IEEE P802.11
Wireless LANs

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| Liaison response to 3GPP R2-141855  |
| Date: 2014-05-12 |
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Abstract

Reply to the liaison from 3GPP RAN R2-141855. Also see 11-14-0519r0.

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 TSG-RAN WG2

According to this letter, 3GPP TSG-RAN WG2 (RAN2) is developing a mechanism for inter-working between 3GPP RATs (UMTS and LTE) and WLAN. The purpose of this inter-working mechanism is to improve access network selection and traffic routing between 3GPP radio access and cellular operator deployed WLAN. In this mechanism, the cellular network provides RCPI and/or RSNI thresholds (in addition to other thresholds and parameters) to the terminal. If, for a WLAN AP, the RCPI measured by the terminal is above the RCPI-threshold and/or RSNI measured by the terminal is above the RSNI-threshold (and other conditions are fulfilled), the terminal should steer traffic to the WLAN AP. Additionally, if the RCPI is below a RCPI-threshold and/or RSNI is below an RSNI-threshold (and other conditions are fulfilled) the terminal should steer traffic away from WLAN towards 3GPP radio access network.

In their letter, RAN2 asks about the suitability of using certain metrics defined in the IEEE Std 802.11 for interworking purposes. 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?

**Discussion**

In our understanding, there exist two main drivers for the work, which are:

* Load balancing between the operator’s 3GPP and WLAN networks
* Ensuring that end user Quality of Service remains at the same level or improves, when subscriber data is offloaded from the operator’s 3GPP network to the operator’s WLAN network.

These above aspects have been captured in the 3GPP TR37.834 Study on Wireless Local Area Network (WLAN) - 3GPP radio interworking, Rel-12, with the following assumptions:

1. Operator deployed WLAN networks are often under-utilized;

2. User experience is suboptimal when the UE connects to an overloaded WLAN network;

Additionally the designed solution shall fulfil the requirements set forward in 3GPP TR 37.834 Section 5.2 as follows:

1. *Solutions should provide improved bi-directional load balancing between WLAN and 3GPP radio access networks in order to provide improved system capacity.*
2. *Solutions should improve performance (WLAN interworking should not result in a lower quality experience but preferably in an improved user experience).*
3. *Solutions should improve the utilization of WLAN when it is available and not congested.*
4. *Solutions should reduce or maintain battery consumption (e.g. additional power consumption* *due to WLAN scanning/discovery should be offset by reduced power consumption due to offload to WLAN).*
5. *Solutions should be compatible with all existing CN WLAN related functionality, e.g. seamless and non-seamless offload, trusted and non-trusted access, MAPCON and IFOM.*
6. *Solutions should be backward compatible with existing 3GPP and WLAN specifications, i.e. work with legacy UEs even though legacy UEs may not benefit from the improvements provided by these solutions.*
7. *Solutions should rely on existing WLAN functionality and should avoid changes to IEEE and WFA specifications.*
8. *Per target WLAN system distinction (e.g. based on SSID) should be possible.*
9. *Per-UE control for traffic steering should be possible.*
10. *Solutions should ensure that access selection decisions should not lead to ping-ponging between
UTRAN/E-UTRAN and WLAN.*

The mechanism of choice in 3GPP RAN2 for such a solution assumes the use of one or more RAN rules residing on the cellular modem of the terminal device which, when conditions of the rule(s) are satisfied, may trigger the selection of an AP and/or steering traffic between the cellular domain and the WLAN.

By selecting specific RAN rule(s) and setting the threshold values for comparison in the selected rule(s), the cellular network operator should be able to balance the load between 3GPP cellular network and operator controlled WLAN network(s), and ensure that end user Quality of Service remains at the same level or improves, when subscriber data is steered from one network to another.

For network selection, a solution shall select a WLAN AP that can provide:

* Minimum required QoS which should not degrade, but preferably improve the user experience;

For traffic steering from cellular to WLAN, a solution shall achieve:

* Per user and per APN traffic differentiation;
* Minimum required QoS per APN which should not degrade, but preferably improve the user experience;

Furthermore, it is our understanding that the provided solution shall not interfere with other WLAN procedures that allow seamless handover between different WLAN APs.

RCPI and RSNI are defined in the IEEE 802.112012 specification as follows:

**received channel power indicator (RCPI):** An indication of the total channel power (signal, noise, and

interference) of a received frame measured on the channel and at the antenna connector used to receive the frame.

For HighThroughput Physical layer (802.11n), sub-clause 20.3.21.6 specifies that RF power in the channel is measured over the data portion of the received frame.

**received signal to noise indicator (RSNI):** An indication of the signal to noise plus interference ratio of a

received frame. RSNI is defined by the ratio of the received signal power (RCPI-ANPI) to the noise plus

interference power (ANPI) as measured on the channel and at the antenna connector used to receive the frame.

The margin of error specified for the RCPI and ANPI parameters is ±5 dB. Additionally,we note that RCPI and RNSI measurement is defined for a single PHY frame, and does not specify any averaging over multiple frames. Furthermore, WLAN throughput performance is a function of many parameters including frequency band of operation, transmission bandwidth, interference from both BSS and OBSS, RSSI, receiver architecture, etc. Throughput is also affected by AP and STA capabilities such as MIMO (e.g. number of spatial streams), support of advanced options like LDPC and beamforming, and supported coding and modulation levels. Therefore, we believe that examining a single threshold value for RCPI and/or RSNI criteria as part of a RAN rule cannot guarantee, or be used to effectively evaluate or differentiate the radio performance that the corresponding WLAN networks can provide. Our belief is that in order to make a reasonable comparison among various WLAN choices to ascertain the best selection for traffic routing, one would need to define:

1. A test or threshold value that would take into account at least:
	1. Operating band
	2. Supported operating bandwidth
	3. STA capability
	4. AP capability
	5. Existing BSS load
2. Suitable time averaging of link quality characteristics

Without fine tuning the threshold value based on the above conditions, a simple RCPI or RSNI threshold would likely end up being either too high, thereby restricting data offloading to the WLAN networks and thus reducing operators’ WLAN network utilization or too low, thereby pushing subscribers connections to the WLAN netoworks that cannot ensure that end user Quality of Service remains at the same level or improves compared to the QoS of the 3GPP network, thereby failing to meet the specified objectives. For these reasons, we believe that the use of RCPI and RSNI as the only parameters for direct comparison for either WLAN network selection or traffic steering mechanism is unsuitable.

Instead of relying on WLAN metrics like RCPI and RSNI which can correlate poorly with performance (actual QoS), it is more suitable to use measured and/or estimated values of throughput to make offload decisions (based on the considerations outlined above).

# Summary of this reply letter

IEEE 802.11 Task Group mc developed this reply letter for approval by the IEEE 802.11 Working Group. The letter replies that the WLAN RCPI and RSNI are not considered suitable for the envisaged use case. Instead the letter suggests the use of estimated and/or measured WLAN throughput.

To: Mattias.a.bergstrom@ericsson.com

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

Date: 2014-05-12

Dear Mattias,

Thank you very much for your letter 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 as follows.

* Regarding Question 1: We consider the WLAN RCPI metric defined in IEEE 802.11™-2012 unsuitable for the purpose of access network selection and traffic routing as described in your letter.
* Regarding Question 2: We consider the RSNI value defined IEEE 802.11™-2012 unsuitable for the purpose of access network selection and traffic routing as described in your letter.
* Regarding Question 3: We consider the use of estimated and/or measured values of WLAN throughput to be more appropriate for the mechanism described.

Sincerely,

Adrian Stephens
IEEE 802.11 Working Group Chair

**References:**