bandwidth percentage to be used during the measurement process (an indication of the amount of energy to consider when the system calculates the ratio between total channel energy and occupied bandwidth energy).

CCDF Measurement

The CCDF measurement view provides you with a graphical representation of the probability that the signal analyzed by the TA/LA exceeds its average level by a given amount.

This measure is used to help designers of output stages and power amplifiers in radio communication transmitters to obtain information about linearity requirements in their designs.

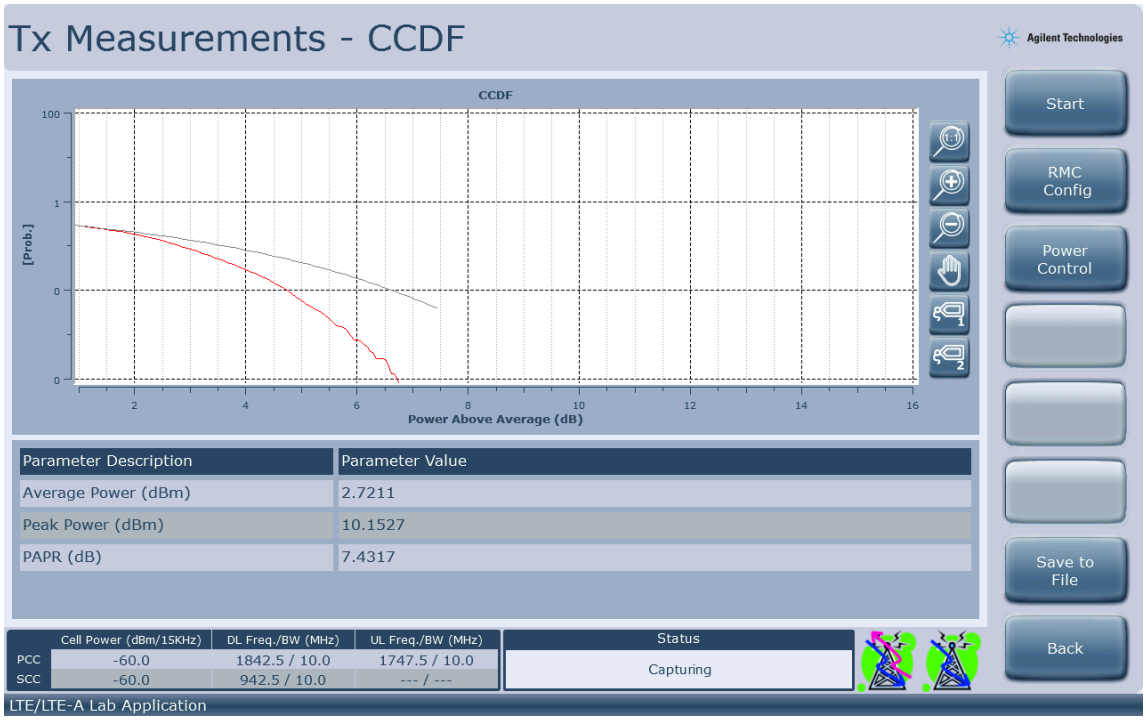


Figure 5-11: CCDF measurement view

When the user selects **Tx Measurements**, **CCDF,** the view in the figure above is shown.

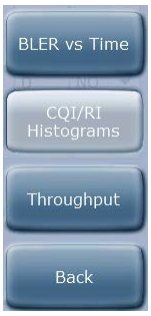
The graph provides the probability (vertical axis) that the signal being analyzed exceeds its average level by an amount specified in dBs (horizontal axis).

The table below the graph displays the Average Power (dBm), Peak Power (dBm) and Peak-to-Average Power Ratio (PAPR).

6 Receiver Measurements

Select the **Rx Measurements** menu key on the right side of the display. A new sub-menu is displayed showing:

- BLER vs Time
-



Overview

The TA/LA includes LTE UE receiver measurement functionality, based on the UE HARQ feed-back that provides BLER measurements including CQI and RI Histogram results.

This functionality enables you to characterize your UE receiver implementation, using different reference measurement channel configurations.

Product option E7515A-C01 provides integrated fading channel emulation, based on 3GPP TS 36.521-1 defined channel models which further enables you to simulate near real-life conditions when testing your UE receiver.

Common measurement support functionalities

The TA/LA provides you with receiver measurement capabilities. The following options are available to enhance them:

- RMC configuration
- Power Control
- Save to File
- Channel Impairments
- Zoom and marker configuration

RMC Configuration

Refer to the section entitled, *RMC Configuration Basics* on page 33 and other previous sections for details of this functionality.

Power Control

Refer to Power Control on page 71 for details of this function.

Save to file

Refer to *Save to File* section on page 71 for details on this functionality as well as the information about the **Set Save Location** menu option described on page 67.

Channel Impairments

During receiver measurements, the TA/LA can introduce impairments to the DL channel, in order to dynamically apply more realistic channel conditions during the test.

The following figure depicts the channel impairment configuration dialog:

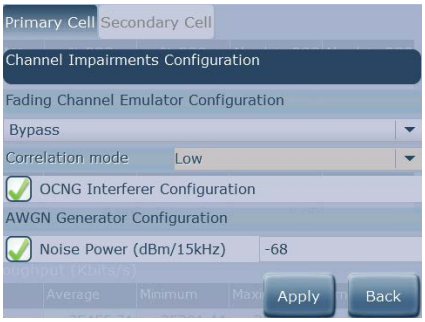


Figure 5-1: Channel impairments configuration dialog

The following channel impairments can be configured:

- Channel model. Following 3GPP TS 36.521-1 channel models are implemented:
  - EPA5
  - EVA5
  - EVA70
  - ETU70
  - ETU300
  - CQI
  - HST
- Fader correlation mode. Following 3GPP TS 36.521-1 fading channel correlation modes are supported:
  - Low
  - Mid
  - High
- OCNG Interferer Configuration (OFDMA Channel Noise Generator)
- AWGN signal level (Additive White Gaussian Noise)

Applying Channel Impairments

1. Select the **Channel Impairments** option from the right-hand key menu. The configuration window opens as shown in the figure below:

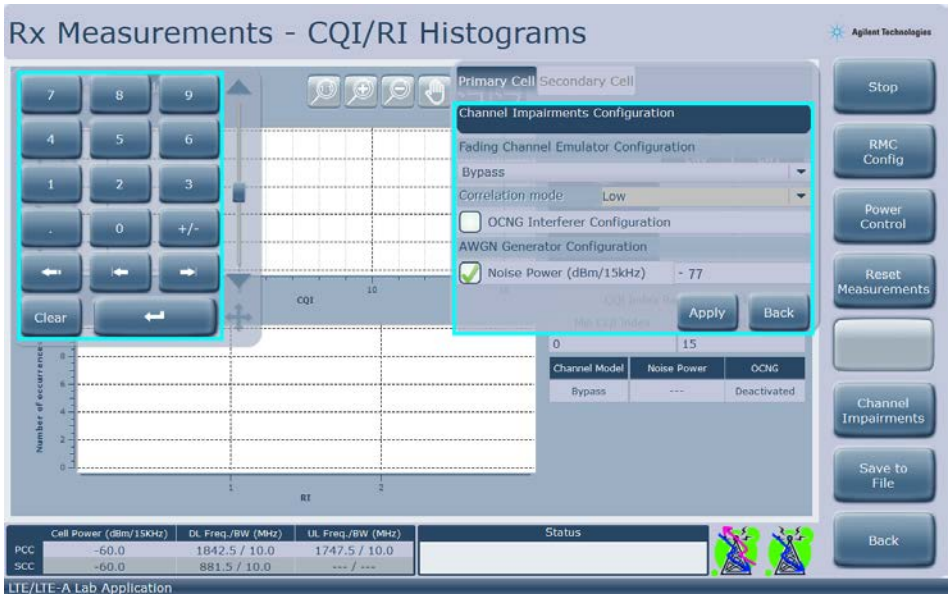


Figure 6-1: Applying Channel Impairments

2. Select the **AWGN** box and then enter **-77** using the displayed numeric keypad or a remote keyboard. (When using the displayed numeric keypad, you need to select **Clear** first. Using either the displayed keypad or a remote keyboard, the negative sign (+/-) must be applied after selecting the value.) Then select **Apply**. The windows outlined in turquoise above will close.

   Applying this noise to the channel increases the difficulty for the UE to decode the DL and a lower CQI value is now reported as shown below.

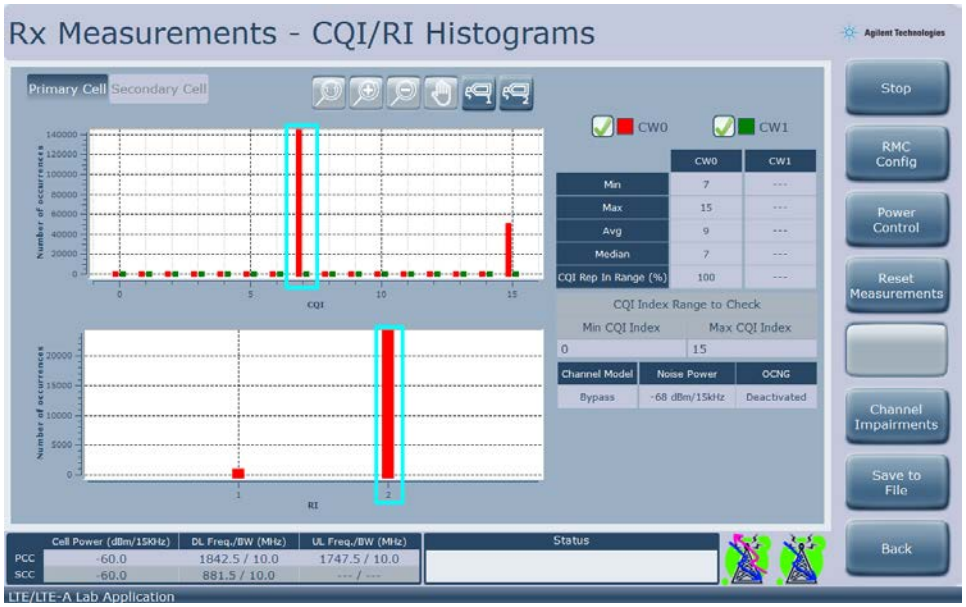


Figure 6-2: Lower CQI with applied AWGN

BLER measurements

The receiver BLER measurements enable you to characterize the UE receiver implementation, by measuring the BLER calculated as a function of HARQ feedback received by the test system when the UE is fed with a reference downlink signal.

You are also able to choose the fading channel model to be emulated during the actual receiver measurements, together with the level of AWGN (and OCNG) to be added to the desired reference signal, thus providing a more realistic testing environment.

BLER vs Time

This measurement enables you to characterize the UE receiver implementation, by measuring the BLER as a function of time.

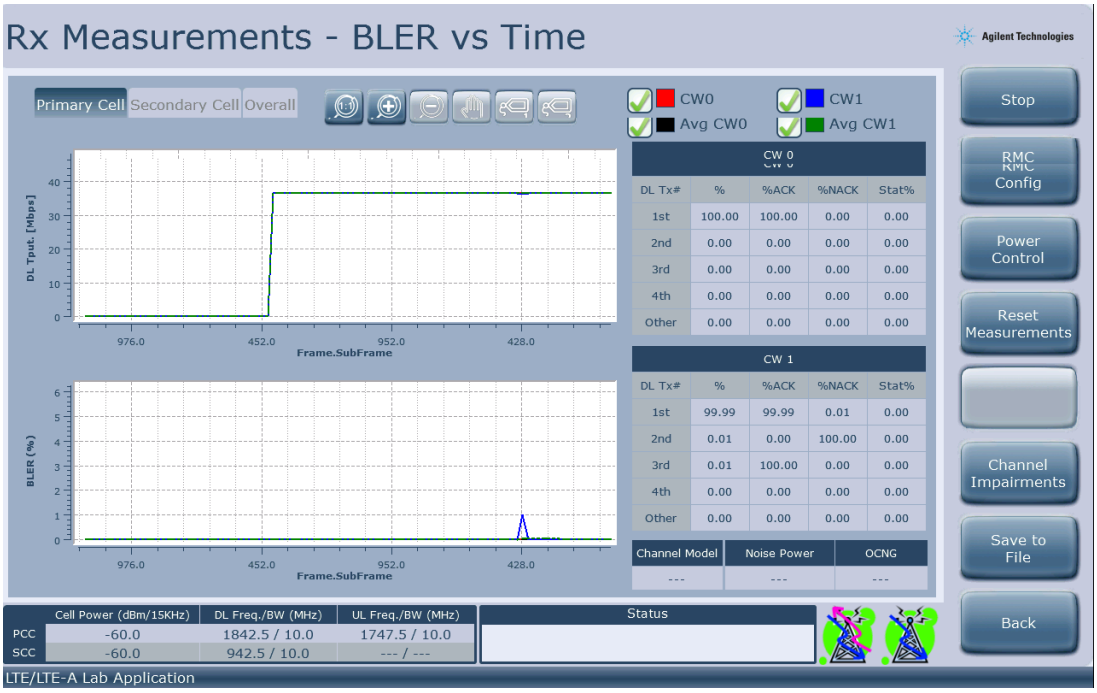


Figure 6-3: Receiver - BLER vs Time measurement view

Selecting **Primary Cell** or **Secondary Cell** from the upper-left screen selections enables you to view the codeword 0 (**CW0**) and/or 1 (**CW1**) results as well as the ACK/NACK/StatDTx counts for each retransmission. (Set the retransmission values on the **HARQ** lower tab.)

BLER/Throughput

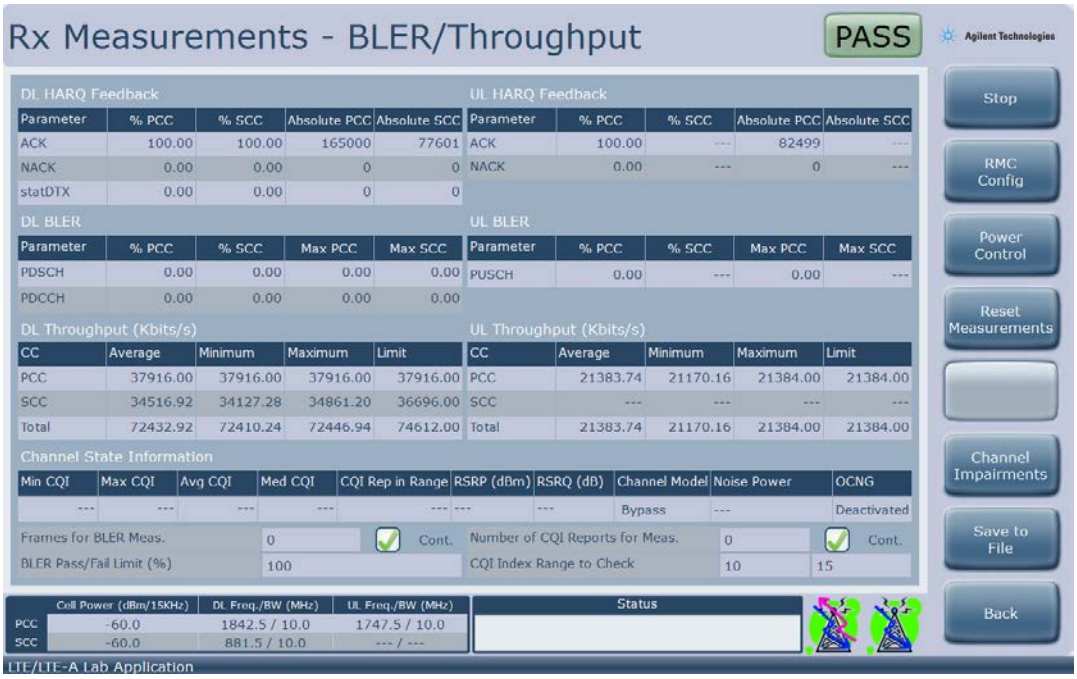


Figure 5-2. Receiver - Throughput measurement view.

When you select **Rx Measurements**, **Throughput**, the view shown in the figure above is displayed.

The receiver measurement results display is divided in two different columns:

- left one displays DL related information
- right one focus on UL data

The table in the upper section provides you with information about the actual HARQ feedback received/sent from/to the UE during the complete measurement process.

The table located just below the previous one provides indication about the measured BLER and is derived from the data presented in the upper table.

The third table starting from the top provides indication about the measured throughput, indicating not only instantaneous throughput, but also maximum and minimum values achieved during the complete measurement process, together with the maximum theoretical throughput achievable with the current RMC configuration.

The table right below this one shows information about CQI and RSRP/RSRQ feedback from the UE, on the DL information column. This table on the UL information column displays information about the current fading emulation and AWGN generation configuration,

Finally, the table located at the bottom enables you to configure several parameters related to the measurement process:

- Number of frames over which the receiver measurement should be performed
- Pass/fail BLER percentage criteria
- Number of CQI reports to account for CQI/PMI reporting measurements
- Minimum and maximum CQI index to account for CQI range measurement

CQI/RI Histograms

CQI must be set up in the **Measurement** and **RMC** lower tabs to enable CQI reporting in the *CellOFF* state .

Notice there are two upper tabs for PCC and SCC, separate results for Codeword 0 and 1, as well as CQI statistics.

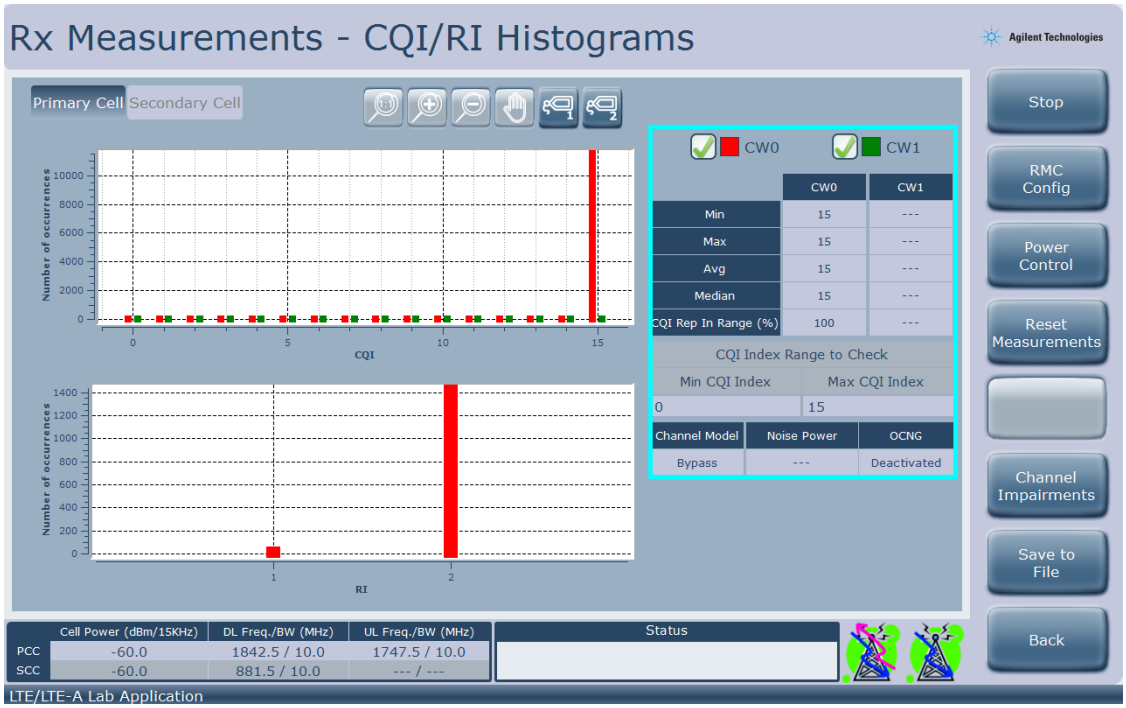


Figure 6-4: CQI Index for Primary Cell

7 Multiple simultaneous measurements in the TA/LA

The TA/LA is capable of simultaneous providing the user with results of several of the previously presented measurement, for both the transmitter and the receiver of the UE.

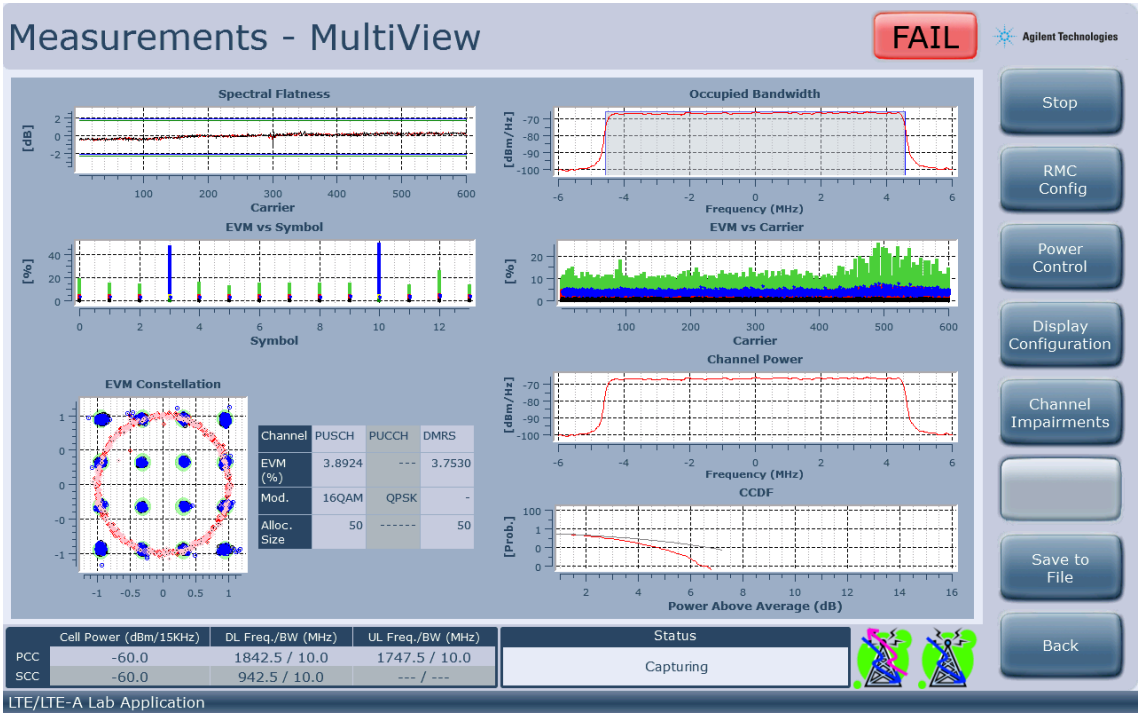


Figure 7-1:Measurement MultiView

When you select **Multiview** in the main display of the TA/LA, you see a similar view as that shown in the figure above.

You can configure the layout of the different measurements in the screen by selecting which measurement is to be assigned to each position in the layout grid (note that some measurements require two positions on the grid). Both transmitter and receiver measurements can be selected for inclusion.

All the functionalities available in the single measurement display are also available in this screen, like the marker functionality.

Additionally, you can use the multi-view display to focus on each one of the measurements by double-tapping any of the grid positions.

Multiple measurement customization

The Agilent LTE/LTE-A TA/LA enables you to customize the type and position within the multiple measurement display for each and every measurement to be displayed.

The maximum amount of measurement graphs that the TA/LA is capable of displaying simultaneously is 6, arranged in a four rows by two columns matrix.

You can select which of the available transmitter and receiver measurements are displayed in each position. The only limitations to this are:

- Only a single instance of each measurement type can be displayed at any one moment.
- While all the available measurements can fit into a single column, some of them require the use of two rows in order to be presented. You cannot configure the measurements on slots which do not have an empty slot in the row right below it or if the slot being configured is in the fourth row.
- By default, if a measurement is configured alone in a row, it is expanded to occupy the complete row. However, you are still able to select the other column to present results of another measurement. The previously configured measurement is resized in order for both measurements to fit within that row.

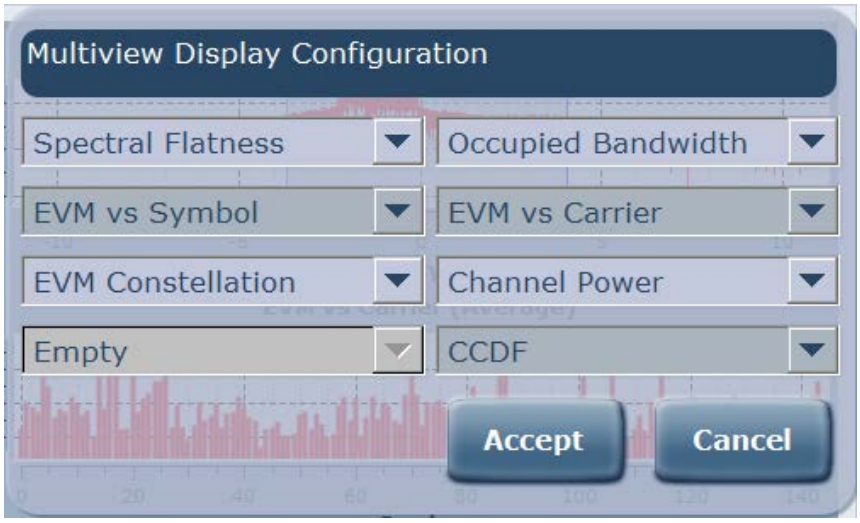


Figure 7-2: Multi-measurement display layout configuration dialog

8 Carrier Aggregation

Carrier aggregation (CA) is the basis of LTE-Advanced and enables LTE to achieve the goals mandated by IMT- Advanced while maintaining backward compatibility with LTE Releases 8 and 9.

Release 10 CA permits the LTE radio interface to be configured with any number (up to five) carriers, of any bandwidth, including differing bandwidths, in any frequency band. Further, the downlink and uplink can be configured completely independently, with only the limitation that the number of uplink carriers cannot exceed the number of downlink carriers. The carriers aggregated in the context of CA are referred to as *component carriers* (CCs). CC arrangements are described as *intra-band contiguous*, *intra-band non-contiguous*, and *inter-band*, referring to immediately adjacent CCs, non-adjacent CCs within the same operating band, and CCs in differing operating bands, respectively.

The example below shows how you can test Release 10 UEs using inter-band CCs for FDD.

Carrier Aggregation Test Setup

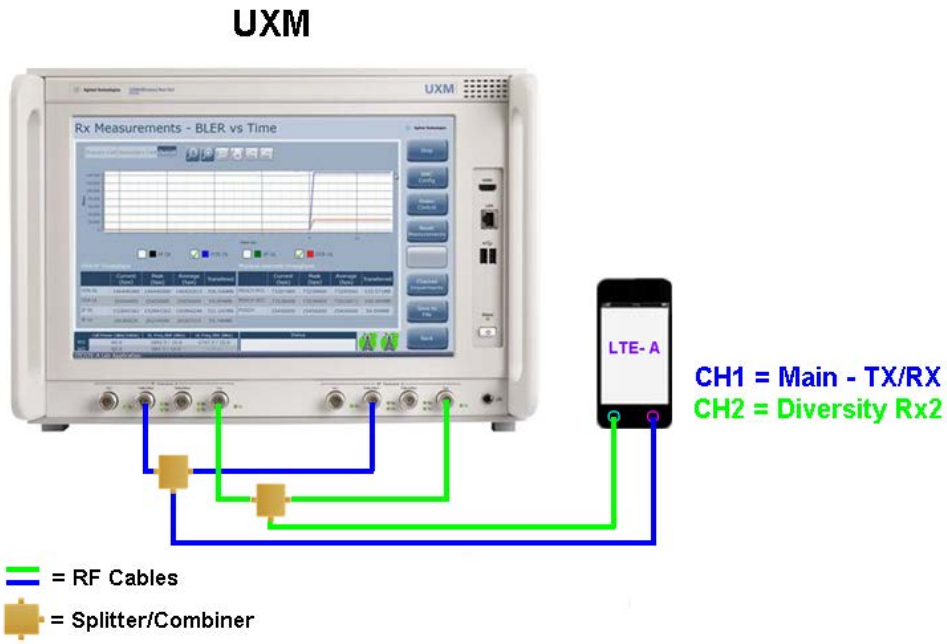


Figure 8-1: Carrier Aggregation Test Setup

Equipment needed for test

- 1 - E7515A configured with options: BA1, BB1 (two digital baseband transceivers)
- 1 - Option AFP-FDD (2CC DL CA) software (This option is required if you purchased the E7530A LTE/LTE-A Test Application.)*
- Cables and adaptors to interconnect the UXM to the combiners and UE
- 2 splitters/combiners
- CA capable UE
- 1 mouse
- 1 keyboard

*__Note__: FDD version A.02 of the LA does not require any extra options to run CA.

Setting Up the Test

1. Turn the UXM **On** and follow the procedure in the *Agilent E7515A UXM Getting Started Guide* for details in booting up the instrument and launching the TA/LA software.
2. Make all connections as shown in Figure 8-1 above.

Instrument Settings

Primary Cell Setup

3. Scroll to the **System** tab from the lower row of tabs near the bottom of the display by selecting the right arrow on the right side of tab row.

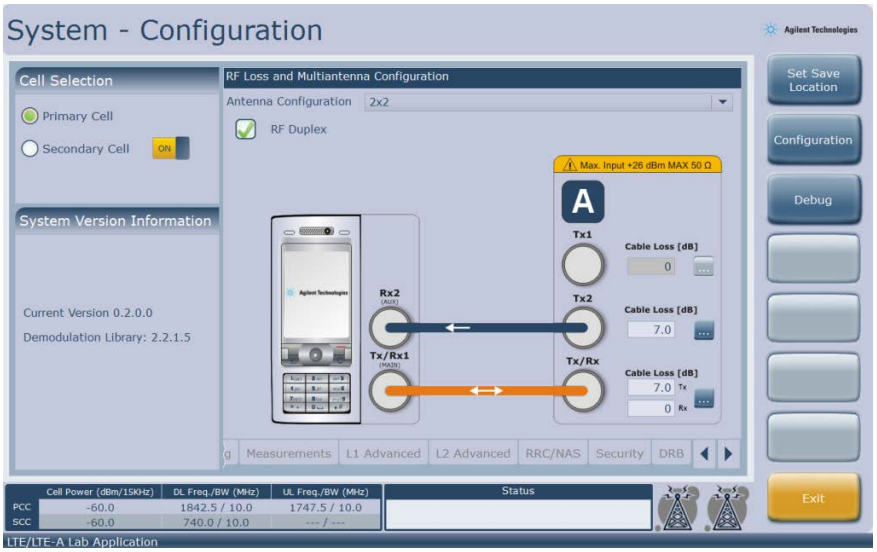


Figure 8-2: Primary Cell - System Tab Configuration

4. Set the **Cable Loss** on this screen to take into account the losses in all RF cables and combiners/splitters.

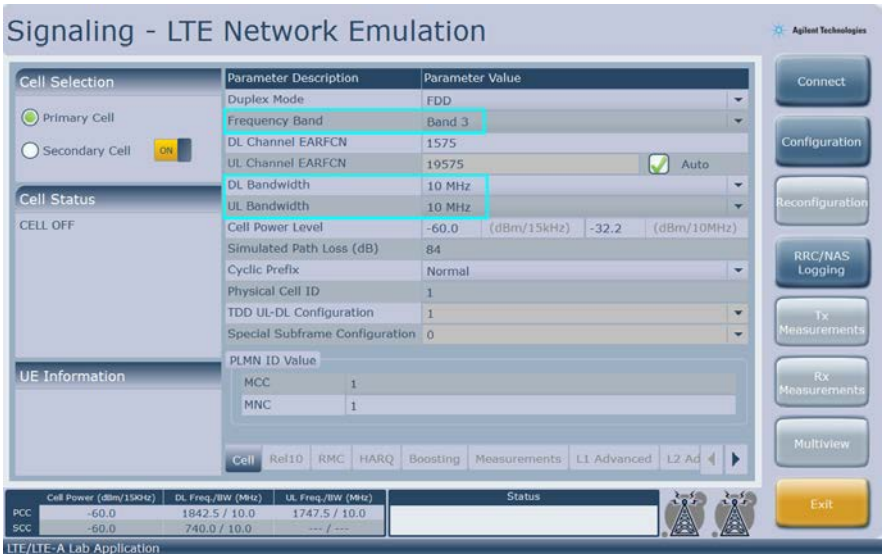


Figure 8-3: Example Cell tab PCC settings

5. Scroll left to the **Cell** tab and select the band, bandwidth and other Cell settings applicable for you UE.
6. Scroll through the various lower tabs, selecting the appropriate settings for your UE.
7. Scroll to the right to the **Security** tab. Select the Authentication key as appropriate for your specific UE SIM.

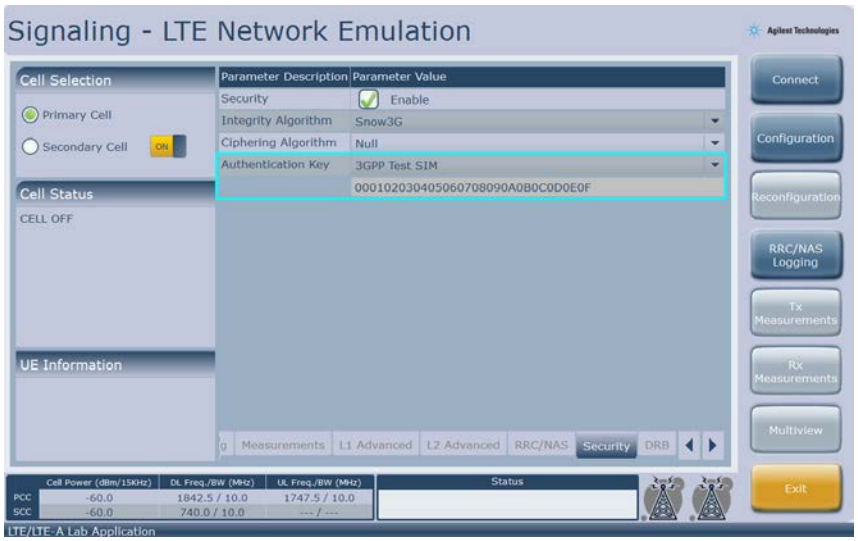


Figure 8-4: Setting the Authentication Key

8. In order to view CQI and RI Histogram measurement results, select the **Periodic CSI Reporting Configuration** box (for both PCC and SCC) located on the screen obtained by scrolling to the **Measurements** lower tab. (You cannot select this option while the **Cell Status** is in the **Cell ON** mode). If you are not interested in these results, skip this step and continue to *Secondary Cell Setup*.

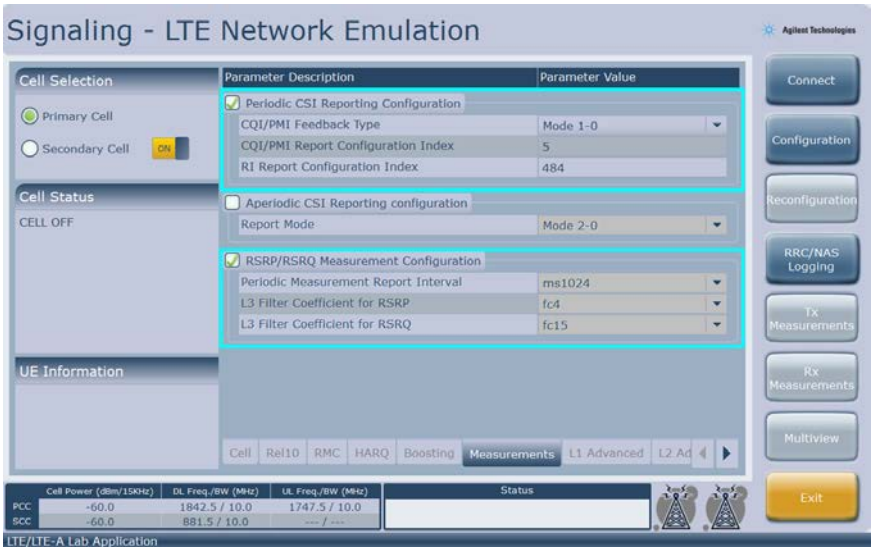
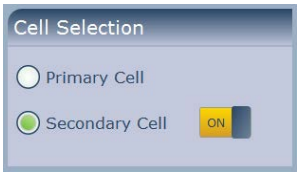


Figure 8-5: Selections for Measurements tab

9. In order to view RSRP and RSRQ values for the PCC when viewing your measurement results, select the **RSRP/RSRQ Measurement Configuration** box located on the same Measurement screen, as shown in the figure above. (You cannot select this option while the **Cell Status** is in the **Cell ON** mode). If you are not interested in these results, skip this step and continue to *Secondary Cell Setup*.

Secondary Cell Setup

10. Set the **Cell Selection** ON/OFF switch to **ON** by touching or selecting the current state: 



NOTE	There are fewer tabs available when you are setting the Secondary Cell.

11. Scroll through the various lower tabs, selecting the appropriate settings for your UE.

Getting Connected

12. Navigate to any of the lower tabs except **System** and select **Connect**.
13. A sub-menu is displayed. Select **Cell ON**.
14. Switch on the UE. The UE may take up to 2 minutes to connect depending on previous connections and settings.

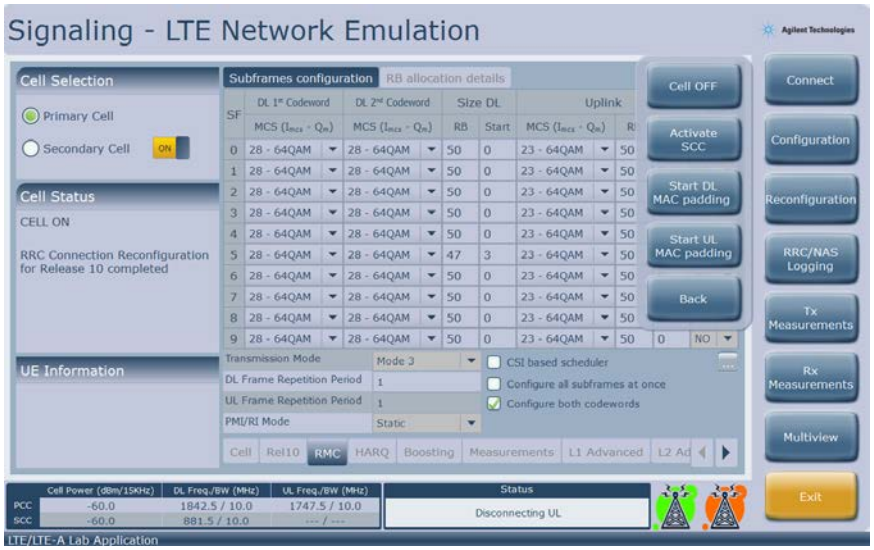
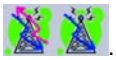


Figure 8-6: UE Attach is complete

NOTE	The Tower icons have changed from no color  to the above green and orange  which means the PCC is active and the SCC is present, but the UE has not been provided an allocation for its use.

15. Select **Activate SCC**, **Start DL MAC padding**, **Start UL MAC padding** and then **Back,** consecutively. (You may have to wait a few seconds for the **Activate SCC** option to become available while the instrument is turning on the SCC.) Cell status shows UE is now connected and the towers are shown as  . Which means PCC/SCC are both active and there are both UL and DL allocations.

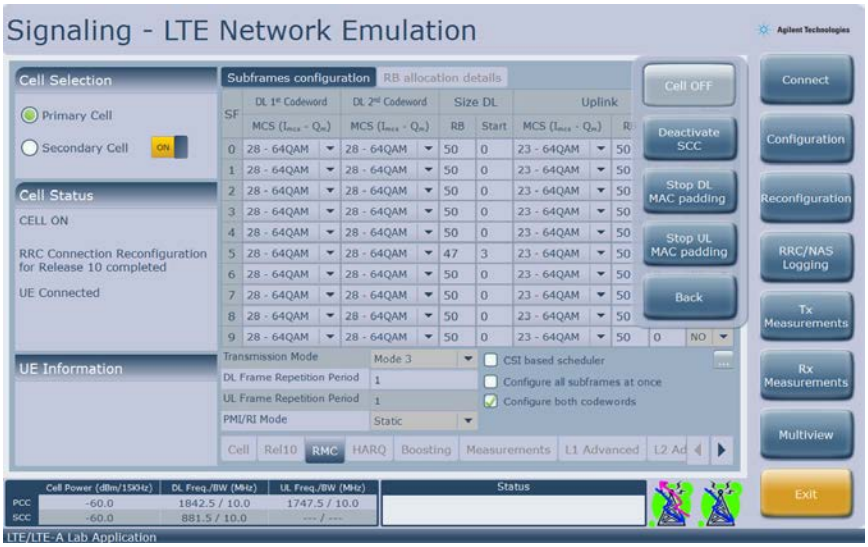


Figure 8-7: UE Connected - Activated SCC

16. Review the *Tx Measurements* section on page 70 and *Rx Measurements* section on page 80 for more information in viewing your desired measurement results.

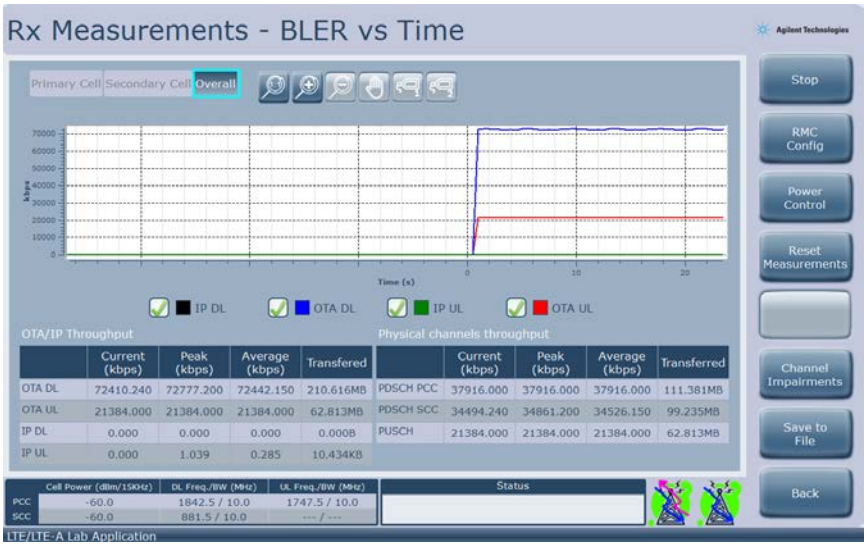


Figure 8-8: BLER vs Time – Overall

17. Selecting **Rx Measurements**, **BLER vs Time** displays the view shown above.

9 End to End (E2E) Throughput Measurement

IMPORTANT	It is recommended that you use an external PC to host software applications you wish to use in conjunction with the UXM. Installing applications on the instrument Host PC may result in a compromised performance of the UXM including decreased throughput and/or measurement performance.

E2E Throughput Test Configuration

Component	IP	Subnet Mask	Default Gateway
Server PC	192.168.1.230	255.255.255.0	192.168.1.60
UXM	192.168.1.60	255.255.255.0	192.168.1.230
UE Host/UE Host Client PC	192.168.1.51	255.255.255.0	

Table 9-1: Component IP Settings

NOTE	1. The IP address settings shown in the above table are configured by following the instructions below in the section, entitled, *Configuring Component IP* settings on page 95. 2. The Server PC in the above table is an external PC. 3. The UE can host the Client or use an external PC to host the client.

Equipment needed for test

- 1 - E7515A configured with options: BA1
- 2 - Cables to connect to UE
- 2 - Combiners and additional cables if testing with Carrier Aggregation
- 1 - UE hosting Client (or external Client PC)
- 1 - Client PC (if UE does not host the Client)
- 1 - LAN cable
- 1 - Server PC
- 1 mouse
- 1 keyboard

Setting Up the Test

1. Turn the UXM **On** and follow the procedure in the *Agilent E7515A UXM Getting Started Guide* for details in booting up the instrument and launching the TA/LA software.
2. Connect UE to UXM and the Server PC to rear LAN1 port. (You can also use LAN3 which is located on the front-panel.) Refer to the *Agilent E7515A UXM Getting Started Guide* for details of the rear LAN port location. It is the upper-most LAN port on the rear panel.
3. If you wish to run this test using Carrier Aggregation, follow the instructions in the Carrier Aggregation chapter above. Stop when you reach Getting Connected on page 91. Then return here, to the next step below.
4. To obtain maximum throughput it is important to allocate the subframes appropriately. Scroll right to the **RMC** tab. Make sure all subframes have full allocation except subframe 5, for which you need to set an RB start offset of at least 2. Depending on the BW and Transmission mode selected, an offset of 2 may not be possible, so the next configurable one (3 or 4) should be used instead to obtain maximum throughput. For example, for BW 10MHz and Transmission Mode 3, a value of *3* should be used for subframe 5 starting point. To make this change, set the **SIZE DL**, **Start** (to 3).

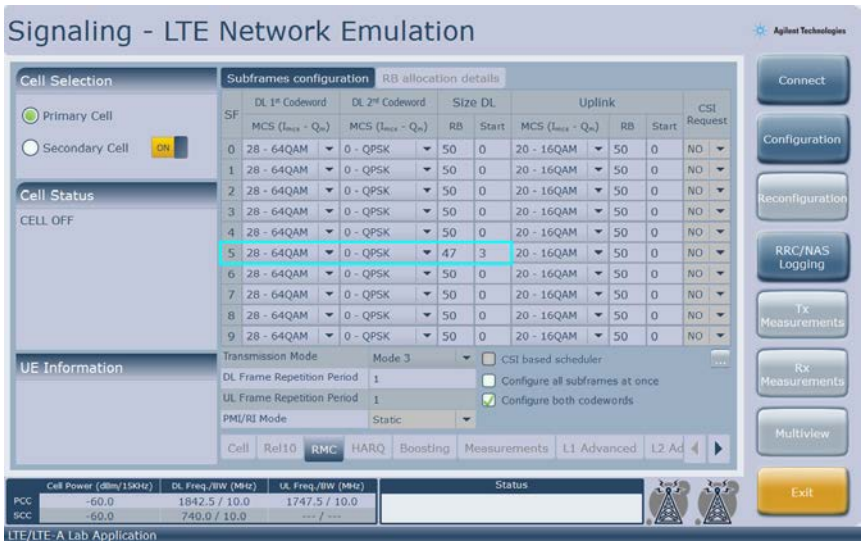


Figure 9-1: 10 MHz BW example: Setting Subframe 5 to start at 3

Configuring Component IP Settings

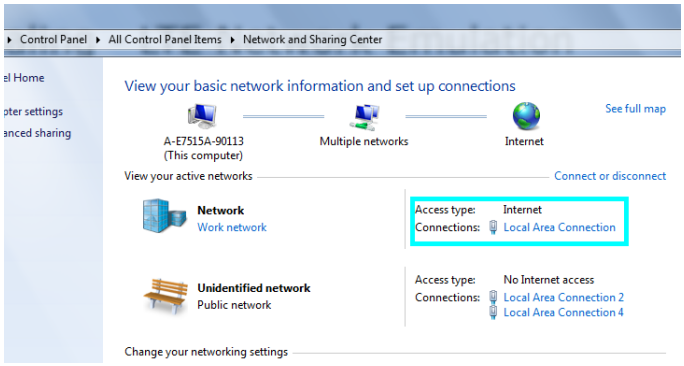
5. Set all component addresses as shown in Table 9-1 above. If you know how to do this, skip the next sections and go to the section entitled, *Getting Connected* on page 97.

Configuring the UXM IP Settings

6. To determine the IP address of the UXM, refer to the section entitled, *LAN Address Configuration* in the *Agilent E7515A UXM Getting Started Guide*.

7. To modify the UXM addresses to those shown in Table 9-1 above, open the windows control panel, and select **Networking and Sharing Center** from the **All Control Panel Items** view.

NOTE	If you are inside the TA/LA software application, press the windows icon  key on your USB connected keyboard to enable you to view your windows task bar.



8. Select the **Local Area Connection** link outlined in the figure above.

NOTE	Do not use LAN Area Connection 2, 4, or any labeled "Tunnel".

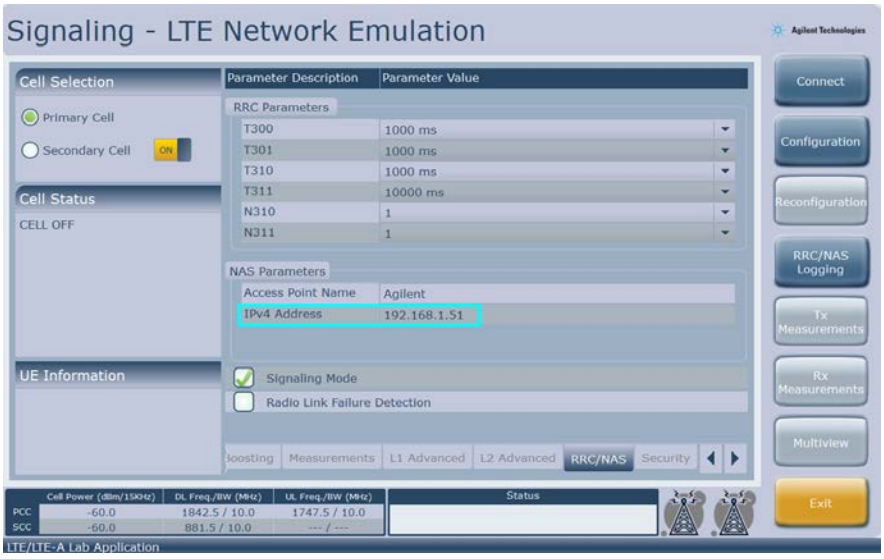
9. Then select **Properties.** In the window that opens, select: **Internet Protocol Version 4 (TCP/IPv4).**

10. Select **Properties**, again. In the window that opens, select: **Use the following IP address:**. This option enables you to set the above addresses required for the UXM.

Configuring the UE (Client) IP Settings

NOTE	Configuration files (<filename>.mta) include a configured IP address for the UE (client). If you intend to load a configuration file when performing this E2E test, be sure to do so before changing this setting as it will overwrite the IP address of the UE.

11. Scroll to the **RRC/NAS** tab and modify the IPv4 Address as shown in the figure below.



12. If you are using a PC to host the client, configure the subnet mask as shown in the Configuring the UXM IP Settings above.

Configuring the Server PC IP Settings

13. Configure the Server PC in a similar manner as shown above for the UXM, except you will select the only Local Area Connection shown in the windows **Network and Sharing Center** view.

Getting Connected

14. Navigate to any of the lower tabs except **System** and select **Connect**.
15. A sub-menu is displayed. Select **Cell ON**.
16. Switch on the UE. The UE may take up to 2 minutes to connect depending on previous connections and settings.

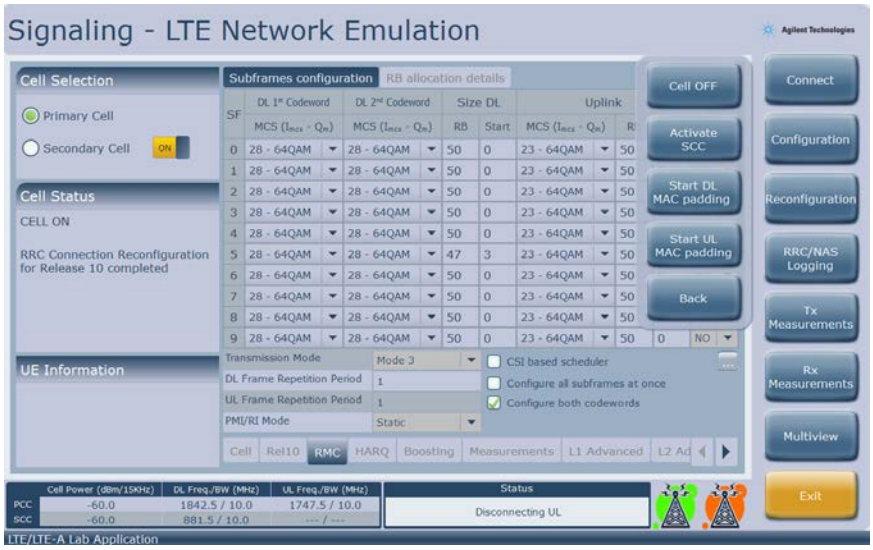


Figure 9-2: UE Attach is complete

17. Using a tool that measures IP network performance to drive the E2E throughput, you can now view the throughput results.

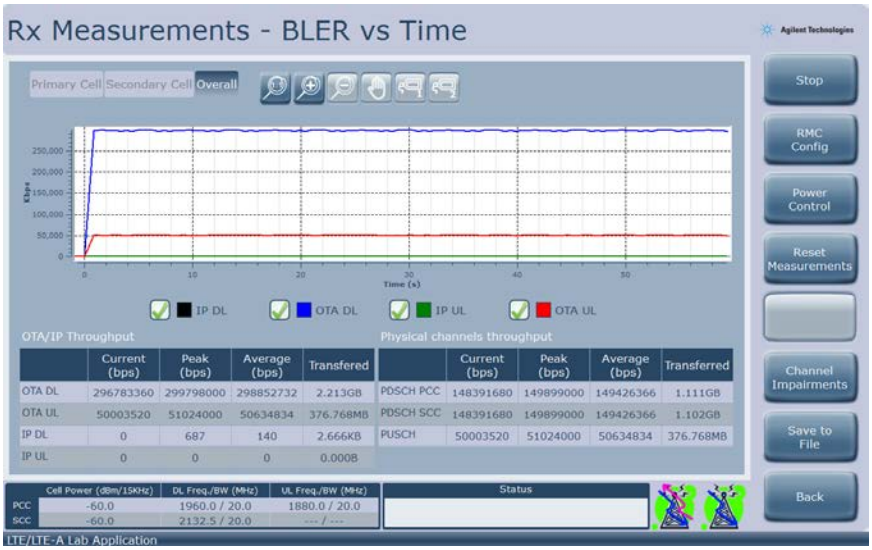
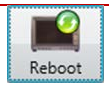


Figure 9-3: E2E Throughput Results

10 Troubleshooting

WARNING	No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

1. Select the *Reboot* icon 

in the Control Panel whenever the UXM hardware and/or software appears to be in a faulty state. Once the Control Panel indicator turns green, the UXM is in the ready state and you can proceed with your testing. Note that you may need to perform this reboot more than once to obtain the green display indicator condition.
2. Perform the BIST if rebooting the Platform boards does not cause the Control Panel indicator to display the green state. These tests provide you with valuable information when speaking with your Agilent representative. Refer to the section entitled, *Built-in Self Tests (BIST)* on page **Error! Bookmark not defined.** for detailed instructions.

Returning Your Test Set for Service

Calling Agilent Technologies

Agilent Technologies has offices around the world to provide you with complete support for your wireless test set. To obtain servicing information or to order replacement parts, contact the nearest Agilent Technologies office listed below or go to www.agilent.com/find/contactus. In any correspondence or telephone conversations, refer to your test set by its product number, full serial number, and software revision.

To access your product information, select this icon 

in the Control Panel view after performing both or only the second action described below:

1. If you are inside the TA/LA software application, press the windows icon  key on your USB connected keyboard to enable you to view your windows task bar .
2. Once you have access to the windows task bar, double-click the Control Panel icon:  to maximize the Control Panel view.

Locations for Agilent Technologies

Online assistance: http://www.agilent.com/find/assist

If you do not have access to the Internet, one of these centers can direct you to your nearest representative:

Should the Declaration of Conformity be required, please contact an Agilent Sales Representative, or the closest Agilent Sales Office. Alternately, contact Agilent at: www.agilent.com.

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