PSCR

Public Safety Communications Research

LTE Demonstration Network Test Plan

Phase 1: Basic Functionality Tests

Version 2.0

April 30, 2012

1 Revision History

Revision	Author	Description of Changes	Date
1.0	PSCR	Initial release	January 21, 2011
1.3	PSCR	Update/Clarification/Addition to the following sections: 4, 5.4	January 28, 2011
1.6	PSCR	Update SEM and supporting material	March 9, 2011
1.6.1	PSCR	Procedures 5.3.7, 5.3.1, 5.3.8, 5.1, 6.3, and 6.1	March 16, 2011
1.6.2	PSCR	Procedures 6.2, 8.1	March 20, 2011
1.6.3	PSCR	Replaced test "Base Station Output Power" with "In Band (IB)"	March 20, 2011
1.6.4	PSCR	Removed "Base Station Output Power" section from Table of Contents and updated TOC. Added table 1 to clause 6.3. Removed reference to clause 6.6.3.2 and replaced with PSCR in Reference clause 6.3.1.2. Replaced reference for how SEM derived from TS 36.141 to TS 36.104. Made additional edits to clause 6.3 for configuration items a and j.	March 22, 2011
1.6.5	PSCR	Modified spurious band emission clause 6.3.4. Modified 6.1.4.	March 23, 2011
1.6.6	PSCR	Added Physical Layer test requirements in 5.1 Added testing details to sections 6.1, 6.2, and 6.3.	March 28, 2011
1.6.7	PSCR	Updated List of Figures and List of Tables. Added Figures 10-18. Increased font size for Figure captions. Created links for Tables 1-3 in List of Tables. Modified text in clause 5.0 introduction, 5.1 Phase 1 Testing Scope and 5.2 Equipment Added new level 3 heading for vector signal generator 5.2.3 which was omitted. Updated the table of contents Added missing values and syntax for clarity into 5.2.2, 5.2.3, 5.2.4, 5.2.5. Modified steps 4-7 in 6.1 and 6.2 Test Sequence.	March 28, 2011, March 29, 2011 March 30, 2011 March 31, 2011
1.6.8	PSCR	Modified and added text in section 6.1-6.3. Modified and added text to 1st paragraph in section 7. Modified and Added all Test Procedures and some equipment descriptions from section 7 Application tests 7.1-7.9 into PSCR Phase 1 test plan section 8.1-8.9. Changed level 4 headings in 6.2 to level 3 headings and updated table of contents. Modified figures in 6.1 and 6.2	April 1, 2011
1.6.9	PSCR	Added Appendix A section 12 Test Fixture Loss Measurement for section 6.3 ENB spectral characteristics. Added Figures 18-20. Modified item 1 "calibration and test fixture loss measurement" in Test Sequence for section 6.3.1.4, 6.3.2.5, and 6.3.3.5	April 4, 2011
1.7.0	PSCR	Modified and added information into section 8. Changed Appendix A using vector network analyzer. Modified figures 18-20. Modified item 1 in Test Sequence for section 6.3.1.4, 6.3.2.5, and 6.3.3.5. Added interference signal configuration to replace IS5 and IS6 after validation. Modified test sequence in 7.1 and 7.2 item 4. Added text to item 3 in test sequence in 6.1 and 6.2. Removed sentence with TBD page 9 in section 5.1	April 5, 2011

Revision	Author	Description of Changes	Date
1.7.1	PSCR	Added paragraph 5.2.7 Network Analyzer. Updated Figures 15 and 16. Updated P25 generation with SMU 200A.	April 7, 2011
1.7.2	PSCR	Revised Annex A and made editorial changes in Sections 6-11. Modified Table 5 in Section 10. Added Acronym list as Section 11.	April 7, 2011
1.7.3	PSCR	Added Annex B. Modified IS5 and IS6 in 6.1.4.1 and 6.2.4.1. Modified Section 6.3.3.5 Step 2a.	April 8, 2011
1.8.1-5	PSCR	Added two tests to determine the characteristics of the UL and DL performance 1) Reference Sensitivity Level at Maximum RB – eNB Receiver 2) Reference Sensitivity Level at Maximum RB –UE Receiver Modified tests to include the changes from the two above tests Adjacent Band Interference Into the eNB Receiver Adjacent Band Interference Into a UE Receiver	May 3, 2011
1.8.6	PSCR	Modified tests procedures for clarity, edited required equipment sections, included JDSU, LG G14 and software as PSCR equipment. Regularized filenames and inserted sign off sheets.	May 12, 2011
1.8.7	PSCR	Updated MXA procedures	May 13, 2011
1.9	PSCR	Updated sign off sheets	May 13, 2011
1.9.1	PSCR	Added Section 5.2.11, updated acronym list	June 6, 2011
1.10	PSCR	Updated Figures 1, 10, 13, 14, 16 and 17. Modified test procedures for the Spirent simulator in Sections 6.1.5 and 6.2.4.1. Added files for test instruments	June 14, 2011
1.11	PSCR	Removed UE tests	June 21, 2011
1.12	PSCR	Updated Annex B	June 24, 2011
1.13	PSCR	Updated Figure 1, updated Table 2, updated Figure 12, combined Sections 6.3.1 and 6.3.2, added Section 6.4 eNB Power Output,	September 2, 2011
1.14-1.19	PSCR	Added information to eNB Power Output test (6.4). Changed 6.3 Spurious Emissions to separate co-location and co-existence specifications. Corrected C block uplink frequency. Updated Figures 9, 12, 14, 16 and 17.	September 8, 2011
1.22	PSCR		September 12, 2011
2.0	PSCR	Changes for 10MHz wide uplink and downlink	February 21, 2012

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5 Introduction

Wherever possible the Public Safety Communications Research (PSCR) demonstration project has attempted to use existing test methodologies of the 3GPP and others to develop the tests in this test plan. The 3GPP test procedures used in this test plan may require subtle changes to meet the goals of the PSCR demonstration project. Where changes and/or deviations from industry established tests are required, the PSCR demonstration project test plan provides detailed documentation. Most of the changes required by PSCR will presumably be determined to be pertinent to public safety functionality, because of engineering considerations and/or because of PSCR laboratory constraints. When vendor devices deviate from this test plan, the deviations will be documented by PSCR for possible inclusion in future efforts. When a particular configuration of the equipment under test may not be possible, it is the intent of PSCR to simply identify the occurrences and not assess whether the configuration constraint impacts public safety functionality. The impacts of test plan short comings are beyond the scope of the document. It is the test plan's objective to observe and report without judgment. The procedures retained either in whole or in part from the 3GPP and other public domain tests have been documented in extensive detail. It is hoped that by leveraging existing test procedures and methods, PSCR can accelerate the process of evaluation of Long Term Evolution (LTE) systems for public safety users.

5.1 Phase 1 Testing Scope

PSCR has established three major phases of testing and evaluation (Phase 1, Phase 2, and Phase 3). The purpose of Phase 1 Basic Functionality Testing is to determine if the LTE equipment submitted for use in the PSCR demonstration project has been configured correctly to achieve a minimal level of functionality. Phase 1 tests are assumed to be executed quickly. In this phase of the PSCR Demonstration Project test plan, four categories of tests are examined (Physical Layer Tests, Messaging/Protocol Tests, Application Tests, and Performance Tests). It should be noted that PSCR reserves the right to add additional phases (beyond the three currently defined) of testing at any time.

Physical Layer Tests: These tests will ensure that the submitted equipment will not interfere with other existing 700 MHz Land Mobile Radio (LMR), PSCR demonstration systems and/or submissions.

The over the air (OTA) tests will be permitted upon successfully demonstrating that the eNB Spectral Characteristics requirements in Section 6.3 are met.

Messaging/Protocol Tests: These tests involve an analysis of the messaging associated with the establishment and teardown of a data session between User Equipment (UE) and an Evolved Node B (eNB). The success of these tests is dependent on successful execution of the Physical Layer Tests.

Application Tests: These tests are a subset of public safety application tests that can be used at a high level to verify that the LTE system can perform basic IP (Internet Protocol) /data functions.

Performance Tests: These tests are used to determine the throughput performance relative to carrier-to-interference ratio (C/I) and cell sector position along a path. More extensive performance tests will appear in later phases of the PSCR demonstration test plan.

Results of all phase 1 tests will be recorded as either executed or not executed unless otherwise stated.

UE and system level conformance testing is not covered in this test plan. PSCR is working with the PTCRB (PCS Type Certification and Review Board) and MSF (Multi Services Forum) to create Band 14 and EPC (Evolved Packet Core) public safety conformance test regimens.

During the period that full PSCR participation is being developed in the PTCRB, MSF and other testing organizations, the PSCR reserves the right to conduct any tests that are slated to be conducted by these external bodies as part of the PSCR demonstration test plan. As tests are adopted by these testing organizations the PSCR demonstration test plan will be amended to reflect those organizations activities in Band Class 14 (BC 14) testing.

The remaining tests described in each of these phases are supplementary tests that are not covered by PSCR's efforts to aggregate testing done by commercial testing bodies (PTCRB, MSF, etc.).

The PSCR demonstration test plan is designed to be a set of tests that progressively increase in complexity (e.g., from Phase 1 to subsequent Phases of testing). Similar tests may appear in successive phases, but will be designed to examine the equipment under test with an increased level of detail.

Please note for clarity the **bold** text in this document represents text as it appears on instrument screens or as buttons.

5.2 Equipment

This test plan uses several specialized pieces of equipment to conduct the measurements. The procedures outlined herein are specifically documented to assist PSCR in performing the tests with a particular set of equipment. Use of any equipment in the PSCR demonstration test plan does not constitute an endorsement in any way by PSCR. The tests in the PSCR demonstration test plan could be executed using a variety of equipment.

Section 5.2 details the exact equipment used in this test to aid PSCR and others in the event that these measurement need to be replicated or expanded. In order to simplify the diagrams that appear in the procedure section of many tests, the block elements in the Figures refer to the specific equipment models given here.

5.2.1 Channel Simulator

1) Spirent SR5500 and SR5500-RFI (Selected Specifications)
   a) RF Inputs – Scalable from 2 to 16

b) RF Outputs – Scalable from 2 to 16
c) Digital Channels - Scalable from 2 to 64
d) RF Configurations - SISO, SIMO, MISO, MIMO (2x2, 2x4, 4x2, 4x4, 8x2 uni- or bi-directional), and Beamforming
e) Standards Based Models - LTE, WiMAX, UMTS, CDMA2000®, WLAN, GSM, and pre-standard models available from Customer Service Center
f) Dynamic Environment Emulation -
   i) Controllable Parameters - State duration, channel output level, AWGN on/off, C/N, path on/off, relative power and delay, LOS AoA, K factor, frequency shift, Doppler velocity, MIMO branch phase and power imbalance.
   ii) Channel Model Update Rate - 100 times per second
   iii) Mode - MIMO, dual and single channel mode; RX and TX diversity modes
   iv) Triggering - Triggered Play, Free Run
g) Real-time Fading –
   i) Types - Rayleigh, Rician, Pure Doppler, Frequency shift, Phase shift
   ii) Fading Velocity - Up to 5396.26 km/h @ 400 MHz; Resolution of 0.1 km/h
   iii) Repetition Interval > 24 hours
   iv) Relative Phase 0 – 360 degrees, 0.1 degree resolution
   v) Rician K factor -30 to +30 dB
   vi) Level Crossing Rate (LCR) Accuracy < ± 2.5% deviation from theoretical LCR curve of the simulated vehicle velocity
   vii) Fading Power Spectrum - Classical 6 dB, Flat, Classical 3 dB, Rounded, Rounded 12 dB
   viii) Correlation - Envelope and Component; Complex correlation is included with MIMO option
h) http://www.spirent.com/Solutions-Directory/SR5500.aspx

5.2.2 Spectrum Analyzer

1) Agilent PXA N9030-A (Selected Specifications)
   a) Option 526 - Frequency range, 20 Hz to 26.5 GHz
   b) Option B25 - 25 MHz analysis bandwidth
   c) Option P26 - Preamplifier, 100 kHz to 26.5 GHz
   d) Option PFR - Precision frequency reference - Reduces frequency drift for more accurate measurements Aging rate: ±1 x 10^{-7}/year
   e) Option NFE – Noise Floor Extension
   f) http://www.agilent.com/find/pxa

2) Tektronix RSA3408A

5.2.3 Vector Signal Generator

1) Rohde and Schwarz SMU 200A (Selected Specifications)
   a) Frequency Range : 100 kHz to 2.2/3/4/6 GHz
   b) Supported standards and digital systems : 3GPP LTE, 3GPP FDD/HSPA/HSPA+, TD-SCDMA, GSM/EDGE/EDGE evolution, cdmaOne, CDMA2000, 1xEV-DO, WiMAX™ IEEE 802.16-

2004/Cor1/D5 and IEEE 802.16e-2005, IEEE 802.11a/b/g/n, TETRA, Bluetooth®, AWGN, user-defined multicarrier CW, GPS, DVB-H/T, DAB/T-DMB, XM-RADIO

c) RF Modulation bandwidth
   i) using external I/Q inputs : 200 MHz
   ii) using internal baseband section : 80 MHz
d) Level
   i) Range: -145 dBm to +13 dBm (PEP)
   ii) Range with high-power output option : -145 dBm to +19 dBm (PEP)
e) http://www2.rohde-schwarz.com/product/SMU200A.html

5.2.4 Directional Coupler

1) Narda 3020A 4 port
   a) Low Frequency (GHz) : 0.05
   b) High Frequency (GHz) : 1
   c) Nominal Coupling (dB) : 20
   d) Minimum Directivity (dB) : 35
   e) VSWR Primary Line Power : 1.05
   f) Equivalent Residual VSWR (max) : 1.04
   g) Absolute Calibration Accuracy dB (per 10 dB step) : -/+ 1.0 from 250-1000 MHz
   h) Power Ave (Incident in W) : 500
   i) Power Ave (Reflected in W) : 500
   j) Peak Power (kW) : 10
   k) http://www.nardamicrowave.com/east/index.php?m=Products&e=getPdf&id=3494

2) Anatech AM1515DC860
   a) http://www.amcrf.com/products/large/datasheet/AM1515DC860.pdf

5.2.5 Circulator

1) Ditom D3C0780 3 port
   a) Frequency Range : 0.7-0.8 GHz
   b) Isolation (dB) Min : + 20
   c) Insertion Loss (dB) Max : +0.40
   d) VSWR (+dBm) Max : +1.25
   e) Operating Temp Range (C) : -20 to +65
   f) http://www.ditom.com/pcspnc.php

5.2.6 Splitter/Combiner

1) AEI Splitter AM505PD1018-N 3 port

5.2.7 Network Analyzer

1) Agilent N5230C PNA-L Network Analyzer
   a) Frequency Range : 300 kHz to 20 GHz
   b) Number of ports: 4
   c) http://cp.literature.agilent.com/litweb/pdf/5989-7607EN.pdf

5.2.8 UE and Drive Test

In the case where PSCR receives a UE that contains a chipset outside of those listed below the drive test software and/or hardware will be negotiated.

1) JDSU
   a) The JDSU E 6474A drive test software will be used to collect RF performance and protocol information.
      i) The JDSU 6474A is capable of collecting RF data from UEs that contain chipsets from:
         (1) LG
         (2) Qualcomm
         (3) Samsung
2) Anritsu Link Master
   a) Link Master LML logs air interface data taken during a drive test from a UE.
   b) Link Master LMA provides in-depth analysis of the post processed log data.
3) LG Band Class 14 UE
   a) G14 - USB Driver FM300 Version 1.0.162
   b) LLDM - R 2.4.6
4) Aeroflex UE Emulator
   a) TM500-C Test Mobile
      i) Single UE Version C 4.1.3
      ii) Multi UE Version 2.11.1

5.2.9 Throughput Software

1) Iperf
   a) Version 2.0.5 (Linux), Version 1.7.0 (Windows)
   b) http://iperf.sourceforge.net/
2) Jperf
   a) Version 2.0.2
   b) http://iperf.sourceforge.net/

5.2.10 Bandreject Filter

1) K&L 5NP26-763/E17.2-N/N
   a) 47dB (minimum) notch 758 to 768MHz
   b) 0.4dB (maximum) loss at 745 and 778MHz

5.2.11 PSCR Server

1) IP address: 10.8.7.240
2) User name: demo
3) Password provided by PSCR
4) Applications
   a) Iperf
   b) FTP
   c) VPN

6 Physical Layer Tests

The physical layer tests will be performed in a cabled/bench environment.

The following Phase 1 UL and DL tests will determine the effects of the adjacent band interference on throughput. Interference has an effect on throughput that is apparent from a comparison to ideal conditions. The ideal or baseline throughput performance is outlined in this section. Tests *6.1 Reference Sensitivity Level at Maximum RB – eNB* and *6.2 Adjacent Band Interference Into the eNB Receiver* have been designed to determine the baseline throughput performance. The methods of these baseline tests are not only relevant to Phase 1 but will be used in Phase 2. Phase 2 tests will examine in great detail the effects of channel characteristics (e.g. fading) on throughput performance. Tests in Phase 2 will require baseline channel throughput measurements to determine the effects of radio environment impairments.

6.1 Reference Sensitivity Level at Maximum RB – eNB Receiver

6.1.1 Test Description

The reference sensitivity power level at maximum RB allocation (P_{RSMRB}) is the minimum power received at the antenna connector for a specified reference measurement channel. This test is designed to baseline the capabilities of the BS.

The test is set up according to Annex I.2.1 in 3GPP TS 36.141 v8.5.0 (2009-12) and performed without interfering signal power applied to the BS antenna connector.

The purpose of the test is to determine the BS Reference sensitivity level at maximum RB allocation, the throughput at that power level and the breakpoint criteria.

6.1.2 Reference

See 3GPP TS 36.141 v8.5.0 (2009-12) Clause 7.2

See 3GPP TS 36.104 v8.5.0 (2009-12) Clause 7.2.1

6.1.3 Required Equipment

See the following sections for information about the equipment required in this section

5.2.1 Channel Simulator

5.2.2 Spectrum Analyzer

5.2.4 Directional Coupler

5.2.5 Circulator

5.2.6 Splitter/Combiner

5.2.8 UE and Drive Test

5.2.9 Throughput Software

6.1.4 Test Procedure

The initial conditions consist of the test environment, RF channels to be tested, and the equipment connections as described in TS 36.141 V8.5.0 (2009-12) clause 7.2.4.1

6.1.4.1 Test Environment

Only the normal test environment will be used. See subclause D.2 3GPP TS 36.141 V8.5.0 (2009-12) with the exception of relative humidity and barometric pressure.

6.1.4.2 RF Channel to be tested:

The RF Channel to be tested will be the middle (M) frequency of the eNB (e.g., 793 MHz) as described in subclause 4.7 of 3GPP TS 36.521 V8.5.0 (2009-12).

6.1.5 Test Sequence

1) *Configure the test circuit* - In this test, the simulator is used without channel impairments. The channel simulator functions as a means to balance the power levels of the desired signal in the UL and DL channels. The detailed channel simulator configuration is shown in Figure 1.

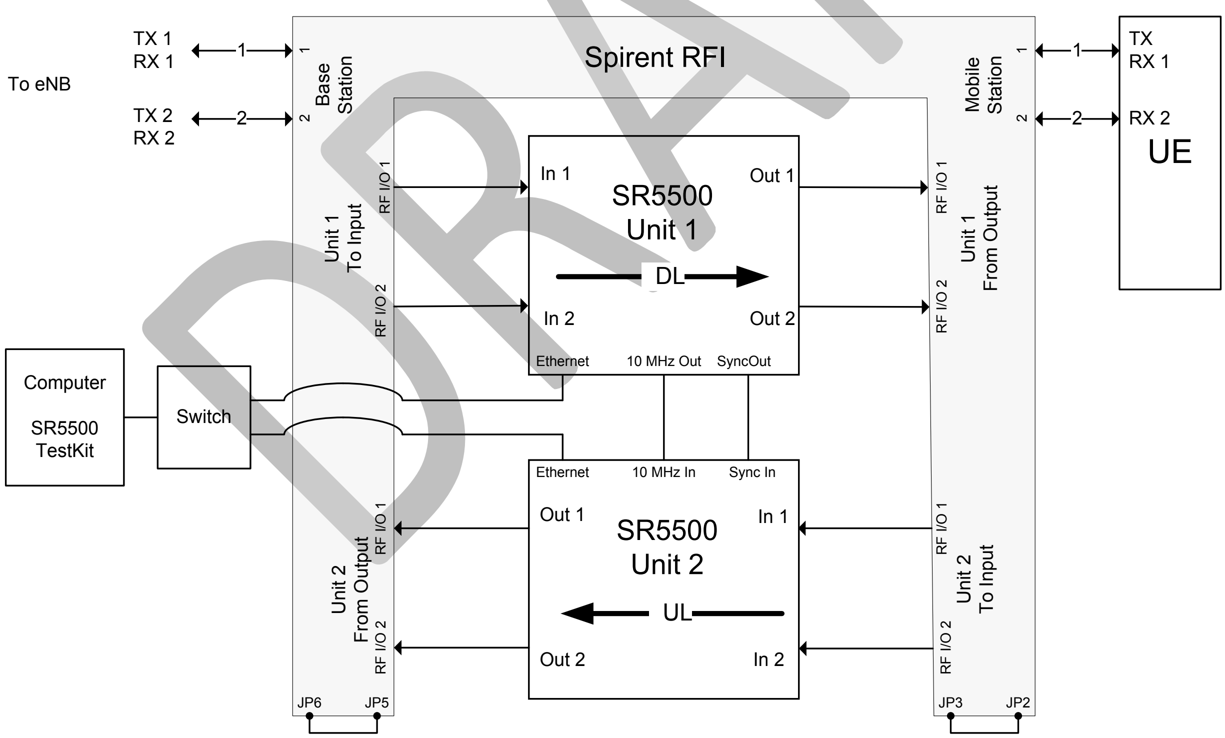


Figure 1. Detailed view of SR5500 connections for eNB receiver tests.

The simulator input and output power levels will vary from one vendor to another. The power measured on the UL and DL will determine the required levels to balance the channels.

a) Connect the test computer, switch, RF Interface (RFI) unit, and SR5500 simulators in the test configuration as shown in Figure 2.

2) *Configure the Spirent SR5500 channel simulator*
   a) Launch the SR5500 TestKit application
   b) Load the settings file: nist_mimo_straight_through.wce (2/21/2012)

nist_mimo_mimo_straight_through.wce

   c) Using the Execute tab select Connect to the SR5500 simulators and go to Step 7)
   d) To set up the SR5500 manually go to Step 3)

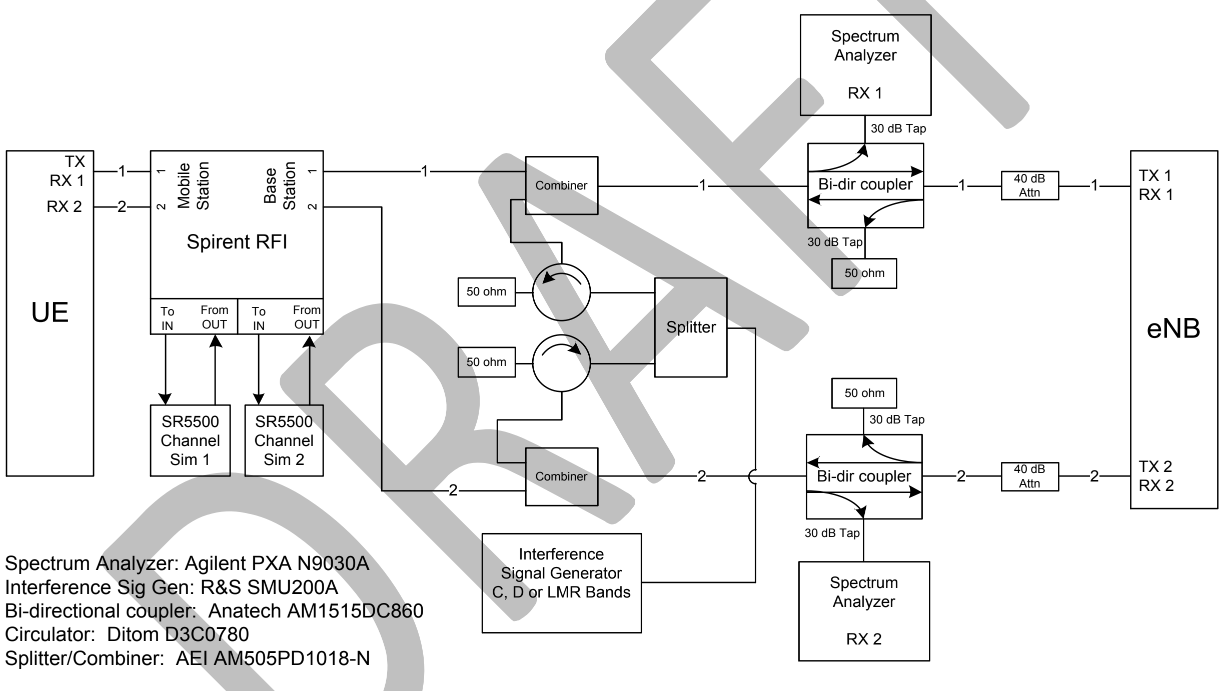


Figure 2. SR5500 simulator test setup for eNB receiver tests.

3) Click the Selected Unit 1 button at the top of the screen to configure the DL channel
   a) Click on the **Configuration** tab
   b) Click on **System/Communication Setup**
      i) In the **System Configuration** dialog box shown in Figure 3, set the following parameters:
         (1) Select Active from the **Synchronize Play/Pause/Stop** pull down menu
         (2) Click the Unit 1 tab (for DL) and select **2X2 MIMO** from the **Channel Configuration** pull down menu

(3) Click the Unit 2 tab (for UL) and select **2X2 MIMO** from the Channel Configuration pull down menu

(a) If applicable, select **Rx Diversity** from the Channel Configuration pull down menu

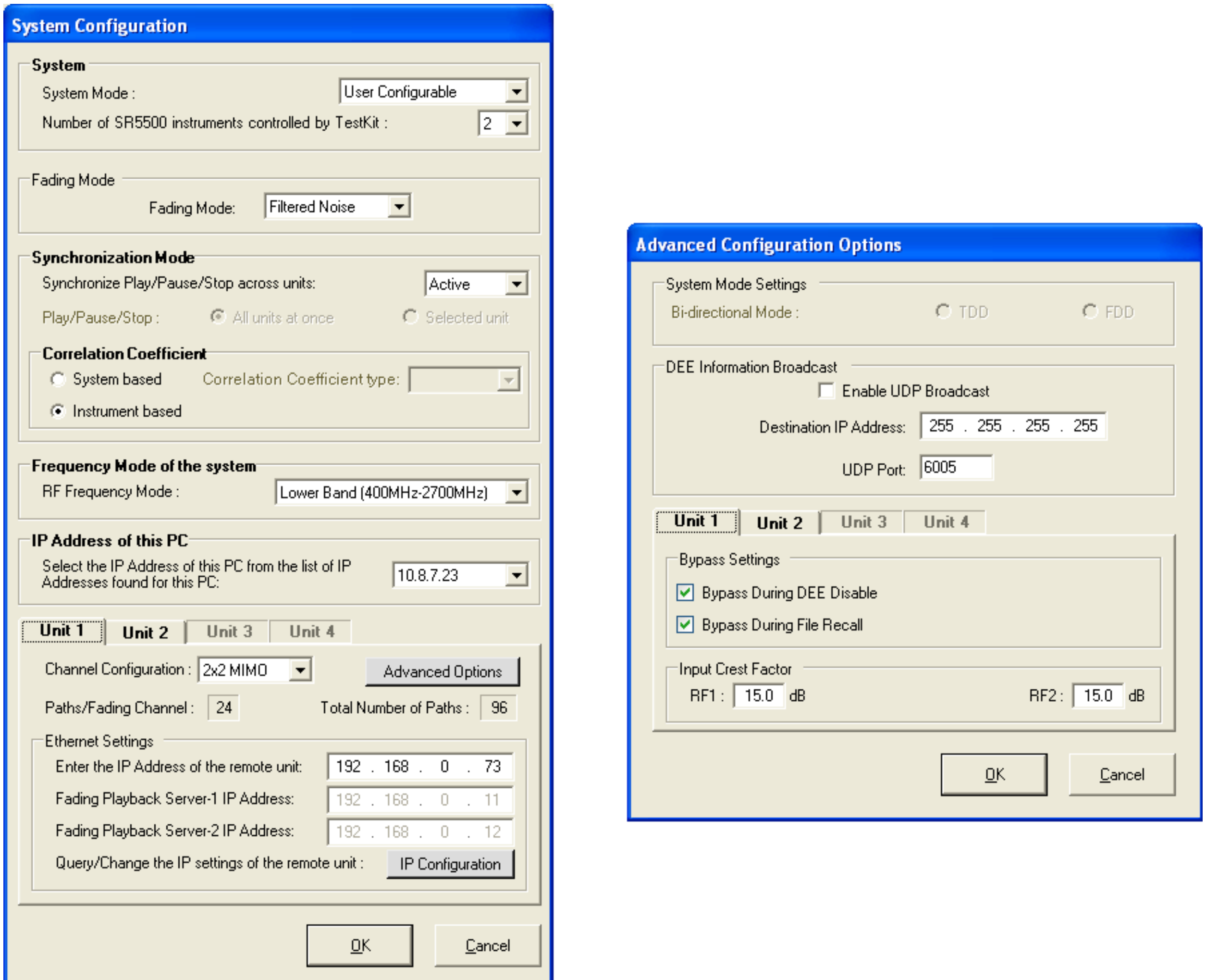


Figure 3. System Configuration and Advanced Configuration Options dialog boxes.

(4) Click the **Advanced Options** button and in the **Advanced Configuration Options** dialog box shown in Figure 3, set the following parameters:

i. Set RF1 and RF2 **Input Crest Factor** to 15 dB on the Unit 1 tab
ii. Set RF1 and RF2 **Input Crest Factor** to 15 dB on the Unit 2 tab
iii. Leave other settings as default values
iv. Click the OK button to exit Advanced Configuration Options
v. Click the OK button to exit System Configuration

4) Click the Channel Editor button in the View column and set he following parameters (See screen shot in Figure 4)

a) Click on the **Selected Unit: 1** button at the top of the screen to configure the DL channel
b) Set **Unit 1 Carrier** to 763 MHz
c) Click on **Unit 2** at the top of the screen to configure the UL channel

    d) Set **Unit 2 Carrier** to 793 MHz

5) Click the **Instrument Setup** button in the View column
    a) Click on the **Selected Unit: 1** button at the top of the screen
        i) Click on the **Advanced Options** button as shown in Figure 5
        ii) In the **MIMO Advanced Options** dialog box shown in Figure 6, set the **Phase Settings** for h22 to 180 degrees. Leave all other settings as the default value.
6) Perform calibration to set input and output levels. This may be done in conjunction with the LTE vendor to balance the UL and DL paths
7) Press the play button and verify that the Elapsed Time window is incrementing
        i) Verify that **Unit 1** (DL) **RF1 Measured Input** and **RF2 Measured Input** levels are equal
        ii) Verify that **Unit 2** (DL) **RF1 Measured Input** and **RF2 Measured Input** levels are equal

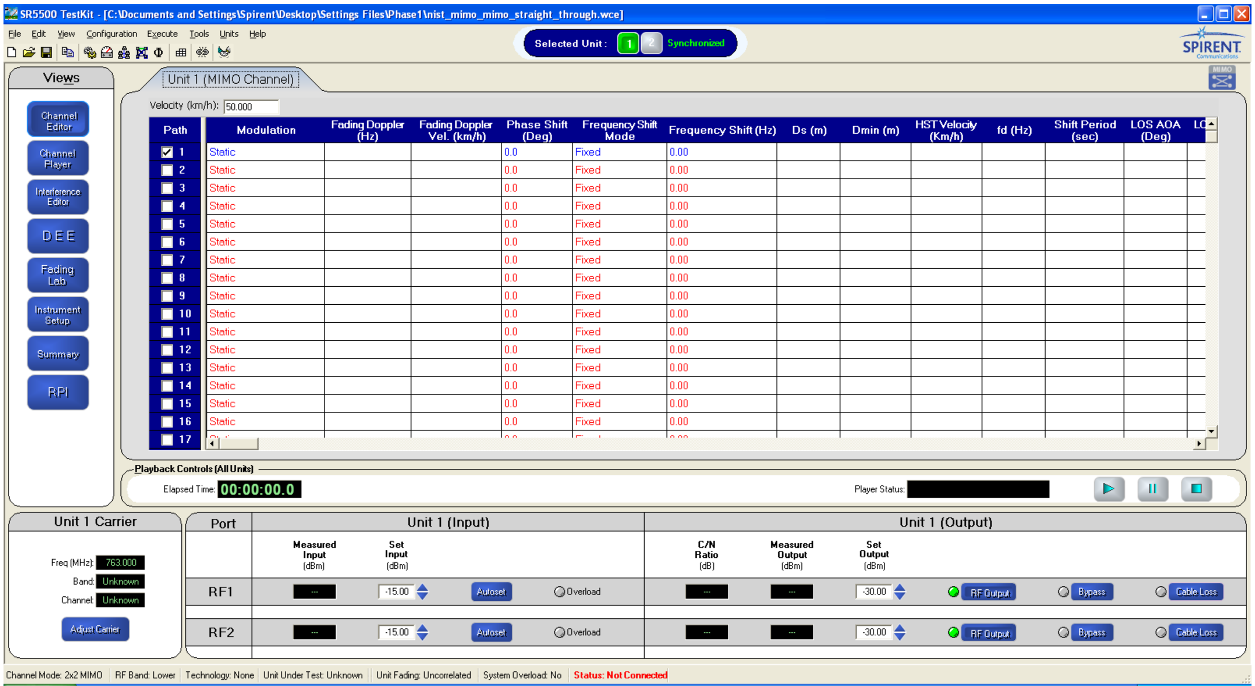


Figure 4. SR5500 channel configuration.

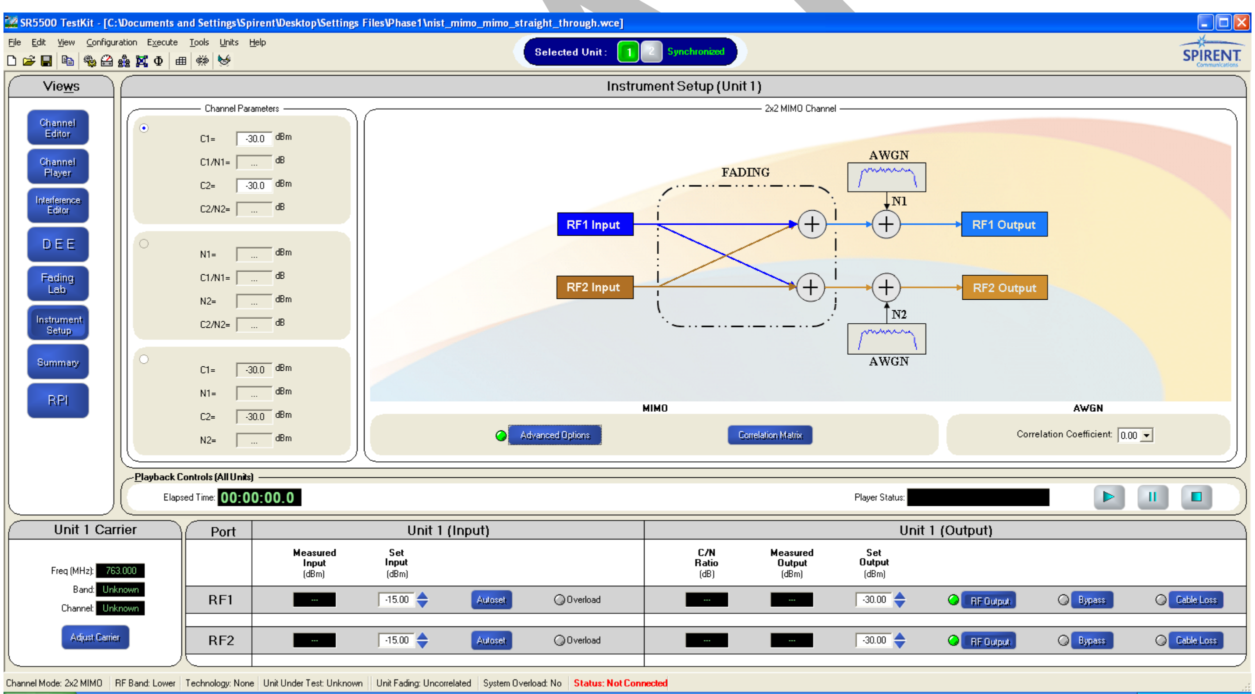


Figure 5. Instrument Setup dialog box.

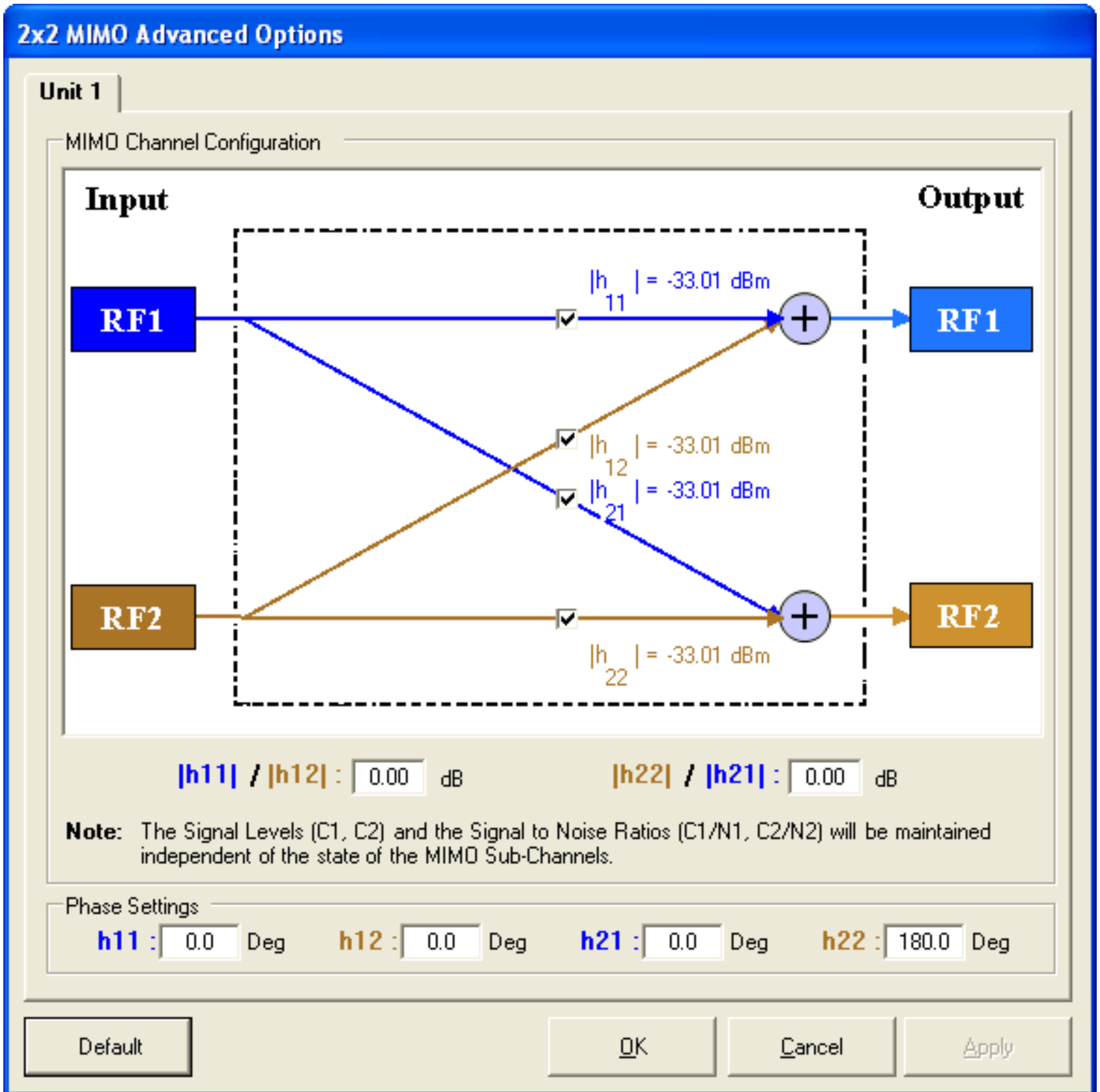


Figure 6. MIMO Advanced Options dialog box.

8) Establish the UL Reference Point.
   a) Using the configuration in Figure 2, establish a link between the UE and eNB using near cell conditions
      i) Near cell is defined as 92 dB path loss at the measured output levels on both of the SR5500 simulators
         (1) Adjust the **Set Output (dBm)** attenuation so that the UL and DL path loss equal 92 dB. Attenuation external to the SR5500 in the test circuit must be taken into account while setting the attenuation.
   b) Initiate an UDP UL data session with iperf or equivalent application to monitor the throughput.
   c) Observe the initial throughput displayed on the UE laptop and the attenuation (path loss) displayed on the SR5500 Channel simulator 1 and 2 (**Measurement Output (dBm)** Level) as shown in Figure 4 .
      i) Capture and save 3 minutes of throughput measurements for the initial attenuation

d) Attenuate the UL and DL signals on both SR5500 simulators using a 1 dB step size
   i) Decrease the **Set Output (dBm)** level by 1 dB. This increases the attenuation (path loss) displayed on the SR5500 Channel simulator 1 and 2 at the **Measurement Output (dBm)**
   ii) Capture and save 3 minutes of throughput measurements for the initial attenuation step
e) In order to find the breakpoint and reference point, continue attenuating the UL and DL signals on both SR5500 simulators in 1 dB steps until maximum Resource Block (RB) utilization is no longer at the peak supported level
   i) Observe that throughput is degrading as the maximum RB utilization is no longer at the peak supported level
   ii) Capture and save 3 minutes of throughput measurements for each attenuation point
f) Evaluate the throughput measurements to determine breakpoint based on the following conditions or any combination thereof (See Figure 7).
   i) RB utilization decreases as the path loss is increased
   ii) Data throughput decreases as the path loss is increased
   iii) Sub-carrier utilization decreases as the path loss is increased

   Note: The LTE system modulation and coding scheme (MCS) changes dynamically to adjust to the radio environment. Small variations in received power can be accommodated by a given MCS. Larger variations, and/or differing levels of receiver input power, may require the LTE system to change the MCS scheme. For instance, decreasing the receiver input power will force the system to adopt an increasingly more robust MCS. In such a case, a breakpoint will be observed where the throughput performance starts to degrade or decline because of changes in the radio channel. Throughput can also be reduced by other methods in the eNB such as those mentioned above in 8)f) as the radio struggles to mitigate against an increasingly harsher radio environment. The reference point is defined at one attenuation step (1dB) before the breakpoint (see Figure 7). The reference point is at the minimum power level where the throughput is relatively stable. The exact criteria to identify the breakpoint will be negotiated with PSCR. See TS 36.141 V8.5.0 (2009-12) Table 7.2-1: BS Station reference sensitivity levels.

9) At the Reference Point record the power level, throughput and maximum number of RB. This power level at the Reference Point is P_{RSMSC}.

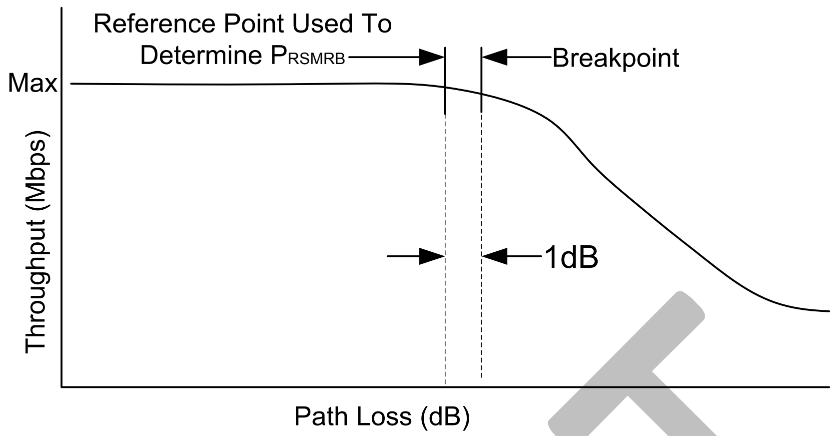


Figure 7. Reference Point (UL)

6.1.6 Expected Outcome

There are three parameters that will be determined in this test. The $P_{RSMRB,}$ throughput at P_{RSMRB} and the breakpoint criteria.

6.2 Adjacent Band Interference Into the eNB Receiver

6.2.1 Test Description

The test examines the coexistence of PS LTE with other systems in the adjacent operating bands (C Block and LMR 700MHz). This test is conducted to determine the interference signals effects into the eNB receiver.

6.2.2 Reference

None

6.2.3 Required Equipment

See 6.1.3 Required Equipment

6.2.4 Test Procedure

The adjacent band interference test into an eNB receiver is conducted in the UL direction for the PS broadband channel centered at 793 MHz. This test focuses on a single sector. The interference signal with corresponding modulation is centered in the appropriate frequency band. This test consists of 2 interference bands (C Block and PS narrowband) using uplink (UL) and downlink (DL) frequencies, for a total of 4 tests. Interference signals consist of the parameters in table 1 below:

Table 1: Interference signal parameters (C Block and PS Narrowband)

Band	Frequency	Center Frequency	Modulation
C Block UL	777 - 787 MHz	782 MHz	LTE SC-FDMA
C Block DL	746 - 756 MHz	751 MHz	LTE OFDMA
PS Narrowband UL	799 - 805 MHz	799 MHz	P25 C4FM +1011 test pattern
PS Narrowband DL	769 - 775 MHz	769 MHz	P25 C4FM +1011 test pattern

6.2.4.1 *Test Sequence*

1) *Configure the Spirent SR5500 channel simulator*
   a) Launch the SR5500 TestKit application
   b) Load the settings file: nist_mimo_mimo_straight_through.wce (2/21/2012)
   c) Using the Execute tab select Connect to the SR5500 simulators and go to Step 7)
   d) To set up the SR5500 manually, go to Step 3) in Section 6.1.5

2) *Perform calibration to set input and output levels in conjunction with the LTE vendor to balance the UL and DL pairs as well as the UL and DL paths*

3) *Press the play button and verify that the Elapsed Time window is incrementing*
   a) Verify that **Unit 1** (DL) **RF1 Measured Input** and **RF2 Measured Input** levels are equal
   b) Verify that **Unit 2** (DL) **RF1 Measured Input** and **RF2 Measured Input** levels are equal

4) *Establish a test operating point on the UL.* The test operating point is determined from the reference point determined in section *6.1 Reference Sensitivity Level at Maximum RB – eNB* . The test operating point determines the level for the desired signal when injecting an interference signal into the eNB receiver. The test operational point is the point that experiences 6 dB more receiver power than the reference point.
   a) Set the path loss to 6 dB lower than P_{RSMRB} (See Figure 8)
      i) Increase **Unit 1 Measured Output (dB)** and **Unit 2 Measured Output (dB)** levels by 6 dB on each SR5500 by increasing the set output level by 6 dB

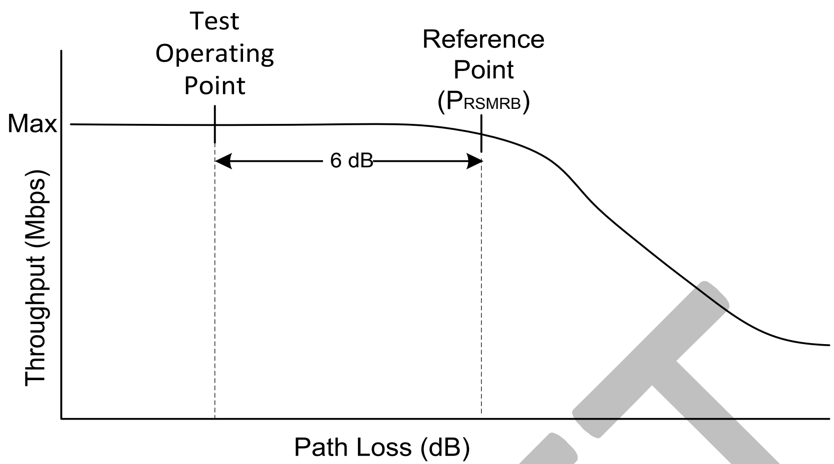


Figure 8. Test Operating Point (UL)

5) *Configure the PXA N9030A spectrum analyzer to measure output power*
   a) *To use an existing configuration file*
      i) Press the **Recall** button
         (1) Press the **State** softkey
         (2) Press the From **File** softkey
      ii) Highlight the file output_power.state (9/1/11)

output_power.state

      iii) Press **Open** button
      iv) Go to step 6)

   b) If a configuration file does not exist then perform the following
      i) Press the **Preset** button to preset the instrument
      ii) Press the **Freq** button
         (1) Press the **Start Freq** softkey
         (2) Enter 745 on keypad
         (3) Press **MHz** softkey
         (4) Press the **Stop Freq** softkey
         (5) Enter 805 on keypad
         (6) Press **MHz** softkey
      iii) Press the **BW** button
         (1) Press the **Res BW** softkey
         (2) Enter 100 on keypad
         (3) Press the **kHz** softkey
      iv) Press the **AMPTD Y Scale** button
         (1) Press the **Attenuation** softkey
         (2) Enter 0 on keypad
         (3) Press the **dB** softkey

    v) Press **Sweep/Control** button
        (1) Press **Points softke**y
        (2) Enter 8001 on keypad
        (3) Push the **Sweep Setup** softkey
        (4) Push the **Sweep Type** softkey
        (5) Push the **Auto** softkey
    vi) Press the **Trace/Detector** button
        (1) Press **More** softkey
        (2) Press **Detector** softkey
        (3) Press **Average** softkey
    vii) Press the **Save** button if necessary
        (1) Press the **State** softkey
    viii) Save the instrument settings as output_power.state.

6) *Configure the eNB*
  a) Set the eNB transmission at maximum output power as specified by the manufacturer.
  b) Set the eNB to transmit a 10 MHz wide signal centered at 763 MHz

7) *Configure the interference source*
  a) Select an interference signal from the set of four interference signals identified below. The interference signal sources are shown in Table 1.
    i) Interference Signal 1 (IS 1): C Block UL
    ii) Interference Signal 2 (IS 2): C Block DL
    iii) Interference Signal 5 (IS 3): PS Narrowband UL
    iv) Interference Signal 6 (IS 4): PS Narrowband DL
  b) For the interference signal selected in step 7)a) above, configure the interference signal generator using the corresponding interference signal configuration described in *6.2.4.2 Interference Signal Configurations for Interference signals IS 1-to-IS 4*
  c) After completing step 7)a), continue to Step 8)

8) *Measure and record the interference signal*
  a) Inject the interference signal via the SMU 200A as described in Step 7)
  b) Set the interference signal level initially to -50 dBm
  c) Monitor throughput at the UE
  d) Incrementally increase the interference signal (e.g., -20dBm, 0dBm, +10dBm) and observe the interference and uplink signals on the spectrum analyzer graphical display.
    i) Maximum output level of SMU 200A is +19 dBm PEP
  e) Observe and record throughput on UE monitoring interface
    i) Set the signal generator power level at the point where degradation of throughput occurs
  f) Record the signal level of interferer with the PXA N9030A spectrum analyzer
  g) Save the measurement graphically on the PXA N9030A
    i) Press the **Save** button
    ii) Press **Screen Image** softkey
    iii) Press **Save As** softkey
    iv) Save the screen shot as a .png file
  h) Press **Save** button
    i) Press the **Save** button
    ii) Press **Data** softkey

iii) Press **Save As** softkey
iv) Save the data as a .csv file

i) Record the channel power levels of the eNB signal and the interferer as measured with the PXA N9030A spectrum analyzer.
   i) Press the **Meas** button.
   ii) Press the **ChannelPower** softkey.
   iii) Press the **Meas Setup** button.
   iv) Press the **Integ BW** softkey.
   v) Enter the bandwidth of the signal (10MHz for C block or eNB signal).
   vi) Press the **FREQ** button.
   vii) Enter the center frequency of the signal being measured (eNB signal or interferer).

j) Repeat steps 7) and 8)for each of the four interference signals IS1 through IS4 shown in step 7)a) until each interference signal has been used in the test.

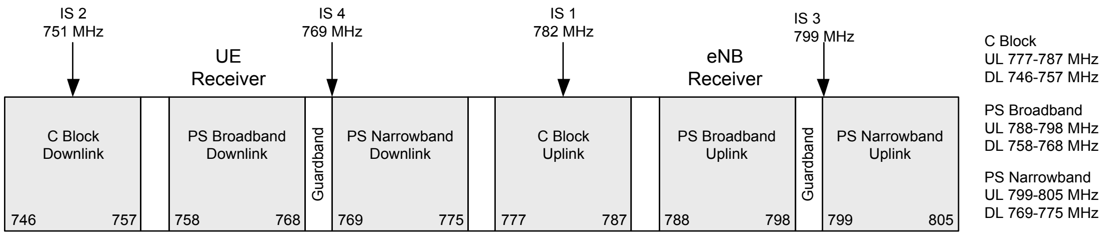


Figure 9. Interference signal identification

6.2.4.2 *Interference Signal Configurations for Interference signals IS 1-to-IS 4*

Each time the test is executed the interference signal generator must be modified to one of the four following interference signal configurations. For the interference signal selected in step 7)a), configure the interference signal generator using the corresponding interference signal configuration

For Interference Signal 1 (IS 1): C Block UL, implement Step 7)b) as follows:

Step 7)b): Configure the SMU200A signal generator for the C Block UL interference signal

1) If a configuration file exists do the following
   a) Press the **File** button
   b) Select **Recall** from the **Select Operation** pull down menu
   c) Highlight the interference file C_block_interference_uplink.savrcl (9/7/11)

C_block_interference_uplink.savrcl

   d) Push the **Recall** button
   e) Go to Step 8)
2) Else If a configuration file does not exist then perform this step
   a) Press the **Preset** button to preset the instrument
   b) Press **FREQ** button and set **Frequency A** to 782 MHz
   c) Click on **Config** in "Baseband A" block diagram
      i) Select **EUTRA/LTE**
         (1) Set **State:** On
         (2) Set **Duplexing**: FDD
         (3) Set **Link Direction:** UL (SC-FDMA)
      ii) Click on **General UL Settings**
         (1) Select **Channel Bandwidth:** 10 MHz
         (2) All other options leave as default settings
         (3) Click on X to save changes made in dialog box
      iii) Click on **Frame Configuration**
         (1) **UE 1**: Check On
         (2) In Row 0, insure number of resource blocks is 50 in "No. RB" column
         (3) In Row 0, insure modulation format is QPSK in "Modulation/Format" column

        (4) In Row 0, insure “state” column is set On
        (5) All other options leave as default settings
        (6) Click on X to save changes made in dialog box
    iv) Click on **Filter/Clipping/Power** Settings
        (1) Check **State**: On
        (2) Select **Filter**: EUTRA/LTE
        (3) Select **Optimization**: Best ACP
        (4) All other options leave as default settings
        (5) Click on X to save changes made in dialog box
    v) Click on X to save changes made in Baseband A dialog box
  d) Check the “I/Q Mod A” On box in block diagram
  e) Press **LEVEL** button and set output power A to -50 dBm initially
  f) Check the “RF/A” On box in block diagram to turn output power on
  g) Save the instrument state
    i) Press the **FILE** button
    ii) Select **Save** from the **Select Operation** pull down menu
    iii) Select the D:\Phase1_config_files directory
    iv) Enter C_block_interference_uplink for the file name
    v) Click the **Save** button

For Interference Signal 2 (IS 2): C Block DL, implement Step 7)b) as follows:

Step 7)b): Configure the SMU200A signal generator for the C Block DL interference signal

1) If a configuration file exists do the following
  a) Press the **File** button
  b) Select **Recall** from the **Select Operation** pull down menu
  c) Highlight the interference file C_block_interference_downlink.savrcl (6/7/11)

C_block_interference_downlink.savrcl

  d) Push the **Recall** button
  e) Go to Step 8)
2) Else If a configuration file does not exist then perform this step
  a) Press the **Preset** button to preset the instrument
  b) Press **FREQ** button and set **Frequency A** to 751 MHz
  c) Click on **Config** in “Baseband A” block diagram
    i) Select **EUTRA/LTE**
        (1) Set **State**: On
        (2) Set **Duplexing**: FDD
        (3) Set **Link Direction**: DL (OFDMA)
    ii) Click on **Test Setups/Models**
        (1) Select E-TM1_1__10MHz
        (2) Click **Select** button
    iii) Click on **General DL Settings**
        (1) Select **Channel Bandwidth** as 10 MHz
        (2) All other options leave as default settings

(3) Click on X to save changes made in dialog box

iv) Click on **Frame Configuration** (See screen shot in Figure 10)

(1) In Rows 1 and 2, insure number of resource blocks is 50 in “No. RB” column

(2) In Rows 1 and 2, insure Modulation Format is QPSK in “Modulation/Format” column

(3) Insure Rows 0-2 are ON in “State” Column

(4) All other options leave as default settings

(5) Click on X to save changes made in dialog box

v) Click on **Filter/Clipping/Power Settings**

(1) Check **State:** On

(2) Select **Filter**: EUTRA/LTE

(3) Select **Optimization**: Best ACP

(4) All other options leave as default settings

(5) Click on X to save changes made in dialog box

vi) Click on X to save changes made in Baseband A dialog box

d) Check the “I/Q Mod A” On box in block diagram

e) Press **LEVEL** button and set output power A to -50 dBm initially

f) Check the “RF/A” On box in block diagram to turn output power on

g) Save the instrument state

i) Press the **FILE** button

ii) Select **Save** from the **Select Operation** pull down menu

iii) Select the D:\Phase1_config_files directory

iv) Enter C_block_interference_downlink for the file name

v) Click the **Save** button

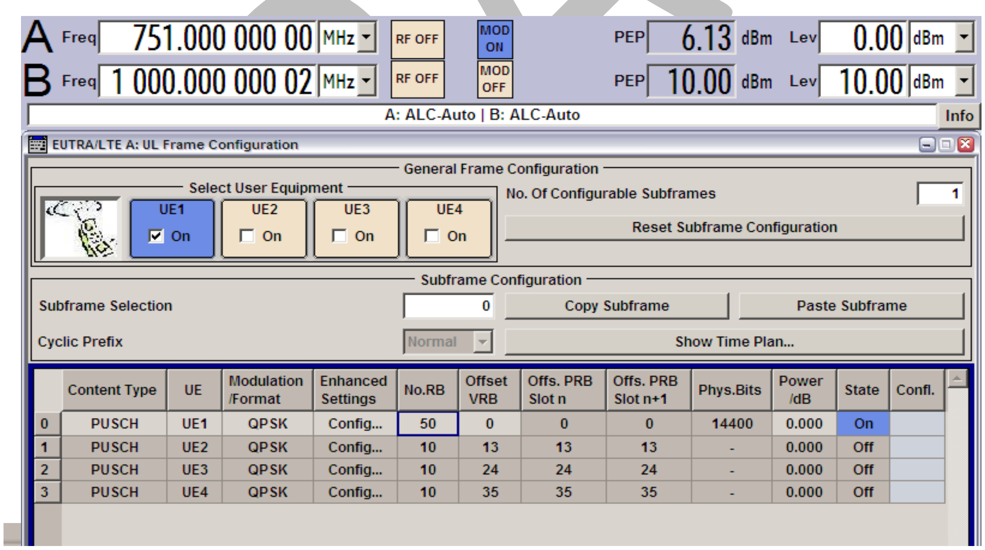


Figure 10. SMU 200A C Block DL frame configuration dialog box.

For Interference Signal 3 (IS 3): PS Narrowband UL, implement Step 7)b) as follows:

Step 7)b) Configure the R&S SMU 200A signal generator for the PS Narrowband UL

1) If a configuration file exists do the following

a) Press the **File** button

    b) Select **Recall** from the **Select Operation** pull down menu
    c) Highlight the interference file P25_C4FM_UL.savrcl (6/7/11)

P25_C4FM_UL.savrcl

    d) Push the **Recall** button
    e) Go to Step 8)
2) Else If a configuration file does not exist then perform this step
    a) Press the **Preset** button to preset the instrument
    b) Press the **Freq** button
        i) Enter 799 MHz on keypad
    c) Click on **Config** in “Baseband A” block diagram
        i) Click on **Custom Digital Mod**
        ii) On the Data Source pull down menu, select **Data List**
        iii) Click the **Select Data List** button
        iv) Select the file 1011.dm_iqd (2/24/11)

1011.dm_iqd

        v) Click the **Select** button
    d) Click the **Symbol Rate** box
        i) Enter 4800 symbols/second
    e) From the **Modulation Type** pull down menu select **Variable FSK/More…**
    f) Click on the **More** button in the **Modulation** box
        i) Select **4 FSK** on the **FSK Type** pull down menu
        ii) In dialog box enter the following
            (1) **Deviation 0000**: 600 Hz
            (2) **Deviation 0001**: 1800 Hz
            (3) **Deviation 0010**: -600 Hz
            (4) **Deviation 0011**: -1800 Hz
        iii) Click on X to save changes made in dialog box
    g) In **Filter** pull down menu select **APCO 25**
        i) Set **Roll Off Factor**: 0.2
        ii) Push the **State** box to set **State** to On
    h) Click on X to save changes made in the Baseband A dialog box
    i) Check the “I/Q Mod A” On box in block diagram
    j) Press **LEVEL** button and set output power A to -50 dBm initially
    k) Check the “RF/A” On box in block diagram to turn output power on
    l) Save the instrument state
        i) Press the **FILE** button
        ii) Select **Save** from the **Select Operation** pull down menu
        iii) Select the D:\Phase1_config_files directory
        iv) Enter P25_C4FM_UL for the file name
        v) Click the **Save** button

For Interference Signal 4 (IS 4): PS Narrowband DL, implement Step 7)b) as follows:

Step 7)b): Configure the R&S SMU 200A signal generator for the PS Narrowband DL interference signal

1) If a configuration file exists do the following
    a) Press the **File** button
    b) Select **Recall** from the **Select Operation** pull down menu
    c) Highlight the interference file P25_C4FM_DL.savrcl (6/7/11)

P25_C4FM_DL.savrcl

    d) Push the **Recall** button
    e) Go to Step 8)
2) Else If a configuration file does not exist then perform this step
    a) Press the **Preset** button to preset the instrument
    b) Press the **Freq** button
        i) Enter 769 MHz on keypad
    c) Click on **Config** in "Baseband A" block diagram
        i) Click on **Custom Digital Mod**
        ii) On the **Data Source** pull down menu, select **Data List**
        iii) Click the **Select Data List** button
        iv) Select the file 1011.dm_iqd
        v) Click the **Select** button
    d) Click the symbol rate box
        i) Enter 4800 symbols/second
    e) From the **Modulation Type** pull down menu select Variable **FSK/More…**
        i) Click on the **More** button in the Modulation box
        ii) Select **4 FSK** on the **FSK Type** pull down menu
        iii) In dialog box enter the following
            (1) **Deviation 0000**: 600 Hz
            (2) **Deviation 0001**: 1800 Hz
            (3) **Deviation 0010**: -600 Hz
            (4) **Deviation 0011**: -1800 Hz
        iv) Click on X to save changes made in dialog box
    f) In **Filter** pull down menu select **APCO 25**
        i) Set **Roll Off Factor:** 0.2
        ii) Push the **State** box to set **State** to On
    g) Click on X to save changes made in the Baseband A dialog box
    h) Check the "I/Q Mod A" On box in block diagram
    i) Press **LEVEL** button and set output power A to -50 dBm initially
    j) Check the "RF/A" On box in block diagram to turn output power on
    k) Save the instrument state
        i) Press the **FILE** button
        ii) Select **Save** from the **Select Operation** pull down menu
        iii) Select the D:\Phase1_config_files directory
        iv) Enter P25_C4FM_DL for the file name
        v) Click the **Save** button

6.2.5 Expected Outcome

Determination of how eNB throughput is affected by adjacent channel interferers.

6.3 eNB Spectral Characteristics

The tests in this section measure the emissions of the base station in 3 frequency bands (in-band, out-of-band and spurious) between 728MHz and 798MHz while the transmitter is in operation. Table 2 details the bands being tested. The purpose of this test is to verify that the eNB does not emit radiation outside the spectral emission mask shown in Figure 11 below.

Table 2: Frequency bands for testing base station emissions between 728 MHz and 798 MHz

DL Frequency Bands	DL Frequency Range (MHz)	Power Level (dBm/100 kHz)	3GPP TS 36.104 version 8.8.0 Reference
In Band	758-768	Pmax	Clause 6.2.1
Out-of-Band	748-753 Lower	-14	Table 6.6.3.1-3
	753-753.7 Lower	-14 to -13	Table 6.6.3.1-3
	753.7-758 Lower	-13	FCC rule 27.53
	768-769 Upper	-7 to -8.4	Table 6.6.3.1-3
	769-777 Upper	-34	Table 6.6.4.3.1-3
Spurious Co-location	728-748 Lower	-62	Table 6.6.4.3.1-1 with Note 1
	777-798 Upper	-96	Tables 6.6.4.2-1 and 6.6.4.4.1-1
Spurious Co-existence	728-748 Lower	-62	Table 6.6.4.3.1-1 with Note 1
	777-788 Upper	-59	Table 6.6.4.3.1-1
	788-798 Upper	-96	Table 6.6.4.2-1

The plot below shows the required eNB Spectral Emission Mask (SEM) for band class 14 for the DL. The SEM was derived from 3GPP TS 36.104 v8.8.0 and FCC rule 27.53. Pmax (3GPP TS 36.104 v8.8.0 (2009-12) Clause 6.2.1) refers to the manufacturer's rated output power, appropriately adjusted for 100 kHz measurement bandwidth. This value must be within 2 dB of the manufacturer's rated output power.

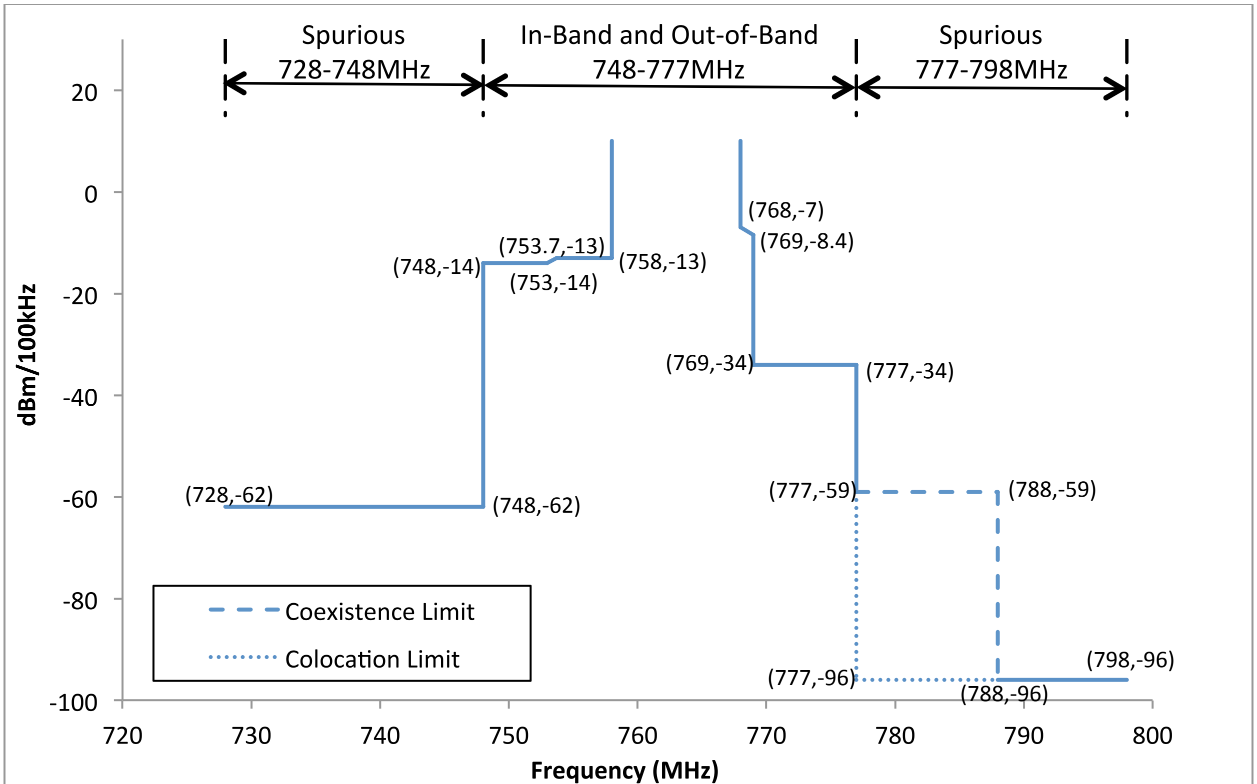


Figure 11. Spectrum Emissions Mask for Band Class 14 eNB Transmitter-DL.

6.3.1 In Band (IB) and Out of Band (OOB) Emissions

6.3.1.1 Test Description

This test examines the spectral distribution of power within the operating band, 748 to 777 MHz. See 3GPP TS 36.104 v8.8.0 (2009-12) Clause 6.6.3.

6.3.1.2 Reference

See 3GPP TS 36.104 v8.8.0 (2009-12) Clause 6.6.3.1.

6.3.1.3 Required Equipment

The equipment necessary for this test:

5.2.2 Spectrum Analyzer

See also 3GPP TS 36.141 v8.5.0 (2009-12) Clause 6.6.3.4.1.

6.3.1.4 Test Procedure

This test will be performed on a single transmitter of a single sector of the eNB. This test calls for one channel configuration; E-TM1.1. The initial conditions for this test are found in TS 36.141 V8.5.0 (2009-12) clause 6.6.3.4.1 with the following caveats:

i) Only the normal test environment will be used. See TS 36.141 V8.5.0 (2009-12) Annex D subclause D.2 with the exception of the relative humidity and barometric pressure .

ii) The RF channel tested will be the middle (M) frequency of the eNB, i.e., 763 MHz, as described in TS 36.141 V8.5.0 (2009-12) subclause 4.7.

1) *Calibration and cable loss measurement*
   a) Configure the calibration lab setup using Figure 16 provided in section A.1 of Annex A
   b) Measure and record the cable and attenuator loss across the frequencies of interest from 748-777 MHz using the steps provided in section A.1 of Annex A.

2) *Configure the test circuit* - Connect the cables, spectrum analyzer and eNB in the testing configuration shown in Figure 12.

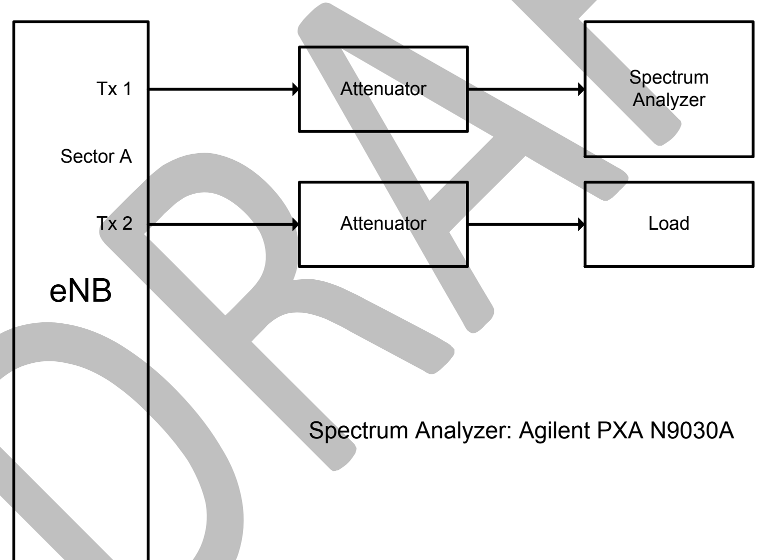


Figure 12. Test setup for in-band and out of band emissions tests.

3) *Configure the eNB*
   a) Channel set up - Configure the eNB in accordance with Step 1) in the procedure of TS 36.141 V8.5.0 (2009-12) clause 6.6.3.4.2.
      (1) The eNB is to be configured in accordance with E-TM1.1 (TS 36.141 V8.5.0 (2009-12) clause 6.1.1.1).
         (a) In the event that the eNB cannot be configured for E-TM1.1 and E-TM1.2, the vendor will propose an alternate channel occupancy model for PSCR approval.
   b) Set the eNB transmission at maximum output power as specified by the manufacturer.

c) Set the eNB to transmit a 10 MHz wide signal centered at 763 MHz

4) *Configure the PXA N9030A spectrum analyzer*

a) To use an existing configuration file
   - i) Press the **Recall** button
     - (1) Press the **State** softkey
     - (2) Press the From **File** softkey
     - (3) Highlight the file inband_outofband.state (2/17/2012)

inband_outofband.state

   - ii) Press **Open** button
   - iii) Go to step c)

b) If a configuration file does not exist then perform the following
   - i) Press the **Preset** button
   - ii) Press the **Freq** button
     - (1) Press the **Start Freq** softkey
     - (2) Enter 748 on keypad
     - (3) Press **MHz** softkey
     - (4) Press the **Stop Freq** softkey
     - (5) Enter 777 on keypad
     - (6) Press **MHz** softkey
   - iii) Press **Sweep/Control** button
     - (1) Press **Points** softkey
     - (2) Enter 8001 on keypad
     - (3) Press the **Sweep Time** softkey
     - (4) Enter 10 on keypad
     - (5) Press the **S** softkey
   - iv) Press the **BW** button
     - (1) Press the **Res BW** softkey
     - (2) Enter 100 on keypad
     - (3) Press the **kHz** softkey
     - (4) Press the **Video BW** softkey
     - (5) Enter 10 on keypad
     - (6) Press **kHz** softkey
   - v) Press the **Meas Setup** button
     - (1) Press the **Average/Hold** softkey
     - (2) Enter 1 on keypad
     - (3) Press the **Enter** softkey
   - vi) Press the **AMPTD Y Scale** button
     - (1) Press the **More** softkey
     - (2) Press the **Ref Lvl Offset** softkey
     - (3) Enter 25 on keypad
     - (4) Press the **dB** softkey
     - (5) Press the **More** softkey
     - (6) Press the **Ref Level** softkey

(7) Enter 40 on keypad
(8) Press the **dBm** softkey
(9) Press **Attenuation** softkey
(10) Enter 30 on keypad
(11) Press **dB** softkey

vii) Press the **Trace/Detector** button
(1) Press the **More** softkey
(2) Press the **Detector** softkey
(3) Press the **Average** softkey

viii) Press the **Meas Setup** button
(1) Press the **Limits** softkey
(2) Press the **Edit** softkey
(3) Enter the following the Frequency/Amplitude pairs:

748MHz	-14 dBm
753MHz	-14 dBm
753.7MHz	-13dBm
758MHz	-13 dBm
758MHz	100 dBm
768MHz	100 dBm
768MHz	-7 dBm
769MHz	-8.4 dBm
769MHz	-34 dBm
777MHz	-34 dBm

(4) Press the **Return** softkey

ix) Press the **Marker** button
(1) Press **Select Marker** softkey
(2) Press **Marker 1** softkey
(3) Press **Normal** softkey
(4) Enter 753 on keypad
(5) Press **MHz** softkey

x) Repeat Step ix) with markers 2, 3, 4 and 5 at 758, 763, 768 and 769 MHz

xi) Press **Marker** button
(1) Press **More** softkey
(2) Press **Marker Table** softkey (turns Marker Table on)

xii) Press **Save** button
(1) Press the **State** softkey
(2) Press To **File** softkey

xiii) Save the instrument settings as inband_outofband.state

c) Set the amplitude offset

i) Press the **AMPTD Y Scale** button
(1) Press the **More** softkey
(2) Press the **Ref Lvl Offset** softkey
(3) Enter the attenuation value from the Step 1) calibration at 763MHz (a positive number)
(4) Press the **dB** softkey

ii) Press the **AMPTD Y Scale** button
(1) Press the **Ref Level** softkey
(2) Enter 40 on keypad
(3) Press the **dBm** softkey

5) *Measure and record the emission spectrum with the PXA N9030A*
   a) Account for test fixture loss measured in Step 1)
   b) If necessary, increase the spectrum analyzer attenuation to prevent input overload.
   c) Save the screen image
      i) Press the **Save** button
      ii) Press **Screen Image** softkey
      iii) Press **Save As** softkey
      iv) Save the screen shot as a .png file
   d) Press **Save** button
      i) Press the **Save** button
      ii) Press **Data** softkey
      iii) Press **Save As** softkey
      iv) Save the data as a .csv file

6.3.1.5 Expected Outcome

Spectral characteristics of the eNB emissions across the 748 to 777 MHz band.

6.3.2 Spurious Emissions

Two separate environments are envisioned for public safety LTE equipment. In some cases the equipment will not be colocated with band 13 equipment, but will be required to coexist with band 13 (and other wireless equipment). In other cases the public safety LTE equipment will be colocated with band 13 equipment and will need to meet stricter spurious emissions requirements to prevent interference. If the vendor intends to use the same equipment for coexistence and colocation environments, then the colocation limits must be used. If the vendor intends to use different equipment for coexistence and colocation environments, then the appropriate limits will apply.

6.3.2.1 Test Description

See 3GPP TS 36.141 v8.5.0 (2009-12) Clause 6.6.4.1

6.3.2.2 Reference

See 3GPP TS 36.104 v8.8.0 (2009-12) Clause 6.6.4

6.3.2.3 Required Equipment

The equipment necessary for this test are described in the following sections

5.2.2 Spectrum Analyzer

5.2.10 Bandreject Filter

See also 3GPP TS 36.141 v8.5.0 (2009-12) Clause 6.6.4.4.1

6.3.2.4 Test Procedure

The initial conditions for this test are found in TS 36.141 V8.5.0 (2009-12) clause 6.6.3.4.1 with the following caveats:

i) Only the normal test environment will be used. See TS 36.141 V8.5.0 (2009-12) Annex D subclause D.2 with the exception of the relative humidity and barometric pressure.

ii) The RF channel tested will be the middle (M) frequency of the eNB, i.e., 763 MHz, as described in TS 36.141 V8.5.0 (2009-12) subclause 4.7.

This test will be performed on a single transmitter port. There are two spurious frequency bands (an upper band (777-to-798 MHz) and a lower band (728-to-748 MHz) as shown in Table 2.

This test calls for the channel configuration E-TM1.1.

1) *Calibration and test fixture loss measurement*
   a) Configure the calibration lab setup using Figure 17 provided in section A.2 of Annex A
   b) Measure and record the test fixture loss (attenuator, cable, and filter loss) across the frequencies of interest from 728 to 798 MHz using the steps provided in section A.2 of Annex A.

2) *Configure the test circuit* - Connect the cables, spectrum analyzer and eNB in the testing configuration as shown in Figure 13.

3) *Configure the eNB*

a) Configure the eNB in accordance with Step 1) in the procedure of TS 36.141 V8.5.0 (2009-12) clause 6.6.4.4.2. The eNB is to be configured in accordance with E-TM1.1 (TS 36.141 V8.5.0 (2009-12) clause 6.1.1.1).
   i) If the above condition cannot be met, the vendor will propose an alternate channel occupancy model for PSCR approval.
b) Set the eNB transmission at maximum output power as specified by the manufacturer.
c) Set the eNB to transmit a 10 MHz wide signal centered at 763 MHz

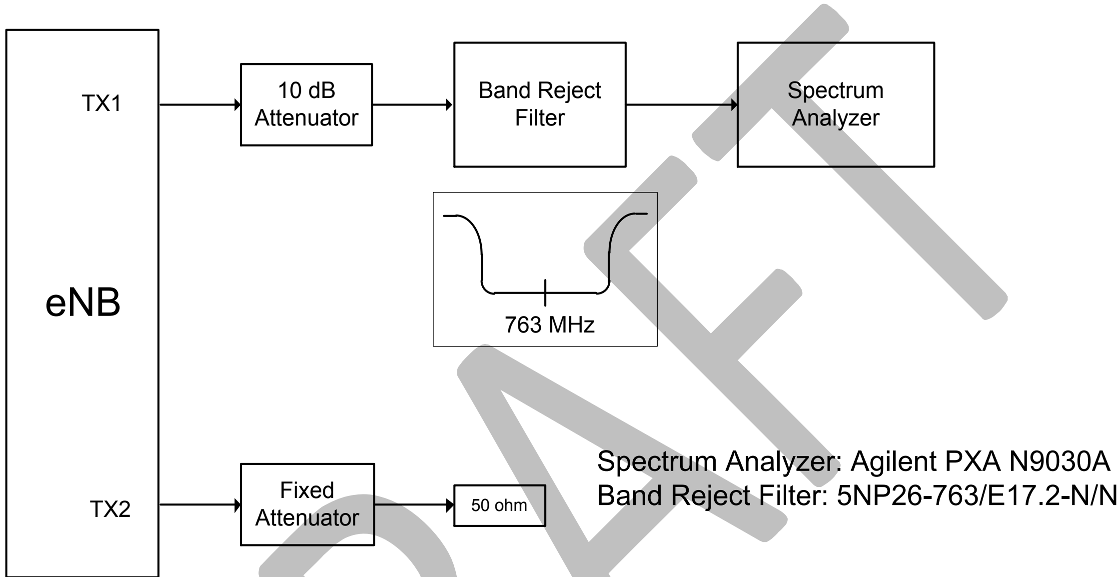


Figure 13. Test setup for spurious emissions.

4) *Configure the PXA N9030A spectrum analyzer to measure*

a) To use an existing configuration file
   i) Press the **Recall** button
      (1) Press the **State** softkey
      (2) Press the From **File** softkey
      (3) Highlight the desired state file:
         (a) For co-existence test select spurious_coexistence.state (2/17/2012)

spurious_coexistence.state

      (b) For co-location test select spurious_colocation.state (2/17/2012)

spurious_colocation.state

   ii) Press **Open** button
   iii) Go to step 5)

b) If a configuration file does not exist then perform the following
   i) Press the **Preset** button
      (1) Press the **Freq** button
      (2) Press the **Start Freq** softkey
      (3) Enter 728 on keypad
      (4) Press the **MHz** softkey
      (5) Press the **Stop Freq** softkey
      (6) Enter 798 on keypad
      (7) Press **MHz** softkey
   ii) Press the **Sweep/Control** button
      (1) Press the **Points** softkey
      (2) Enter 8001 on keypad
      (3) Press the **Enter** softkey
      (4) Press the **Sweep Time** softkey
      (5) Enter 10 on keypad
      (6) Press **Seconds** softkey
   iii) Press the **Trace/Detector** button
      (1) Press the **More** softkey
      (2) Press the **Detector** softkey
      (3) Press the **Average** Softkey
   iv) Press the **BW** button
      (1) Press the **Res BW** softkey
      (2) Enter 100 on keypad
      (3) Press the **kHz** softkey
      (4) Press **Video BW** softkey
      (5) Enter 1 on keypad
      (6) Press **kHz** softkey
   v) Press the **Meas Setup** button
      (1) Press the **Average /Hold** softkey
      (2) Enter 1 on keypad
      (3) Press the **Enter** softkey
   vi) Press the **AMPTD Y Scale** button
      (1) Press the **Ref Level** softkey
      (2) Enter 20 on keypad
      (3) Press **-dBm** softkey
      (4) Press **Attenuation** softkey
      (5) Enter 0 on keypad
      (6) Press **dB** softkey
   vii) Press the **Mode Setup** button
      (1) Press the **Noise Reduction** softkey
      (2) If not already on, press the **Noise Floor Extension** softkey to turn on noise reduction
   viii) Press the **Meas Setup** button
      (1) Press the **Limits** softkey
      (2) Press the **Edit** softkey
      (3) Enter the following the Frequency/Amplitude pairs:
         (a) For Co-location test
            728MHz -62 dBm

748MHz -62 dBm
748MHz -14 dBm
753MHz -14 dBm
753.7MHz -13 dBm
758MHz -13 dBm
758MHz 100 dBm
768MHz 100 dBm
768MHz -7 dBm
769MHz -8.4 dBm
769MHz -34 dBm
777MHz -34 dBm
777MHz -96 dBm
798MHz -96 dBm

(b) For co-existence test

728MHz -62 dBm
748MHz -62 dBm
748MHz -14 dBm
753MHz -14 dBm
753.7MHz -13 dBm
758MHz -13 dBm
758MHz 100 dBm
768MHz 100 dBm
768MHz -7 dBm
769MHz -8.4 dBm
769MHz -34 dBm
777MHz -34 dBm
777MHz -59 dBm
788MHz -59 dBm
788MHz -96dBm
798MHz -96dBm

(4) Press the **Return** softkey

ix) Press **Save** button
   (1) Press the **State** softkey
   (2) Press **To File** softkey

x) Save the instrument settings as spurious_colocation.state or spurious_coexistence.state

5) *Measure and record the emission spectrum with the PXA N9030A*
   a) Account for test fixture loss measured in Step 1) of section .
   b) Set the amplitude offset
      i) Press the **AMPTD Y Scale** button
         (1) Press the **More** softkey
         (2) Press the **Ref Lvl Offset** softkey
         (3) Enter the attenuation value from the Step 1) calibration (a positive number)
         (4) Press the **dB** softkey
      ii) Press the **AMPTD Y Scale** button
         (1) Press the **Ref Level** softkey
         (2) Enter 20 on keypad
         (3) Press the **-dBm** softkey

c) Press **Save** button
   i) Press the **Save** button
   ii) Press **Screen Image** softkey
   iii) Press **Save As** softkey
   iv) Save the screen shot as a .png file
d) Press **Save** button
   i) Press the **Save** button
   ii) Press **Data** softkey
   iii) Press **Save As** softkey
   iv) Save the data as a .csv file

6.3.2.5 Expected Outcome

Identification of transmitter spurious emissions at < 748MHz and > 777MHz.

6.4 eNB Power Output

6.4.1 Test Description

See 3GPP TS 36.141 v8.5.0 (2009-12) Clause 6.2.1

6.4.2 Reference

See 3GPP TS 36.104 v8.8.0 (2009-12) Clause 6.2.1

6.4.3 Required Equipment

The equipment necessary for this test are described in the following sections

5.2.2 Spectrum Analyzer

See also 3GPP TS 36.141 v8.5.0 (2009-12) Clause 6.2.4.1

6.4.4 Test Procedure

The initial conditions for this test are found in TS 36.141 V8.5.0 (2009-12) clause 6.2.4.1 with the following caveats:

i) Only the normal test environment will be used. See TS 36.141 V8.5.0 (2009-12) Annex D subclause D.2 with the exception of the relative humidity and barometric pressure.
ii) The RF channel tested will be the middle (M) frequency of the eNB, i.e., 763 MHz, as described in TS 36.141 V8.5.0 (2009-12) subclause 4.7.

This test will be performed on a single transmitter port.

This test calls for the channel configuration E-TM1.1.

1) *Calibration and test fixture loss measurement*
   a) Configure the calibration lab setup using Figure 17 provided in section A.2 of Annex A
   b) Measure and record the test fixture loss (attenuator and cable loss) across the frequencies of interest from 728 to 798 MHz using the steps provided in section A.2 of Annex A.

2) *Configure the test circuit* - Connect the cables, spectrum analyzer and eNB in the testing configuration as shown in Figure 13.

3) *Configure the eNB*
   a) Configure the eNB in accordance with Step 1) in the procedure of TS 36.141 V8.5.0 (2009-12) clause 6.6.4.4.2. The eNB is to be configured in accordance with E-TM1.1 (TS 36.141 V8.5.0 (2009-12) clause 6.1.1.1).
      i) If the above condition cannot be met, the vendor will propose an alternate channel occupancy model for PSCR approval.
   b) Set the eNB transmission at maximum output power as specified by the manufacturer.
   c) Set the eNB to transmit a 10 MHz wide signal centered at 763 MHz

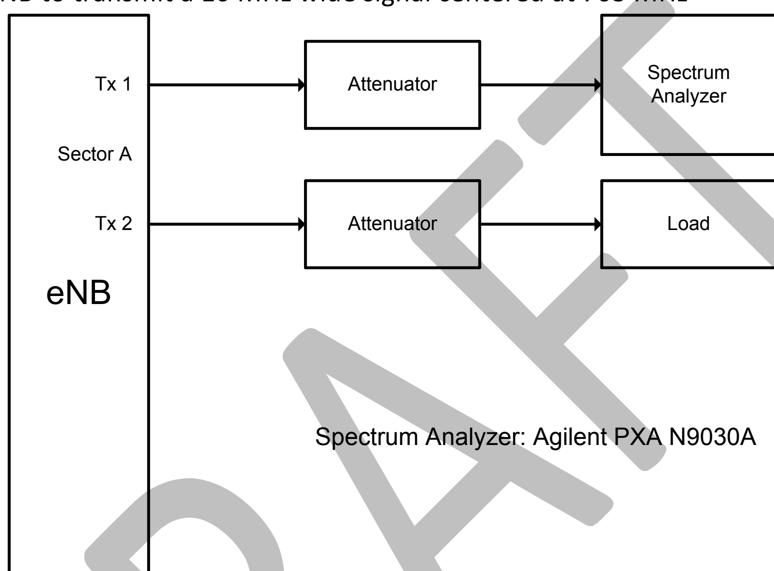


Figure 14. Test setup for eNB Power Output.

4) *Configure the PXA N9030A spectrum analyzer*

   a) To use an existing configuration file
      i) Press the **Recall** button
         (1) Press the **State** softkey
         (2) Press the From **File** softkey

Highlight the file channel_power.state (2/17/2012)

channel_power.state

      ii) Press **Open** button
      iii) Go to step c)

   b) If a configuration file does not exist then perform the following
      i) Press the **Preset** button
      ii) Press the **Meas** button
      iii) Press the **Channel Power** softkey
      iv) Press the **Center Freq** softkey

(1) Enter 763 on keypad
(2) Press the **MHz** softkey
v) Press the **Meas Setup** button
vi) Press the **Integ BW** softkey
(1) Enter 10 on keypad
(2) Press the **MHz** softkey
vii) Press the **AMPTD Y Scale** button
(1) Press the **More** softkey
(2) Press the **Ref Lvl Offset** softkey
(3) Enter 25 on keypad
(4) Press the **dB** softkey
(5) Press the **More** softkey
(6) Press the **Ref Level** softkey
(7) Enter 40 on keypad
(8) Press the **dBm** softkey
(9) Press **Attenuation** softkey
(10)Enter 30 on keypad
(11)Press **dB** softkey
viii) Press **Save** button
(1) Press the **State** softkey
(2) Press To **File** softkey
ix) Save the instrument settings as channel_power.state

5) *Measure and record the emission spectrum with the PXA N9030A*
a) Account for test fixture loss measured in Step 1) of section 6.4.4.
b) Set the amplitude offset
i) Press the **AMPTD Y Scale** button
(1) Press the **More** softkey
(2) Press the **Ref Lvl Offset** softkey
(3) Enter the attenuation value from the Step 1) calibration for the middle of the range being measured (a positive number)
(4) Press the **dB** softkey
ii) Press the **AMPTD Y Scale** button
(1) Press the **Ref Level** softkey
(2) Enter 40 on keypad
(3) Press the **dBm** softkey
c) Press **Save** button
i) Press the **Save** button
ii) Press **Screen Image** softkey
iii) Press **Save As** softkey
iv) Save the screen shot as a .png file

6.4.5 Expected Outcome

eNB output power shall be within ±2dB of manufacturer's rated maximum output power.

7 Messaging/Protocol Tests

There are three tests in this section consisting of the Authentication Procedure (section 7.1), the Detach Procedure (section 7.2), and the Verification of IP Connectivity Procedure (section 7.3). The Authentication Procedure and Detach Procedure tests are to assure basic connection functionality by examining the message exchange between a UE and eNB. The Verification of IP Connectivity Procedure test is a test developed by PSCR and draws upon the completed Authentication Procedure test.

7.1 Attach Procedure

7.1.1 Test Description

The purpose of this test is to establish that a UE can successfully be authenticated by the infrastructure.

7.1.2 Reference

See 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.1.2.1.2

7.1.3 Required Equipment

The equipment necessary for this test are described in the following sections

5.2.8 UE and Drive Test

And or other equipment, hardware and software, provided by the vendor.

7.1.4 Test Procedure

The pre-test conditions for this test are found in 3GPP TS 36.523-1 V8.4.0 (2009-12) clause 9.1.2.1.3.1. The following caveats will apply to the pre-test conditions:

i) The System simulator, Cell A, in the clause will be replaced with the PSCR demonstration project eNB under test.

ii) The types and character of the security context programmed into the USIM will be negotiated between PSCR and the vendor.

7.1.4.1 Test Sequence

The test message sequence is found in 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.1.2.1.3.2 Table 9.1.2.1.3.2-1: Main behavior. This table illustrates the message exchange between the eNB and the UE. This test requires that this message exchange during the attachment procedure be logged and examined for conformance. The PSCR demonstration project may have several pieces of equipment that may be used for this purpose. PSCR demonstration will determine with the vendor the number and type of security context(s) necessary.

1) Configure the eNB in accordance with the vendor's specification and PSCR direction
2) Configure the UE in accordance with 3GPP TS 36.523-1 V8.4.0 (2009-12) clause 9.1.2.1.3.1.
3) Initiate message logging and establish call
4) Save the attachment message exchange between UE and eNB.

5) Verify the message exchange is consistent with 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.1.2.1.3.2 Table 9.1.2.1.3.2-1. Pertinent information from the table was extracted and shown in Table 3.
   a) Document that the message sequence shown in Table 3 is followed. As a minimum, the contents of the logged messages should consist of the following information:
      i) Time of message
      ii) Message type
      iii) Message content
      iv) Security context
      v) Message Direction
6) If multiple security contexts were determine necessary, repeat Steps 1) through 5).

7.1.5 Expected Outcome

The message exchange conforms to Table 3.

Table 3. Message Exchange for Authentication Procedure

State	Procedure	Message Sequence		Verdict
		UE - EPC	Message	
1	Switch the UE on	-	-	-
2	The UE transmit an ATTACH REQUEST including a GUTI and a PDN CONNECTIVITY REQUEST message	-->	ATTACH REQUEST	-
3	EPC transmits an AUTHENTICATION REQUEST message, KSI_{ASME} value is different to the KSI_{ASME} value provided in the ATTACH REQUEST	<--	AUTHENTICATION REQUEST	P
4	Check: Does the UE respond with AUTHENTICATION RESPONSE message within 6 seconds and the included RES is equal to the XRES calculated in the EPC?	-->	AUTHENTICATION RESPONSE	-
5	EPC transmits a NAS SECURITY MODE COMMAND message including the KSI_{ASME} of the new EPS security context (as provided in step 3)	<--	SECURITY MODE COMMAND	P
6	Check: Does the UE respond with NAS SECURITY MODE COMPLETE message integrity protected and ciphered with the new EPS security context identified by the KSI_{ASME} received in the SECURITY MODE COMMAND message in step 5	-->	SECURITY MODE COMPLETE	-
-	EXCEPTION: Steps 7a1 to 7a2 describe behaviour that depends on UE configuration; the "lower case letter" identifies a step sequence that take place if the UE has ESM information which needs to be transferred.	-	-	-
7a1	IF the UE sets the ESM information transfer flag in the last PDN CONNECTIVITY REQUEST message THEN the EPC transmits an ESM INFORMATION REQUEST message to initiate exchange of protocol configuration options and/or APN.	<--	ESM INFORMATION REQUEST	P
7a2	The UE transmits an ESM INFORMATION RESPONSE message to transfer protocol configuration options and/or APN.	-->	ESM INFORMATION RESPONSE	-
8	EPC responds with ATTACH ACCEPT message. The ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message is piggybacked in ATTACH ACCEPT message	<--	ATTACH ACCEPT	P
-	EXCEPTION: In parallel to the event described in step 9 below the generic procedure for IP address allocation in the U-plane specified in TS 36.508 subclause 4.5A.1 takes place performing IP address allocation in the U-plane if requested by the UE.	-	-	-
9	The UE transmits an ATTACH COMPLETE message including an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message	-->	ATTACH COMPLETE	-

7.2 Detach Procedure

7.2.1 Test Description

The purpose of this test is to establish that a UE can successfully detach from the infrastructure.

7.2.2 Reference

See 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.2.2.1.1.2

7.2.3 Required Equipment

The equipment necessary for this test are described in the following sections

5.2.8 UE and Drive Test

And or other equipment, hardware and software, provided by the vendor.

7.2.4 Test Procedure

The pre-test conditions for this test are found in 3GPP TS 36.523-1 V8.4.0 (2009-12) clause 9.2.2.1.1.3.1. The following caveats will apply to the pre-test conditions:

i) The System simulator, Cell A (HPLMN), in the clause will be replaced with the PSCR demonstration project eNB under test.

7.2.4.1 Test Sequence

The test message sequence is found in 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.2.2.1.1.3.2 Table 9.2.2.1.1.3.2-1: Main behavior. This table illustrates the message exchange between the eNB and the UE. This test requires that this message exchange during the attachment procedure be logged and examined for conformance. The PSCR demonstration project may have several pieces of equipment that may be used for this purpose.

1) Configure the eNB in accordance with the vendor's specification and PSCR direction.
2) Configure the UE in accordance with 3GPP TS 36.523-1 V8.4.0 (2009-12) clause 9.2.2.1.3.1.
3) Initiate message logging and establish call
4) Save the detach message exchange between UE and the eNB.
5) Verify the message exchange is consistent with 3GPP TS 36.523-1 V8.4.0 (2009-12) Clause 9.2.2.1.1.3.2 Table 9.2.2.1.1.3.2-1. Pertinent information from the table was extracted and shown in Table 4.
    a) Document that the message sequence shown in Table 4 is followed. As a minimum, the contents of the logged messages should consist of the following information:
        i) Time of message
        ii) Message type
        iii) Message content
        iv) Security context
        v) Message Direction

7.2.5 Expected Outcome

The message exchange conforms to Table 4.

Table 4: Message Exchange for Detach Procedure

State	Procedure	Message Sequence		Verdict
		UE - EPC	Message	
1	Cause switch off	-	-	-
2	Check: does the UE transmit an *RRCConnectionRequest* message with *establishmentCause* set to 'mo-Signalling' followed by a DETACH REQUEST with the Detach Type IE indicating "switch off"?	-->	DETACH REQUEST	P

7.3 Verification of IP Connectivity

7.3.1 Test Description

After completion of test 7.1 Attach Procedure, verify that a data session as been established and that an IP ping test is successful.

7.3.2 Reference

PSCR

7.3.3 Required Equipment

IP Client, IP Server, UE and EPC.

7.3.4 Test Procedure

1) Open a command line window on client
2) Verify client, default gateway, and DNS IP addresses
3) Use Ping of a public domain name (i.e. Google) and IP address to verify connectivity

7.3.5 Expected Outcome

Evidence that an IP link has been established between the client and server over an established LTE data session.

8 Application Tests

Note: All application tests will be assumed to be conducted through a centralized server in order to maintain consistency across different vendors.

The following tests require at least the following basic configuration:

- All Ue's must support LTE PS frequency (BC 14).
- LTE Base Station configured for PS frequency, EPC with Public Safety Access Point Name (APN)/Packet Data Network (PDN); user set up with default APN connected to private public safety network used for internet access & PDN connected to internal applications. These will be defined by PSCR at the time of system commissioning.

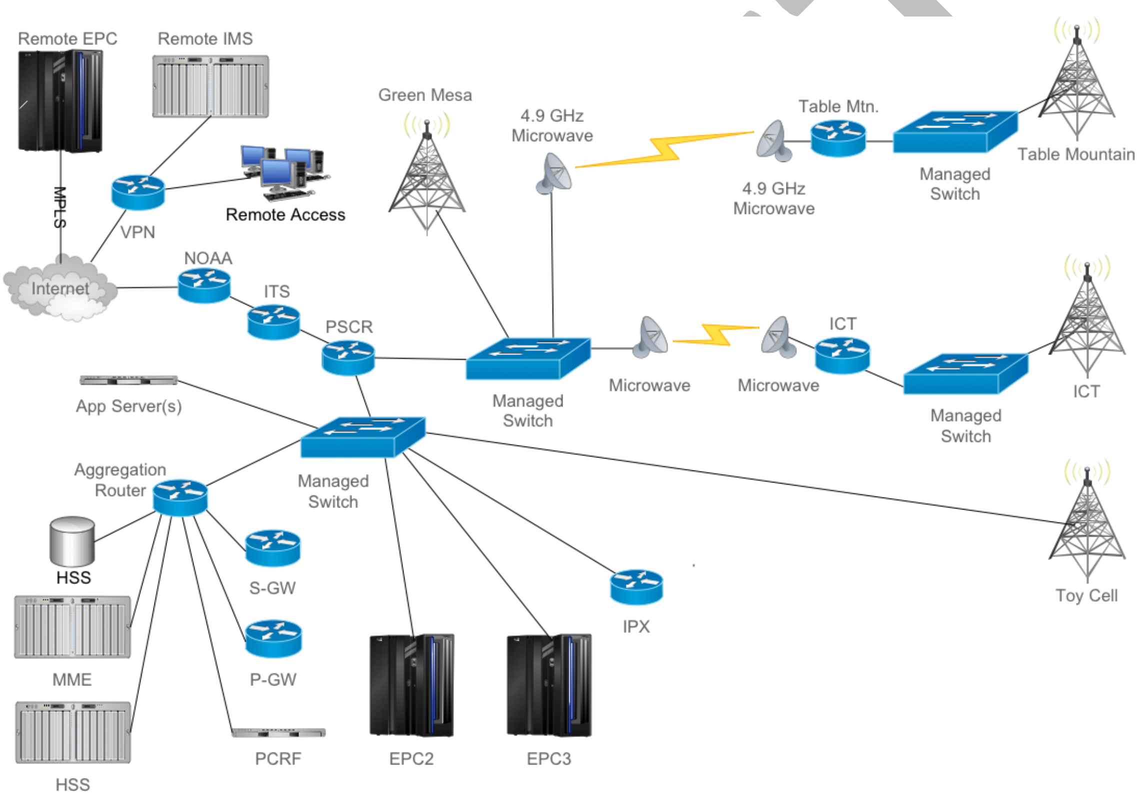


Figure 15. Application Test Architecture - Sufficient for Over-the-Top Applications

An over-the-top application uses the IP protocol and may or may not take advantage of specific functionality of the LTE network. Over the top applications assume that there is sufficient bandwidth to perform the indicated test.

Note: For the Application tests a single data session is established for all tests with all traffic on the default bearer.

8.1 Internet Access Test – Web Browsing

8.1.1 Test Description

Demonstrate web browsing via the *UE* utilizing standard HTTP and secure HTTP (HTTPS).

8.1.2 Reference

Requirement #3 Section 3.2 700MHz BB (Broadband) SoR (Statement of Requirements) v0.6

8.1.3 Required Equipment

Basic configuration + Web Browser application

8.1.4 Test Procedure

Perform Web Browsing with the *UE*.

1) Open a Firefox web browser and enter www.pscr.gov in the URL window.
2) From the top of the www.pscr.gov page click **Projects**
3) Click **Broadband**
4) Click **700 MHz Demonstration Network**
5) Click **Demonstration Network Flyover**
6) Scroll to the bottom of the page and click on **OLES**
7) Zoom in on some portion of the OLES home page
8) At the bottom right of the OLES home page enter the email address **PSALTE01@gmail.com** and clock **GO**

8.1.5 Expected Outcome

1. The expectation is that the end user will be able to:
    a. View a web site
        i. Scroll - View content that is larger than the client view port
            1. i.e. Multiple Pages
        ii. Zoom
2. Interact with the website:
    a. Click on hyper-links to go to a new page
    b. Type text into the web page

8.2 Internet Access Test - File Transfer Downlink (DL)

8.2.1 Test Description

Demonstrate downloading a file to the *UE*.

8.2.2 Reference

Requirement #1 Section 3.2 700MHz BB SoR v0.6

8.2.3 Required Equipment

Basic configuration + access to the PSCR FTP file server

8.2.4 Test Procedure

1) On the *UE* initiate an FTP session to the PSCR FTP server. PSCR will provide the user name and password. Set the FTP client for a binary download
2) Transfer the file 36143-830.doc found in the home directory from PSCR FTP server to the *UE.*
3) Transfer the file June 22nd Heist 15.avi found in the home directory from PSCR FTP server to the *UE*
4) Verify that the two files have been downloaded correctly[1]
    a. For file 36143-830.doc, the MD5 checksum is 8ECF02979A65B6C8104FE6B753C7CEF2
    b. For file June 22nd Heist 15.avi, the MD5 checksum is 6490D5B4067AF6D15DB57E03063B7AB1

8.2.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully download a files via FTP and/or HTTP
    a. Verify the files received at the *UE* are correct by performing MD5 checksum

[1] The MD5 can be found using a Windows utility such as WinMD5Free (www.winmd5.com) or for Unix/Linux using the command md5sum.

8.3 Internet Access Test - File Transfer Uplink (UL)

8.3.1 Test Description

To demonstrate the *UE* can upload a file to a server.

8.3.2 Reference

Requirement #1 Section 3.2 700MHz BB SoR v0.6

8.3.3 Required Equipment

Basic configuration + access to the PSCR FTP file server

8.3.4 Test Procedure

1) On the *UE* initiate an FTP session to the PSCR FTP server. PSCR will provide the user name and password. Choose *a* file to upload that is at least 100 MB, run the MD5 checksum on this file and record the value.
2) Upload the file from the *UE* to the PSCR FTP server in the home directory.
3) Open a command line session on the PSCR server
4) Run the MD5 checksum on the uploaded file on the PSCR server. (i.e. use md5sum)
5) Verify that the check sums are correct

8.3.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully upload a file via FTP and/or HTTP
    a. Verify the file received at the server is correct

8.4 Internet Access Test – Email

8.4.1 Test Description

Demonstrate the *UE* can send and receive email to and from an email server.

8.4.2 Reference

Requirement #2 Section 3.2 700MHz BB SoR v0.6

8.4.3 Required Equipment

Basic configuration + Email client application and access to an email server.

8.4.4 Test Procedure

1) Start an email client on the *UE*
2) Send a test email from the *UE* email client to user **PSALTE01@gmail.com**
3) Confirm receipt of test email to **PSALTE01@gmail.com**
4) Send an email from an external account to an email account that the *UE* has access to
5) Confirm at the *UE* that the externally sent email was received correctly
6) Repeat steps 2) through 5) with an attachment to the email

8.4.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully send a known text email to a known address.
    a. Verify email was received at addressee.
2. Successfully receive a known text email from the *UE* email client
    a. Verify email was received at the *UE*
3. Successfully send a known text email with an attachment to a known address.
    a. Verify email and attachment was received at addressee.
4. Successfully receive a known text email with an attachment to the *UE* email client
    a. Verify email and attachment was received at the *UE*

8.5 Secure Data - VPN (Virtual Private Network) Access & Traffic

8.5.1 Test Description

Demonstrate the *UE* can access and transmit traffic over a VPN.

8.5.2 Reference

Requirement #15 Section 3.2 700MHz BB SoR v0.6,

BBTF Requirement Section 6.2.2 700MHz BBTF Final Report v1.1

8.5.3 Required Equipment

Basic configuration + External VPN network accessible from PSCR Demonstration network, VPN client, client applications (i.e. web browser, email client, etc.), fileserver behind VPN.

8.5.4 Test Procedure

1) Using the UE VPN client, log into the PSCR VPN server (10.8.7.240).
2) Verify that the UE has the correct access to the VPN. For instance, verify VPN directories can be navigated, files can be uploaded and downloaded, verify VPN web resources can be accessed etc.

The PSCR server (10.8.7.240) can be used for this test if necessary.

8.5.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully attach to the VPN
    a. Verify th**at** a user can successfully login to VPN
2. Successfully confirm the end user is able to access permitted VPN resources
    a. If applicable, verify directories can be navigated
    b. If applicable, verify that a file can be uploaded and/or downloaded
    c. If applicable, verify that web resources that are restricted to VPN access are accessible.
        i. Refer to Internet Access Test - Web Browsing for procedure to verify web page.
    d. If applicable, verify that email access that is restricted to VPN access is accessible. (Requires Email server inside VPN)
        i. Refer to 8.4 Internet Access Test – Email, for procedure

8.6 Basic Voice Test - Mobile Originated (MO) IP Call

8.6.1 Test Description

Demonstrate an MO IP voice call over LTE via a Ue. NOTE: This test is a non-VoLTE call, non-mission critical, non-PTT call to exhibit basic VoIP functionality.

8.6.2 Reference

Requirement #4 Section 3.2 700MHz BB SoR v0.6

8.6.3 Required Equipment

Basic Configuration + *UE* with VoIP capability

8.6.4 Test Procedure

1) From the *UE* launch a VoIP client application and configure it for a mobile originated call
2) Call a desired VoIP conversation recipient.
3) Verify a two way voice communication was successful

8.6.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully establish a voice call and verify that a known voice message is audibly received.

8.7 Basic Voice Test - Mobile Terminated (MT) IP Call

8.7.1 Test Description

Demonstrate an MT IP voice call over LTE via a *UE*.

NOTE: This test is a non-VoLTE (Voice over LTE) call, non-mission critical, non-PTT (Push-to-Talk) call to exhibit basic VoIP (Voice over IP) functionality.

8.7.2 Reference

Requirement #4 Section 3.2 700MHz BB SoR v0.6

8.7.3 Required Equipment

Basic Configuration + *UE* with VoIP capability

8.7.4 Test Procedure

1) From the *UE* launch a VoIP client application and configure it for a mobile terminated call.
2) Originate a VoIP call to the *UE*.
3) Verify a two way voice communication was successful

8.7.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully establish a voice call and verify that a known voice message is audibly received.

8.8 Message Test - Instant Message (IM)

8.8.1 Test Description

Demonstrate an Instant Message exchange.

8.8.2 Reference

BBTF Requirement Section 6.2.4 700MHz BBTF Final Report v1.1, Requirement #10 Section 3.2 700MHz BB SoR v0.6

8.8.3 Required Equipment

Basic Configuration + *UE* with IM capability + remote IM device

8.8.4 Test Procedure

1) From the *UE* launch the IM application and configure for IM activity
2) From the remote IM device establish an IM session with the *UE*
3) Verify that the *UE* can communicate with the remote IM device
4) End the IM session
5) From the *UE* establish an IM session with a remote IM device
6) Verify that the remote IM device can communicate with the *UE*

8.8.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully establish an IM session with a remote IM device. The remote IM device for the purposes of this test could be one or more of the following: Ue, Client Computer, cell phone etc
    a. Verify IM presence information is available to the *UE*
    b. Verify that the *UE* can initiate and terminate a IM session with a remote IM device
    c. Verify that an IM can be sent from the remote IM device to the *UE*
    d. Verify that an IM can be received by the remote IM device from the *UE*

8.9 Strategic Data – Database Transactions

8.9.1 Test Description

Demonstrate that a given database can be accessed over an LTE connection.

8.9.2 Reference

Requirement #9 Section 3.2 700MHz BB SoR v0.6

8.9.3 Required Equipment

Basic configuration + remote & local servers

8.9.4 Test Procedure

1) From the *UE* access a strategic database
    a. A strategic database could be any database public or private.
        i. Such a database would not necessarily be secure for the purposes of this test.
2) Conduct known functions to verify that the *UE* has access to the strategic database.
    a. Known functions might include editing data within the database, adding data to the database, performing structured queries on the database, etc.

8.9.5 Expected Outcome

The expectation is that the end user will be able to:

1. Successfully access a database and verify user functionality.

9 Performance Tests

These sets of tests are performed over the air.

9.1 Basic Cell Throughput – Throughput vs. Cell Location

9.1.1 Test Description

This test is designed to determine the throughput at near, mid, and cell edge locations. The near, mid and cell edge locations will be determined at the 90^{th}, 50^{th} and 5^{th} percentiles of the CDF of the SNR. This test will be conducted between a loaded and unloaded, single sector of an eNB and a nomadic UE in the presence of co channel interference.

9.1.2 Reference

None

9.1.3 Required Equipment

See the following sections for information about the equipment required in this section

5.2.8 UE and Drive Test

5.2.9 Throughput Software

9.1.4 Test Procedure

This test will be conducted between a UE and a single eNB sector under test. The single sector will be in the presence of interfering sectors from the same and other eNB's as a simulation of a real network configuration. There are three parts to this test procedure;

i) Configuration of measurement equipment
ii) Characterization of near cell, mid cell and cell edge the eNB sector under test
iii) Throughput measurements at near cell, mid cell and cell edge

9.1.4.1 Test preparation

Before the test commences, the vendor must negotiate with PSCR which signal quality parameter will be collected to characterize the sector. SNR is the preferred signal quality metric. PSCR will entertain other measurements at the vendor's request. Signal quality measurements other than SNR will require full approval by the PSCR demonstration project.

Characterization of the cell is performed to determine the near cell, mid cell and cell edge. PSCR has defined these parameters as the 90^{th}, 50^{th} and 5^{th} percentiles, respectively, of signal quality binned by 10 meter areas. The amount of drive test data necessary to perform this statistical analysis will be negotiated with the vendor.

The location and configuration of the vendor eNB interfering signal must be determined and approved by PSCR.

The final section of this test will be to determine the UL and DL throughput measured at near cell, mid cell and cell edge locations in both an unloaded and fully loaded network. The desired near cell and mid cell locations will have an SNR within ±1 dB of the target value determined from the CDF. The desired cell edge will have an SNR as close to the target value as can reasonably be obtained. The desired locations will be determined by PSCR and the vendor.

9.1.4.2 Test Sequence

1) *Configuration*
    a) Configure the Ue
        i) Set the Ue to measure signal SNR
    b) Configure the eNB
        i) Set the eNB transmission at maximum output power
        ii) Set the eNB to transmit a 10 MHz wide signal centered at 763 MHz
        iii) Set the interferers to transmit a 10 MHz wide signal centered at 763 MHz with OCNS on.
    c) Configure the drive test measurement to log the UE signal SNR. At each measurement location the time and coordinates will be recorded.
2) *Characterize the sector*
    a) Collect the signal quality data throughout the sector.
        i) Collect signal quality data via a Ue at a temporal and spatial granularity negotiated with the PSCR demonstration project.
    b) Determine the CDF of the signal quality
        i) Determine 5th, 50th and 90th percentile.
            (1) Define the locations of the near, mid and cell edge for the sector under test.

3) *Measure the throughput versus cell location*
    a) Determine location of near cell, mid cell and cell edge along the path for the Green Mountain Alpha sector under PSCR direction.
        i) At near and mid cell locations verify that the SNR is ± 1dB of that determined in Part 2). Cell edge will be at a location that is a best-effort attempt to match the target SNR.
        ii) Measure throughput in an unloaded (0%) network configuration
            (1) Measure DL throughput
            (2) Measure UL throughput
            (3) Perform measurement 3 times at a minimum duration of 3 minutes each
        iii) Measure throughput in a fully loaded (100%) network configuration
            (1) Measure DL throughput
            (2) Measure UL throughput
            (3) Perform measurement 3 times at a minimum duration of 3 minutes each
            (4) Record location and throughput for each measurement

There will be a total of 36 throughput measurements, 3 measurements per cell location (near, mid and edge), UL and DL, and two levels of loading.

9.1.5 Expected Outcome

Empirical data obtained in this test are;

1. Locations of near, mid and cell edge
2. Throughput for near, mid and cell edge
3. SNR vs. position

10 Vendor Test Case Checklist

The purpose of the table in Annex B: Test Signoff Checklist is to identify the Phase 1 test cases that are applicable to each vendor type. Some test cases are end-to-end by nature and will require the participation of a Ue, eNB, and EPC vendor in order to ensure that a given Phase 1 test can be successfully executed. The "All" category is defined as participation by Ue, eNB, and EPC vendors. Every vendor who participates in the PSCR demonstration network will negotiate with PSCR to determine which tests will be required for successful execution of Phase 1.

11 Acronyms

See 3GPP TR 21.905 V8.8.0 (2009-03) Section 4.

3GPP	Third Generation Partnership Project
ACP	Adjacent Channel Power
AMPTD	Amplitude
AoA	Angle of Arrival
APCO	Association of P25 Communication Officials
APN	Access Point Name
ASME	Access Security Management Entity
Attn	Attenuation
AWGN	Additive White Gaussian Noise
BBTF	Broadband Task Force
BC	Band Class
Bi-dir	Bi-directional
CDMA2000	Code Division Multiple Access 2000
C4FM	Constant Envelope 4-Level Frequency Modulation
DL	Downlink
dB	Decibel with respect to a watt
dBm	Decibel with respect to a milliwatt
EMM	EPS Mobility Management
eNB	Evolved Node B
EPC	Evolved Packet Core
EPS	Evolved Packet System
ERP	Effective Radiated Power
ESM	EPS Session Management
E-TM1.1	Evolved-Universal Terrestrial Radio Access Test Model 1.1
E-TM1.2	Evolved-Universal Terrestrial Radio Access Test Model 1.2
EUE	End User Equipment
EUTRA	Evolved Universal Terrestrial Radio Access
EUTRA/LTE	Evolved Universal Terrestrial Radio Access/Long Term Evolution
FDD	Frequency Division Duplexing
Freq	Frequency
FSK	Frequency Shift Keying
GUTI	Globally Unique Temporary Identity
GHz	Gigahertz
GSM	Global System for Mobile Communications
HPLMN	Home Public Land Mobile Network
IB	In band
IE	Information element
IP	Internet Protocol

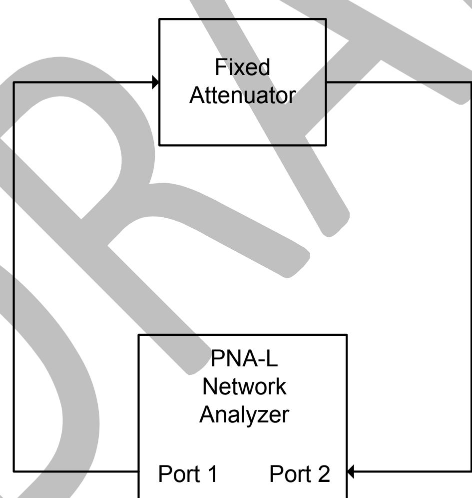
I/Q Mod	In-Phase/Quadrature Modulator
KSI	Key set identifier
kW	kilowatt
LMR	Land Mobile Radio
MHz	Megahertz
MISO	Multiple Input and Single Output
MIMO	Multiple-Input and Multiple-Output
MOD	Modulation
MSF	Multi-Service Forum
NAS	Non-access stratum
NIST	National Institute of Standards and Technology
OFDMA	Orthogonal Frequency Division Multiple Access
OLES	Office of Law Enforcement Standards
OOB	Out of Band
P25	Project 25
PBCH	Physical Broadcast Channel
PDCCH	Physical Downlink Control Channel
PDN	Packet data network
PDSCH	Physical Downlink Shared Channel
PS	Public Safety
PTCRB	PCS Type Certification and Review Board
PTT	Push To Talk
PUSCH	Physical Uplink Shared Channel
QPSK	Quaternary Phase Shift Keying
RES	Response
Res BW	Resolution Bandwidth
RF	Radio Frequency
RX	Receive
SC-FDMA	Single Carrier Frequency Division Multiple Access
SEM	Spectral Emission Mask
SIMO	Single-Input and Multiple-Output
Sim	Simulator
SISO	Single-Input and Single-Output
SoR	Statement of Requirements
TS	Technical Specification
TX	Transmit
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
VPN	Virtual Private Network
VSWR	Voltage Standing Wave Ratio

Annex A: Test Fixture Loss Measurement for Section 6.3 eNB Spectral Characteristics

Annex A describes the procedure for determining the test fixture loss for the in band, OOB and spurious emission tests in section 6.3 eNB Spectral Characteristics and for the eNB power output in section 6.4. The in band and OOB frequency emission tests use the test setup shown in Figure 12 of section 6.3.1.4. The power output test uses the test setup shown in Figure 14 of section 6.4

A.1 Test fixture loss measurement for IB, OOB and eNB output power tests

This section describes the procedure for determining the test fixture loss for the test circuit in 6.3.1 for the in band frequencies and for the OOB frequencies and for the test circuit in 6.4 for measuring eNB power output. The frequencies of interest are 748-777 MHz. The test circuit (cable and attenuators) is isolated and its impedance is measured across the frequency band using a network analyzer as shown in Figure 16.



Network Analyzer: Agilent N5230C

Figure 16: Measurement of test fixture loss for IB, OOB and output power tests

Record the attenuation measured at 748, 758, 763, 768, 769 and 777MHz.

A.2 Test fixture measurement loss for spurious frequencies

This section describes the procedure for determining the test fixture loss for the test circuit in 6.3.2 for the spurious emissions (from 728-748 MHz and 777-798 MHz). The test circuit (attenuator, cable, and filter) is isolated and its impedance is measured using a network analyzer as shown in Figure 17.

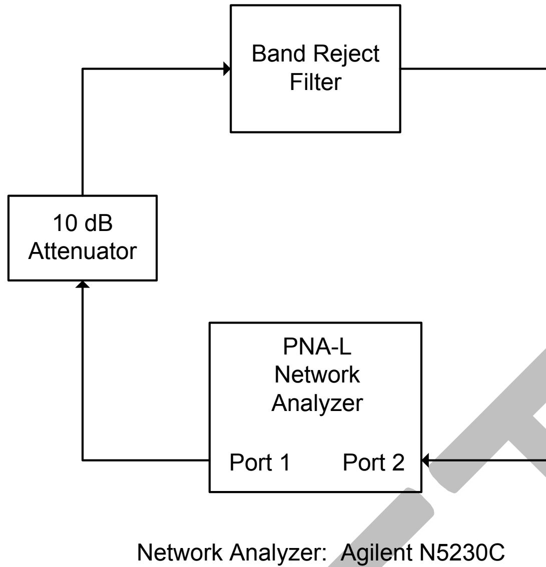


Figure 17. Measurement of test fixture loss for spurious emissions.

A.3 Test sequence for spurious frequencies

This test will be performed on the two test circuits shown in Figure 16 and Figure 17 using the test sequence described in this section.

1) Configure the Agilent N5230C network analyzer to measure test fixture loss
    a) Press the **Preset** button
    b) Press the **Freq** button
        i) Press the **Start** softkey
        ii) Enter 700 MHz on keypad
        iii) Press the **Stop** softkey
        iv) Enter 800 on keypad
        v) Press **MHz** softkey
    c) Press the **Sweep** button
        i) Press the **Number of Points** softkey
        ii) Input 2001 on keypad
        iii) Press the **Enter** softkey
    d) Press the **Measurement** button
        i) Press the **S21** softkey
    e) Press the **Cal** button
        i) Press the **Start Cal** softkey
        ii) Press the **Cal Wizard** softkey
        iii) Click the **Unguided** circle
        iv) Click **Next**
        v) Scroll to **Response** on pull down menu
        vi) Click **Next**
        vii) Click on **Through** button

viii) Connect cable from Port 1 to Port 2
ix) Click **Next** button
x) Click **Finish** button

2) Measure loss for spurious test circuit in Figure 17
   a) Insert test fixture between Port 1 and Port 2
   b) Record test fixture loss from 728-748 MHz and 777-798 MHz

Note that the test fixture loss will be subtracted when determining the emission spectrum.

Annex B: Test Signoff Checklist

Test Case Number	Test Case Title	Date of Execution	Vendor	DUT	Test Status -Passed -Passed w/exceptions -Failed - N/A	Comments	PSCR Initials	Vendor Initials
6.1	Reference Sensitivity Level at Maximum RB - eNB Receiver							
6.2	C Block UL (IS1) Interference Into eNB Receiver							
6.2	C Block DL (IS2) Interference Into eNB Receiver							
6.2	LMR UL (IS3) Interference Into eNB Receiver							

Test Case Number	Test Case Title	Date of Execution	Vendor	DUT	Test Status -Passed -Passed w/exceptions -Failed - N/A	Comments	PSCR Initials	Vendor Initials
6.2	LMR DL (IS4) Interference Into eNB Receiver							

Test Case Number	**Test Case Title**	**Date of Execution**	**Vendor**	**DUT**	**Test Status** **-Passed** **-Passed w/exceptions** **-Failed** **- N/A**	**Comments**	**PSCR Initials**	**Vendor Initials**
6.3.1	eNB In-Band Emissions							
6.3.2	eNB Out of Band Emissions							
6.3.3	eNB Spurious Emissions							
6.4	eNB Power Output							

Test Case Number	**Test Case Title**	**Date of Execution**	**Vendor**	**DUT**	**Test Status** **-Passed** **-Passed w/exceptions** **-Failed** **- N/A**	**Comments**	**PSCR Initials**	**Vendor Initials**
7.1	Authentication Procedure							
7.2	Detach Procedure							
7.3	Verification of IP Connectivity							
8.1	Internet Access Test – Web Browsing							
8.2	Internet Access Test - File Transfer DL							
8.3	Internet Access Test – File Transfer UL							
8.4	Internet Access Test – Email							

Test Case Number	**Test Case Title**	**Date of Execution**	**Vendor**	**DUT**	**Test Status** **-Passed** **-Passed w/exceptions** **-Failed** **- N/A**	**Comments**	**PSCR Initials**	**Vendor Initials**
8.5	Secure Data – VPN (Access and Traffic)							
8.6	Basic Voice Test – MO IP Call							
8.7	Basic Voice Test – MT IP Call							
8.8	Message Test - IM							
8.9	Strategic Data – Database Transactions							
9	Basic Cell Throughput – Throughput vs. Cell Location							