NBIoT_Inband_UL_RX_TestBench

Where To Find This Example

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Open Install Example

Design Notes

NB-IoT In-band Uplink eNB RX Test Bench

This example demonstrates operation of NB-IoT inside an LTE signal band. The NB-IoT uplink signal is configured as in-band, NPUSCH format 1, compliant with 3GPP Release 13 specification.

NB-IoT signal is placed in an unused RB within the LTE band.

Configuration options include:

- Carrier frequency (in MHz)

- Transmit power sweep for BER and throughput test (TxOutLvlStart_dBm, TxOutLvlSpan_dBm, TxOutLvlStep_dBm).

The TxOutLvl parameters are specified for "total transmit power". The BER plot, however,

uses derived "per-subcarrier power" in the x-axis so that the BER performance of various

subcarrier modes can be compared.

- NB-IoT subcarrier mode (NBIoT_SCMode)

0: 3.75kHz single tone (use NBIoT_SCAssign parameter to specify between 0-47)

1: 15kHz single tone (use NBIoT_SCAssign parameter to specify between 0-11)

2-5: 15kHz three tone {0,1,2}, {3,4,5}, {6,7,8}, or {9,10,11}

6,7: 15kHz six tone {0,1,...,5} or {6,7,..., 11}

8: 15kHz with twelve tone

-NB-IoT subcarrier assignment when NBIoT_SCMode is 0 or 1 (NBIoT_SCAssign)

-NB-IoT resource block location (NBIoT_RB)

- Use NBIoT_RB<0 or NBIoT_RB>N_RB_UL for guard band operation

- Use NBIoT_RB between 0 and N_RB_UL for in-band operation

-NB-IoT modulation type (NBIoT_ModType)

- Supports pi/2-BPSK or pi/4-QPSK (rotated)

-LTE source has selectable UL RB occupancy using N_RB_Channel. Default is {15,34} which means that the PUSCH0 occupies the first 15RBs and PUSCH2 the 34RBs. N_RB_Buffers parameter is used to select the buffer RBs between PUSCH0 and PUSCH1. Default setting is N_RB_Buffer=1 such that RB location 16 is left open for NB-IoT transmission. Thus selecting "NBIoT_RB=15" places the NB-IoT signal in RB location 16 which is blanked in the LTE UL configuration.
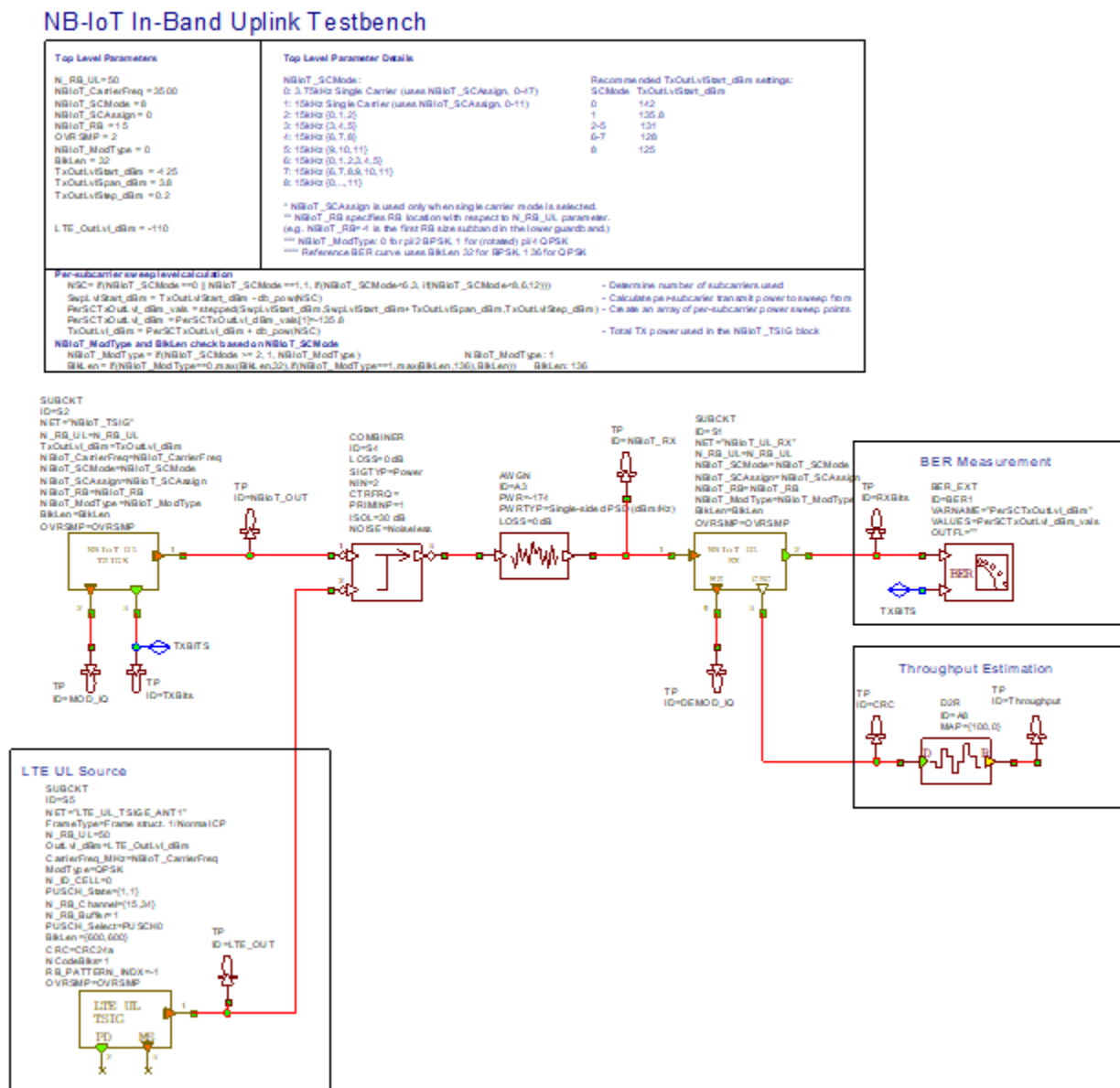
The test bench can be used to monitor:

- The TX signal spectrum at various points in the link

- NB-IoT link performance in the presence of LTE UL signal

- IQ constellation of the transmitted and demodulated signals

- Bit error rate (BER), block error rate (BLER), and throughput
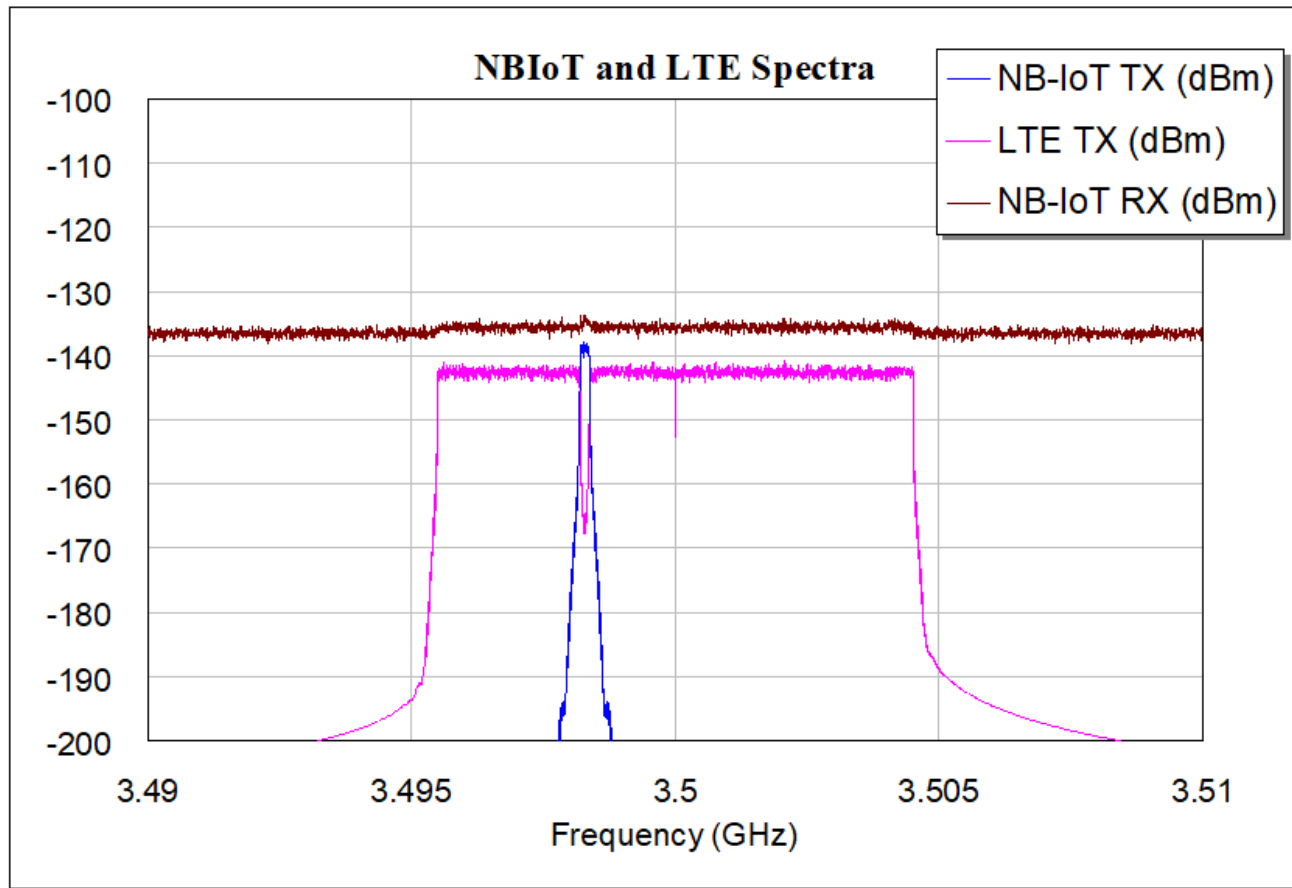
- CRC error for each block

References:
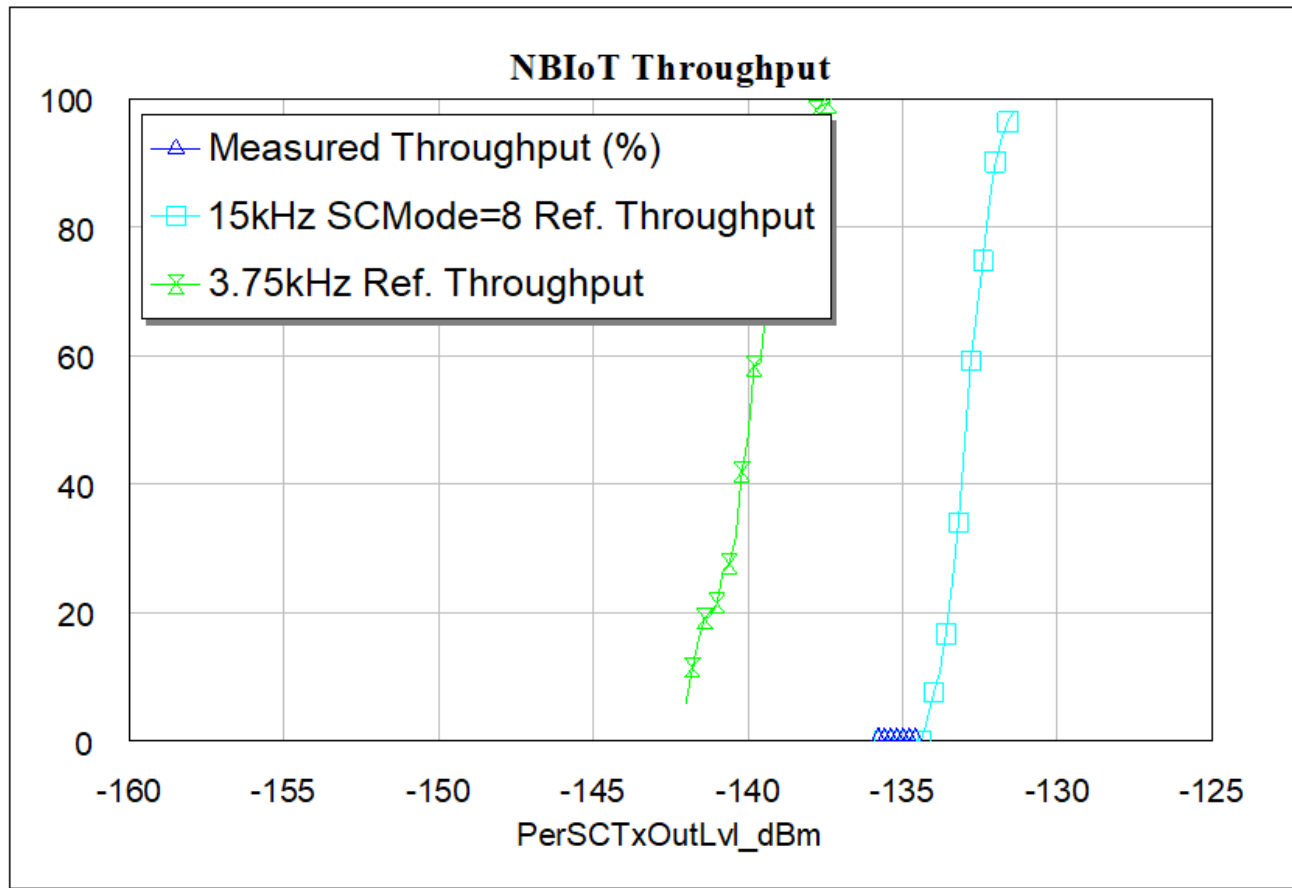
TS 36.211 Release 13, Chapter 10

TS 36.212 Release 13, Chapter 6

TS 36.213 Release 13, Chapter 16

TS 36.104 Release 13.5, Appendix A.16 Fixed Reference Channels for NB-IoT NPUSCH Format 1

System Diagram - NB IoT Testbench

Graph - NBIoT and LTE Spectra

Graph - NBIoT Throughput

Graph - NBIoT BER