IEEE P802.11  
Wireless LANs

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| LS Response to Letter from 3GPP on RCPI (R2-141855) | | | | |
| Date: 2014-05-14 | | | | |
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Abstract

This is a reply to the letter from 3GPP, R2-141855 - LS on WLAN signal measurements for WLAN/3GPP Radio interworking. This reply provides a technically sound and comprehensive response to the questions asked in the LS from 3GPP.

The 3rd Generation Partnership Project (3GPP) submitted a letter to the IEEE 802.11 Working Group (WG). The letter is documented in 11-14/0519r0. This document contains recommended response text drafted by members of the IEEE 802.11 Task Group MC.

# Summary of the letter from 3GPP

According to the letter the 3GPP Working Group RAN2 developed a letter to the IEEE 802.11 Working Group during the 3GPP TSG-RAN2 Meeting #85bis. The letter reports that “3GPP TSG-RAN WG2 (RAN2) is developing a mechanism for inter-working between 3GPP RATs [Radio Access Technologies] (UMTS and LTE) and WLAN.” To allow for efficient inter-working of IEEE 802.11 WLAN and 3GPP’s radio technologies, the 3GPP WG RAN2 intends to develop mechanisms that provide access network selection and traffic routing. The proposed 3GPP mechanism allows a device to steer traffic from one radio technology to another based on signal strength measurements and other, additional parameters. In their letter, the 3GPP WG RAN2 asks about the applicability of certain measurement functionality in the IEEE Std 802.11. The questions are as follows.

* Question 1: Does IEEE 802.11 WG consider WLAN RCPI a suitable metric of WLAN signal strength such that it can be compared to thresholds as in the above described mechanism?
* Question 2: Does IEEE 802.11 WG consider WLAN RSNI a suitable metric of WLAN signal quality such that it can be compared to thresholds as in the above described mechanism?
* Question 3: Does IEEE 802.11 WG consider any other WLAN signal metric more suitable for the above described mechanism?

# Summary of this reply letter

The authors developed this reply letter for discussion by the 11mc TG and approval by the 802.11 Working Group. This letter provides responses to the questions above within a comprehensive technical framework explaining the use of metrics for network selection.

The 11mc TG is invited to consider, critique and improve this draft letter for submission to the 802.11 Working Group.

To: Mattias.a.bergstrom@ericsson.com

Subject: Liaison on WLAN signal measurements for WLAN/3GPP Radio interworking

Date: 2014-05-16

Dear Mattias,

Thank you very much for your letter, R2-141855, that we received on 2014-04-14. In your letter you asked the IEEE 802.11 Working Group the following three questions:

1. Does IEEE 802.11 WG consider WLAN RCPI a suitable metric of WLAN signal strength such that it can be compared to thresholds as in the above described mechanism?
2. Does IEEE 802.11 WG consider WLAN RSNI a suitable metric of WLAN signal quality such that it can be compared to thresholds as in the above described mechanism?
3. Does IEEE 802.11 WG consider any other WLAN signal metric more suitable for the above described mechanism?

We answer your questions briefly and then in detail:

* Regarding Question 1: We consider the RCPI value defined in IEEE 802.11™-2012 to be insufficient, on its own, for this purpose. See below detailed discussion.
* Regarding Question 2: We consider the RSNI value defined IEEE 802.11™-2012 to be insufficient, on its own, for this purpose. See below detailed discussion.
* Regarding Question 3: The IEEE Standard 802.11™-2012 defines many metrics suitable for access network selection and traffic routing for the mechanism described in your letter. As detailed below, a technically sound network selection requires using multiple metrics to select the best network for the QOS required by the STA.

DETAILED DISCUSSION:  
The 802.11 specification describes many metrics suitable for WLAN network selection. There is no single WLAN metric which is adequate for network selection for radio technology steering. WLAN Network selection has been studied extensively to support WiFi roaming within a WLAN network. In this context, the “best” target Access Point (AP) for handoff (called BSS transition) when roaming is evaluated continuously by the mobile WiFi STA. The WiFi STA may use any or all of the defined 802.11 metrics to assist in the selection of the “best” BSS for roaming transition.

Table 1, below, lists the metrics for WLAN network selection and reselection.

A technically sound approach for selecting a BSS for transition is based on a two step selection process. In the first step, the STA scans all channels for available BSSs and then uses certain key metrics, *screening metrics*, and policy considerations to filter available BSSs to form a smaller subset of BSS transition candidates, all of which meet the minimum requirements of the STA. In the second step, the STA uses a single scalar metric, *the ranking metric*, along with user preferences to rank transistion candidates in the list. The BSS at the top of the ranked list is the best BSS in the list of transition candidates for initial network selection. For network reselection, the ranking metric value of the best BSS candidate is compared to the ranking metric of the current BSS. When the metric for the best candidate exceeds the value of the metric for the current BSS, a BSS transition is scheduled.

The STA should continuously scan all the BSSs in the transistion candidate list. After each scan, the STA should use the new scanning measurements to update, screen and rank the BSSs in the transition candidate list. After each screening and ranking, the STA selects and saves the best BSS candidate to use if a transition is required. If a candidate BSS falls below the minimum requirement for any of the screening metrics, it is removed from the candidate list.

Table 1: 802.11 Metrics Suitable for WLAN Selection and Reselection.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Metric Name | For Screen-ing | For Rank-ing | Avail in  Beacon | Avail in Probe Response | | Avail in Measu-rement | Avail via ANQP | Notes |
| RCPI | Y | Y |  |  | Y | |  | from Beacon Measurement by STA. See Note 2 |
| RSNI | Y | Y |  |  | Y | |  | from Beacon Measurement by STA. See Note 2 |
| ANPI | Y |  |  |  | Y | |  | from Noise Histogram Measurement By STA. See Note 2 |
| Channel Load | Y |  |  |  | Y | |  | from Channel Load Measurement By STA or AP |
| BSS Load | Y |  | Y | Y |  | |  | measured at AP |
| BSS Avg Access Delay | Y | Y | Y | See Note 1 | Y | |  | From STA Statistics Measurement measured at AP for non-QOS STA |
| BSS AC Access Delay | Y | Y | Y | See Note 1 | Y | |  | From STA Statistics Measurement measured at AP for QOS STA |
| BSS Available Admission Capacity | Y |  | Y | See Note 1 |  | |  | estimated at AP |
| FCS Error Count | Y |  |  |  | Y | |  | from STA Statistics Measurement |
| Retry Count | Y |  |  |  | Y | |  | from STA Statistics Measurement |
| Retry AMSDU Count | Y |  |  |  | Y | |  | from STA Statistics Measurement |
| Supported Operating Classes | Y |  | Y | Y |  | |  | from AP for BSS |
| BSS Capabilities | Y |  | Y | Y |  | |  | from AP for BSS |
| Roaming Consortium | Y |  | Y | Y |  | | Y | from AP for BSS |
| NAI Realm | Y |  |  |  |  | | Y | from AP in ANQP Query |
| 3GPP Cell Network | Y |  |  |  |  | | Y | from AP in ANQP Query |
| Capability Lists | Y |  |  |  |  | | Y | from AP in ANQP Query |
| WAN Metrics | Y |  |  |  |  | | Y | from AP in ANQP Query, this is vendor specific metric used by Wi-Fi Alliance |

NOTE1: Available when requested in Probe Request using optional Request Elements.  
NOTE2: RCPI has a specified accuracy requirement of ±5 dB. There is no explicit accuracy requirement for RSNI, but RSNI is calculated as RCPI minus ANPI which both has accuracy requirements of ±5 dB, and hence RSNI has an implicit accuracy requirement of ±5 dB.

The STA should periodically (1-5 minutes) scan each channel for all BSSs and then use screening metrics and policy to filter the scanned BSS measurements (step 1) to continuously augment and update the BSS transition candidate list. If the number of candidates on the transistion list falls to 2 or 3, the STA should immediately scan all channels and screen all BSSs in order to renew the BSS transisition candidate list.

Note that no single metric will be sufficient for network selection. For instance RCPI may be used to determine the BSS with the strongest RF signal. But selecting the BSS with the strongest signal may not provide adequate throughput rate, access delay or backhaul capacity for the required QOS for the service the STA is using. Selecting the BSS with the lowest access delay for the STA service may not provide adequate admission capacity, RSNI or throughput rate for the STA. Technically sound network selection must use multiple metrics.

Finally note that for QOS services, averaged metrics may be misleading and must be carefully considered. For instance, a BSS with a high or very high BSS load may have more than enough capacity to support an additional high priority QOS voice stream. Averaged metrics may be useful for network selection for non-QOS STAs. For QOS STAs seeking a QOS service, the BSS AC Access Delay should be used to make a sound network selection decision.

We trust that you will find this information adequate to answer your questions.

Sincerely,

Adrian Stephens  
IEEE 802.11 Working Group Chair