IEEE P802.19
Wireless Coexistence

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| Update to section 10.6 on Measurements and measurement reporting |
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Abstract

This document is a submission to IEEE 802.19 TG1 that contains an informative annex proposal that contains measurement report descriptions that were in the DF3.02 in section 10.6. The proposal is to have the descriptions moved to a new informative annex.

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# Annex C

(informative)

This informal annex specifies different measurement report types for use in IEEE 802.19.1 compliant coexistence system.

A CM that supports measurement request and measurement reporting related procedures has means to obtain measurement results from all the CEs it serves and that support the same set of procedures. Such a CM shall be able to configure the measurement reporting. Such a CM may request the CE to provide one-time measurements or scheduled measurements by sending a measurement request to the CE.

A WSO performs measurements according to its capabilities. A 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 following sub-clauses define the measurement types and the way how the measurement report fields are filled with each measurement type.

## C.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):



where

*S* = Received signal strength (RSS) measured at the reference point of the measuring device during reception of own network transmissions, and

*IN* = RSS measured at the reference point of the measuring device during periods when the measuring device considers the channel to be idle

The SINR is indicated in dB and it is scaled in steps of 0.5 dB to obtain the SINR values, which cover the range from –10 dB (value = 0) to + 117 dB (value = 254). The value 255 indicates that SINR is not available.

## C.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:



* + 1. Interference plus noise floor measurement

The interference plus noise floor (IPNF) 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 considers the channel to be idle.

The IPNF is indicated in dBm and is scaled in steps of 0.5 dBm to obtain values, which cover the range from –134 dBm (value = 0) to – 7 dBm (value = 254). The value 255 indicates that IPNF is not available.

## C.3 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 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:



where

*Time\_within\_thresholds* = Time that the received and measured signal is between the thresholds defined for the signal level range, and

*Measurement\_duration* = Time taken by the measurement

Figure 209 shows an example of thresholds and the proportion of detected signal within each signal level range.



1. — An example of signal distributions

## C.4 Spectrum measurement

The spectrum measurement provides the frequency response as perceived by the measuring device. The measurement is performed at the reference point of the measuring device.

The spectrum measurement report contains the number of sub-channels, the received signal strength for each sub-channel, and the measurement bandwidth.

The number of sub-channels indicates into how many sub-channels the measured and reported bandwidth is divided. The number of sub-channels value is indicated in the range from 1 to 4095. This field also indicates the number of the fields indicating the received signal strength for the sub-channel in the frame.

The received signal strength for the sub-channel is defined as described for the received signal strength for the measured bandwidth. The received signal strength for the sub-channels is indicated in dBm and is scaled in steps of 0.5 dBm to obtain values, which cover the range from –134 dBm (value = 0) to – 7 dBm (value = 254). The frame contains a field for each sub-channel.

The measurement bandwidth is indicated in kHz.



1. — An example of frequency response, measured bandwidth and sub-channel

## C.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.

### C.5.1 Own network channel occupancy

Own network channel occupance 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 occupance 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:



where

*Occupancy\_time* = Time that the channel is occupied by the network to which the measuring WSO belongs, and

*Measurement\_duration* = Time taken by the measurement

### C.5.2 Total channel occupance

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

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



where

*Channel\_utilized\_time* = Time that the channel is assessed to be utilized, and

*Measurement\_duration* = Time taken by the measurement

## C.6 Measurements detecting other spectrum users

These measurements enable a measuring device to report operation of other wireless transmitters, 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 wireless transmitter that it reports. As an example the measuring device may have spectrum sensor with feature detector capable of detecting specific radio access technology, or it may recognize the operation of other wireless transmitters because it supports the same radio access technology.

RAT of the detected wireless transmitter is indicated with technology type field.