MEASUREMENT OF REFERENCE SIGNAL RECEIVED QUALITY IN LTE

Z. A. Zulkarnain
Supervisor - PhD Kadatskaja O.
Kharkov National University of Radio Electronics
(61166, Kharkov, Nauka Avenue, 14, Info communication Engineering Department, tel. (057) 702-13-20),
E-Mail: tkc@kture.kharkov.ua fax (057) 702-13-20

In this work the reference signal received quality (RSRQ) is studied. It has been defined in a number of ways. Some of these definitions have been looked at including the 3GPP's definition. The reporting range as well as a brief calculation of RSRQ has also been done in this piece of work.

In LTE network, there are two parameters measured by the UE (User Equipment) on reference signal (RS). These parameters are RSRP and RSRQ. These parameters are key measures of signal level and quality for modern LTE network. In this article, the focus is on the study of the RSRQ measurement in LTE. Unlike RSRP, RSRQ give information as to the quality of the reference signal. It is equally an important measurement that the UE has to do for a reliable cell selection, reselection and handover. This important parameter is studied and some practical work done.

RSRQ can be defined as the purity of Reference Signal (RS) across the system bandwidth. It is a calculated value from RSSI and RSRP. It simply denotes a measure of signal and interference. It indicates the quality of the received reference signal (RS). RSRQ measurement provides additional information when RSRP is not sufficient to make reliable handover or cell selection/re-selection decision. In handover procedure, the LTE specification provides the flexibility of using RSRP, RSRQ or both. When the RSRP is sufficient enough to provide a reliable handover, it used, if not then it is used alongside the RSRQ. Whichever case is applicable, must be measured over the same bandwidth. As in the case of RSRP, UE reports an integer value to eNodeB. The value ranges from 0-34. 3GPP has provided a table. Using the table, the integer value can be translated to a range of RSRP value in dB
Mathematically[1],

$$RSRQ = (N*RSRP)/RSSI,$$

where N - the number of resource blocks.

RSRP - Reference Signal Received Power

RSSI - Received Signal Strength Indicator

The 3GPP defined RSRQ [2] as the ratio of the product of the number (N) of the Physical Resource Blocks (PRBs) over which RSSI is measured and RSRP to E-UTRA Carrier RSSI. The measurements of the RSRP and the E-UTRA Carrier RSSI shall be made over the same set of resource blocks.
Mathematically,

$$\text{RSRQ} = \frac{Nprb * RSRP}{C\ RSSI},$$

where $Nprb$ is the number of Physical Resource Blocks

C RSSI is the E-UTRAN Carrier RSSI

It is worth noting that, the RSSI is the measurement of the pure wide band power, which includes noise, serving cell power and interference power during reference signal symbol. The reporting range of RSRQ is from -3 to -19.5dB.

For RSRQ to be maximum it is based on the assumption that RS REs are occupied, no traffic what so ever. There are two RS REs per OFDMA symbol. As such

RSRQ = $\frac{Nprb * RSRP}{C\ RSSI}$ = RSRP/ (2xRSRPx $Nprb$ / $Nprb$)

The maximum value of RSRQ is therefore = 0.5 = -3dB

The absolute accuracy for intra-frequency RSRQ is between +/-2.5 and +/-3.5dB. No relative accuracy is specified for intra-frequency case. The absolute accuracy for inter-frequency RSRQ is between +/-2.5 and +/-3.5dB. Finally, the relative accuracy between the inter-frequency and the intra-frequency is between +/-3dB and +/-4dB.

References

1. https://mauriziolarocca.com/78-rsrp-and-rsrq-measurement-in-lte/
2. https://www.itu.int/rec/T-RECOMNDAITION -G.729