IEEE P802.19
Wireless Coexistence

Measurements and measurement reporting

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Abstract

This document contains text proposal for section 9.7 “Measurements by TVBD networks or devices”. Measurement reporting is introduced and a set of measurements are defined.

9.7 Measurements and measurement reporting

A CM has means to obtain measurement results from all the CEs connected to it. The CM shall be able to configure the measurement reporting. The CM may request the CE to provide one-time measurements or scheduled measurements by sending a measurement request to the CE (as defined in 5.2.8).

The WSO performs measurements according to its capabilities. The WSO provides measurement results to the CE and the CE shall form the IEEE 802.19.1 measurement reports out from the measurement results. In the CE registration the CE shall indicate the CM which of the measurement reports it supports with the WSO. The measurement reports are defined in section 5.3.9.

The following sub-clauses define the measurement types. In all the measurement types the measurement report also contains measurement frequency field that indicates the measurement bandwidth and frequencies that have been used in the measurements.

9.7.1 SINR measurement

The signal to interference plus noise ratio (SINR) measurement indicates the ratio of the received signal power (S-IN) to the average interference plus noise power (IN):

SINR= (S-IN) / IN, where

S = Received signal strength (RSS) measured at the reference point of the measuring device during reception of own network transmissions
IN = RSS measured at the reference point of the measuring device during periods when the measuring device evaluates the channel to be idle

The SINR is indicated in dB and is scaled in steps of 0.5 dB to obtain the 8-bit SINR values, which cover the range from –10 dB to + 117 dB. The value 255 indicates that SINR is not available.

9.7.2 FER measurement

The frame error rate (FER) measurement indicates the ratio of the frames that the measuring device received with errors to the total number of frames received by the measuring device. The measurement is carried over all the wireless links the measuring device has during the measurement period.

The FER is indicated as the percentage, linearly scaled with 255 representing that all frames have errors (FER=100%). The percentage shall be computed using the following formula:

FER = Integer ((number of frames with errors / number of measured frames) × 255)

9.7.3 Interference plus noise floor measurement

The interference plus noise floor measurement is an indication of the average interference plus noise power measured at the reference point of the measuring device during periods when the measuring device evaluates the channel to be idle.

The noise floor is indicated in dBm and is scaled in steps of 0.5 dBm to obtain 8-bit Noise Floor values, which cover the range from –134 dBm to – 14 dBm. The measurement bandwidth is defined in the measurement frequency field (9.7). The value 255 indicates that Noise Floor is not available. The values 241-254 are reserved.

9.7.4 Signal distribution measurement

The signal distribution measurement indicates the ratio of time that received signal is within each defined received signal level range. The received signal level is measured at the reference point of the measuring device and in this measurement type any detected signal is considered.

The signal distribution measurement report contains a set of signal level ranges and indications of proportion of detected signal within the ranges. The signal level ranges are indicated with means of level thresholds that shall determine signal level ranges that are all equal in size. The proportion of detected signal within each signal level range is indicated as the percentage of time the measuring device has detected signal within the signal level range. The percentage is computed using the following formula:

> *Signal distribution within a signal level range = Integer ((time that the received signal is between the thresholds defined for the signal level range / measurement duration) × 255)*

Figure 1 shows an example of thresholds and the proportion of detected signal within each signal level range.

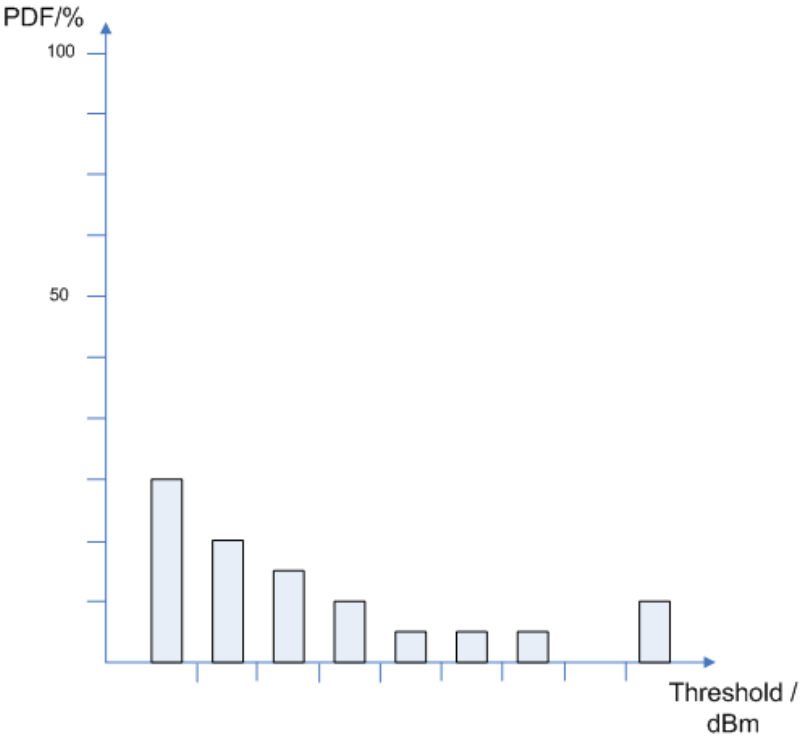

Figure 1: An example of signal distributions

9.7.5 Channel load measurements

The channel load measurement provides a channel utilization measure as seen by the measuring device. Two different channel load measurement types are defined: Channel load of the network in which the measuring device operates and Total channel load.

9.7.5.1 Own network channel load

Own network channel load is defined as the percentage of time that the measuring device assesses the channel to be utilized by its own network.

The own network channel load is indicated as the percentage of time, linearly scaled with 255 representing that the channel is 100% utilized by the own network. This percentage shall be computed using the following formula:

Own network channel load = Integer((time that the channel is occupied by the own network / measurement duration) × 255)

9.7.5.2 Total channel load

Total channel load is defined as the percentage of time that the measuring device assesses the channel to be busy.

The total channel load is indicated as the percentage of time, linearly scaled with 255 representing that the channel is assessed to be busy 100% of the measurement time. This percentage shall be computed using the following formula:

Total channel load = Integer((channel busy time / measurement duration) × 255)

9.7.6 Measurements detecting other spectrum users

These measurements enable the measuring device to report operation of other spectrum users which it has detected on the TV band spectrum. A CE that supports these measurement reports is connected to a WSO that has capabilities to recognize the type of the other spectrum user that it reports. As an example the measuring device may have spectrum sensor with feature detector capable of detecting specific primary user operation, or it may recognize the operation of other TVBDs because it supports the same radio access technology.

9.7.6.1 Primary user detection measurement

Primary detection measurement indicates that the measuring device has detected primary user operation. Primary user operation is detected by means of spectrum sensing with feature detection capability.

The primary user type field indicates the detected primary user type.

The detection reliability field indicates the evaluated detection reliability. 0=reliability information not available, 1=poor, 2=fair, 3=good.

9.7.6.2 TVBD detection measurement

TVBD detection measurement indicates that the measuring device has detected another TVBD in operation. The measuring device may detect another TVBD in operation because they use the same radio access technology. The measuring device may detect another TVBD in operation by performing spectrum sensing with feature detection capability.

The TVBD type field indicates the detected TVBD type.

The detection reliability field indicates the evaluated detection reliability. 0=reliability information not available, 1=poor, 2=fair, 3=good.