

# MEASUREMENT OF REFERENCE SIGNAL RECEIVED POWER IN LTE

Master student 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](mailto:tkc@kture.kharkov.ua) fax (057) 702-13-20

In this work the reference signal received power (RSRP) is studied. It has been defined in a number of ways. Some of these definitions have been looked at including the 3GPP's definition. As an RSSI type of measurement, its relationship with RSSI is also established. The reporting range as well as a brief calculation of RSRP has also been done in this piece of work.

For 4G LTE, RSRP, RSRQ and SINR are the metrics measured by the User Equipment on reference signal (RS). Parameters RSRP and RSRQ are key measures of signal level and quality for modern LTE network. In this article, the focus is on the study of the RSRP measurement in LTE. RSRP is an RSSI type of measurement. Essentially, it measures only the reference power and does not give any information about the signal quality. It is the most important measurement that the UE has to do for cell selection, reselection and handover. This important parameter is studied and some practical work done.

Received Signal Strength Indicator (RSSI) is a measure of the average total received power observed of the carrier RSSI only in OFDM (Orthogonal Frequency Division Multiplexing) symbols containing reference symbols for antenna port 0 in the measurement bandwidth over N resource blocks. The carrier's RSSI total received power includes the power from co-channel serving and the non-serving cells, the adjacent channel interference, the thermal noise, among others.

It provides information about the total received wide-band power. All symbols are measured including all interference and thermal noise. UE do not report RSSI to eNodeB. RSSI is simply computed from RSRP and RSRQ which are reported by UE. From the above, it could be deduced that,

$$\text{RSSI} = \text{ns} + \text{sc} + \text{inp},$$

where ns is noise

sc is serving cell power

inp is interference power

It implies that without noise and interference, there is 100% downlink (DL) physical resource block (PRB) activity. In this case, we can say that

$$\text{RSSI} = 12 * N * \text{RSRP},$$

where  $-RSRP$  is the received power of 1 resource element (1RE), that is average of the power levels received across all Reference Signal symbols within the considered measurement frequency bandwidth.

$N$  -the number of resource blocks (RBs) across the RSSI.

$RSRP$ - is the linear average of reference signal power (in Watts) measured over a specified bandwidth (in number of REs).

This is the most important measurement UE has to do for cell selection, re-selection and handover. It is very similar to CPICH RSCP in WCDMA. The average here is with respect to the received power of a single reference signal resource element. So, the power of multiple resource elements is measured by the UE and the average of which is taken. The resource elements are those used in the transfer of the reference signals.

According to the 3GPP definition in 36.214 specifications,  $RSRP$  is the linear average over the power contributions of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth. For  $RSRP$  determination the cell-specific reference signals R0 according to TS 36.211 shall be used.

This parameter measures only the reference power and does not give any information about the signal quality. Information about the signal strength of the desired signal is obtained. Usually the UE measures  $RSRP$  based on the direction (RRC message) from the eNodeB and report the value. A non-negative value ranging from 0-97 is send. Each of these values is mapped to specific range of values of real  $RSRP$  values as defined in 3GPP specifications 36.133.

The reporting range is between -44 to -140dBm. This is with 1dB resolution. This corresponds to the range of non-negative values from 0-97 that is sent by the UE. Measuring signal power while potentially excluding noise and interference is a unique characteristic of  $RSRP$ .

Consider a single antenna system. Let's assume the Reference Signal Transmitted Power is about 20dBm and the path loss experienced by a UE located elsewhere in the cell is 100dB. Then by definition, the  $RSRP$  measured by the UE is  $20 - 100 = -80$ dBm. Comparing this value to the table of real values of  $RSRP$  as in the 3GPP specification 36.133, it corresponds to  $RSRP$  integer value 60. In this case UE can report  $RSRP = 60$  in the measurement report.

## References

1. <https://www.itu.int/rec/T-RECOMNDAITION-G.729>