IEEE 802.19 WG

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| Proposed response to most recent liaison from 3GPP RAN/RAN1 related to LAA |
| Date: 20170310 |
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Abstract

*This document contains a proposal for consideration by IEEE 802.19 WG, and ultimately by the IEEE 802 EC, at the IEEE 802 plenary meeting in Vancouver in March 2017 for a Liaison Statement from IEEE 802 to both 3GPP RAN and 3GPP RAN1 in response to 3GPP RAN’s Liaison Statement, dated November 2016 (R1-1613770)*

## Proposed liaison letter

TO:

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CC:

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SUBJECT: IEEE 802 response to 3GPP RAN1 LS (R1-1613770)dated November 2016

DATE: 17 March 2017

Dear Dino & Satoshi,

Thank you once again for supporting the ongoing cooperation over the last year or so between IEEE 802 and 3GPP RAN/RAN1 in relation to coexistence issues between LAA and 802.11 systems. This cooperation will hopefully ensure the various versions of LAA are designed in such a way that 802.11 and LAA systems will coexist fairly in unlicensed spectrum.

The following table contains a summary from IEEE 802’s perspective of the status, in terms of consensus and resolution, of the fourteen issues related to LAA/802.11 coexistence that were addressed in 3GPP RAN1’s most recent Liaison Statement to IEEE 802 in November 2016 (R1-1613770). Details of IEEE 802’s current position on each issue are included in the appendix of this Liaison Statement.

The table also summarizes the status at the time of IEEE 802’s previous Liaison Statement to 3GPP RAN1 dated 1 August 2016 (IEEE EC-16-0140-01-00EC), for information purposes. The status column is color coded to indicate the level of consensus on each issue. Green indicates “consensus” or “resolution”; red indicates “lack of consensus” or “no resolution”; orange indicates “progress towards consensus” or “progress towards resolution”.

IEEE 802 looks forward to a continued, productive interchange with 3GPP RAN/RAN1/RAN4 on these and other issues related to LAA/802.11 coexistence during the development of LAA Rel. 14.

For your information, the next two IEEE 802 meetings are on 7‑12 May 2017 in Daejeon, Korea and 9‑14 November 2016 in Berlin, Germany.

Regards,

/s/ Paul Nikolich

Paul Nikolich, Chairman, IEEE 802 Executive Committee

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| **#** | **Comment by IEEE 802 in Liaison Statement to 3GPP RAN1** | **Previous status** | **Current status** |
| 1 | *Radio equipment in unlicensed spectrum should not transmit energy for the primary purpose of blocking access to the channel to others* | **Possibility for consensus & resolution** | **Consensus,subject to additional RAN1 spec work** |
| 2 | *Transmission of Discovery Reference Signals should be clearly bounded to avoid excess airtime overhead on unlicensed spectrum* | **Some consensus,but not fully resolved** | **Consensus,subject to field experience** |
| 3 | *Radio equipment in unlicensed spectrum should detect neighboring networks with sufficient sensitivity to ensure fair coexistence* | **No consensus, and not resolved** | **No consensus,but possible with RAN4 testing**  |
| 4 | *LAA and IEEE 802.11 slot boundaries should align as accurately as possible to preserve spectral efficiency in unlicensed spectrum* | **No consensus,and not resolved** | **No consensus,but possible with RAN4 & field testing** |
| 5 | *LAA and 802.11 multi-channel aggregation schemes should align* | **No consensus,wait for measurements** | **No consensus,wait for measurements** |
| 6 | *Radio equipment in unlicensed spectrum should stop transmission as soon as transmission of useful data is complete* | **Possibility for consensus & resolution**  | **Consensus, subject to use of short sub-frames** |
| 7 | *Channel access that is obtained using special access mechanisms for high priority data should not be used to transmit lower priority data* | **Consensusbut not fully resolved** | **Consensus, subject to use of short sub-frames** |
| 8 | *The maximum continuous transmission time should be limited to avoid blocking latency sensitive traffic on coexisting networks* | **Consensusbut not fully resolved** | **No consensus,but possible with RAN4 & field testing** |
| 9 | *Adjustment of channel access contention window should be based on comparable indicators of congestion to ensure fairness between technologies* | **No consensus,wait for measurements** | **No consensus,but possible with use of short sub-frames** |
| 10 | *Adjustment of channel access contention window should be clearly defined* | **Consensus,and resolved** | **Consensus,and resolved** |
| 11 | *The channel access state machine during channel sensing should be clearly defined* | **Consensus,and resolved** | **Consensus,and resolved** |
| 12 | *The use of the back off mechanism should be clearly defined* | **Substantial consensus, but not fully resolved** | **Consensus,and resolved** |
| 13 | *Issues related to ED threshold and coexistence between LAA and IEEE 802.11* | **n/a** | **No consensus,but possible with RAN4 testing** |
| 14 | *Continued dialog towards a future framework for efficient sharing of the 5 GHz band* | **n/a** | **Waiting for RAN decision** |

## Appendix: responses to 3GPP RAN1’s Liaison Statement (R1-1613770)

### There is consensus on Issue 1: “*Radio equipment in unlicensed spectrum should not transmit energy for the primary purpose of blocking access to the channel to others*” but resolution is subject to RAN1 completing proposed additional work

IEEE 802 suggested in its Liaison Statement to 3GPP RAN1 dated 18 March 2016 (IEEE 802 19-16-0037-09-0000-laa-comments.pdf) that *LAA should be modified to avoid sending energy for the primary purpose of blocking access to the channel to others.* IEEE 802 continued to argue for this important principle in its Liaison Statement to 3GPP RAN1 dated 1 August 2016 (IEEE EC-16-0140-01-00EC). In the same Liaison Statement, IEEE 802 suggested (Response 1.1) a compromise solution whereby the LAA Rel. 13 specification is modified to include a recommendation that implementations should avoid transmitting *any signals in a channel between the time a device obtains access to the channel using LBT Category 4 and the time of the next subframe or partial subframe boundary*. As an alternative, it suggested (*Response 1.2*) that 3GPP RAN1 define *additional partial sub-frame starting positions in LAA Rel. 13, so that the need to send reservation signals is minimized*.

3GPP RAN1 responded to IEEE 802 in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770). In the first part of its response, 3GPP RAN1 asserted that such reservation signals represent legitimate overhead. However, 3GPP RAN1 also notified IEEE 802 that there is discussion of *adding a statement in 36.300 to minimize the transmission of such signals.* In the second part of its response, 3GPP RAN1 noted that *shortened TTI[[1]](#footnote-1) candidates may be incorporated into FS3 for LAA in the future* as a follow on from the current work to add *2-symbol, 4-symbol and 1-slot TTI* to Release 14 for *FS1 and FS2*.

IEEE 802 does not agree that reservation signals are legitimate overhead, at least partially based on 3GPP RAN1’s assertion in a previous Liaison Statement to IEEE 802 that *deferring sending energy until a subframe boundary or partial subframe boundary … provided good LAA performance.* This assertion highlights the unnecessary and wasteful nature of these reservation signals thus emphasizing their illegitimacy in unlicensed spectrum. However, IEEE 802 is pleased that 3GPP RAN1 is likely to adopt IEEE 802’s suggestions for a recommendation to avoid the use of reservation signals and for LAA to include more partial sub-frame starting positions (albeit not in LAA Rel. 13).

IEEE 802 now believes that this issue is heading towards consensus based on 3GPP RAN1’s efforts to minimize the time between the time a device obtains access to the channel and the next subframe. In the meantime, IEEE 802 requests that:

* 3GPP RAN1 provide a copy of the proposed *statement in 36.300*  as soon as it is available for IEEE 802’s consideration and comment
* 3GPP RAN1 notify IEEE 802 on the progress for the approval of work item to incorporate shortened TTI candidates in FS3 for LAA.

IEEE 802 also thanks 3GPP for clarifying that the introduction of partial sub-frames do not make HARQ operation inefficient.

### There is consensus on Issue 2: “*Transmission of Discovery Reference Signals should be clearly bounded to avoid excess airtime overhead on unlicensed spectrum*” but final resolution will depend on satisfactory field experience

IEEE 802 expressed a concern in its Liaison Statements to 3GPP RAN1 dated 18 March 2016 (IEEE 802 19-16-0037-09-0000-laa-comments.pdf) and 1 August 2016 (IEEE EC-16-0140-01-00EC) that there was the potential for excessive DRS overhead with short LBT periods. IEEE 802 requested that 3GPP RAN1 define much tighter constraints on the DRS overhead in LAA Rel. 13.

3GPP RAN1 responded to this concern in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770). It noted that the DRS limit agreed in 3GPP RAN1 *is only a strong upper bound for the amount of time to be used with 25us LBT*, and that it is 3GPP RAN1’s expectation that most DRS will be transmitted using Cat 4 LBT access.

It appears there is consensus between IEEE 802 and 3GPP RAN1 that the use of 25us LBT access for DRS should be limited. IEEE 802 is willing to accept 3GPP RAN1’s expectation that it will be limited in practice, subject to satisfactory experience in field deployments.

### There is not consensus on Issue 3: “*Radio equipment in unlicensed spectrum should detect neighboring networks with sufficient sensitivity to ensure fair coexistence*” but successful RAN4 testing may lead to resolution

Issue 3 is addressed in a separate Liaison Statement from IEEE 802 (<insert reference>). There is not yet consensus on this issue, but resolution is possible based on the completion of suitable test plans by 3GPP RAN4 and the successful execution of those test plans with satisfactory results.

### There is not consensus on Issue 4: “*LAA and IEEE 802.11 slot boundaries should align as accurately as possible to preserve spectral efficiency in unlicensed spectrum*” but resolution can result from satisfactory RAN4 testing & deployment experience

IEEE 802 highlighted several issues related to slot synchronisation in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC). In particular, IEEE 802 noted that if there is not slot synchronisation the system will be ALOHA-like rather than slotted-ALOHA like. IEEE 802 suggested that the situation would be improved by LAA detecting 802.11 preambles or finer grained energy detection. Finally, IEEE 802 explained why the *SI simulations cannot reasonably be used to draw any conclusions about the details of LAA Rel. 13 coexistence with IEEE 802.11*.

3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770). 3GPP RAN1 noted that good slot synchronisation between LAA and 802.11 is only possible if all systems transmit and receive 802.11 preambles and NAVs, but also notes that this would not be technology neutral. IEEE 802 agrees that this is best solution for slot synchronisation and thus fair and efficient use of the spectrum. Further, IEEE 802 asserts such a solution is “technology neutral” if it is the only way to achieve these goals; contrary to popular misconception, technology neutrality can sometimes mean only one technology is appropriate.

3GPP RAN1 also challenged IEEE 802’s comments about the efficacy of the SI simulations to prove LAA and 802.11 fairly coexist in any cases beyond the very simple indoor scenario with the known limitations of the chosen propagation model. IEEE 802 does not belief it is productive to argue further about simulations and associated assumptions at this point.

IEEE 802 notes that *RAN4 has decided on the development of a set of coexistence test cases including multi-node tests to verify the coexistence between LAA and IEEE 802.11 devices in various scenarios*. IEEE 802 requests that the question of the effect of slot desynchronization be examined in these coexistence tests, as well as in actual deployment scenarios.

### There is not consensus on “*LAA and 802.11 multi-channel aggregation schemes should align”* issue but resolution can result from successful deployment experience

Notes from volunteer:

* The RAN1 response notes that LAA UL has agreed to restrict transmission to subset of Wi-Fi bonded channels (i.e. following Wi-Fi channel bonding rules) in case the CCA scheme is similar to Wi-Fi.
* It also writes that “RAN1 notes IEEE 802’s comments and looks forward to any other input that IEEE 802.11 may have on this item.”
* IEEE should use this opportunity to request RAN1 to implement channel bonding for LAA DL too. IEEE should also point out the following:
	+ Due the latest ETSI channel access updates, LAA DL multi-carrier transmissions that perform CCA similar to Wi-Fi have to anyway follow channel bonding for DL too for operations within EU.
	+ The above coupled with the fact that LAA has an objective of a “single global solution” means that it should implement channel bonding in the DL not only within EU but across all deployment geographies.
	+ Per 3GPP procedure, it requires unanimity to change an existing design. So, it is much more difficult to make the change for LAA DL. However, it is possible to make this happen if there is a strong recommendation from IEEE together with pressure for Wi-Fi companies participating in 3GPP.

Andrew writes:

* I could not map the response to what 3GPP RAN1 wrote
* Maybe the volunteer would like to have a go at writing some text

### There consensus on Issue 6: “*Radio equipment in unlicensed spectrum should stop transmission as soon as transmission of useful data is complete*” but final resolution is subject to the use of shorter sub-frames

IEEE 802 requested a confirmation in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC) that a *LAA Rel. 13 system is mandatorily required to end transmission at the shortest end partial sub-frame boundary when it has no more data to transmit of the appropriate channel access priority class(s)*. IEEE 802 thanks 3GPP RAN1 for the requested confirmation in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770).

IEEE 802 also requested that *3GPP RAN specify LAA Rel.14 to accommodate partial sub-frames of one OFDM symbol duration in order to minimize channel wastage resulting from coarse sub-frame granularity in LAA*. IEEE 802 understands from 3GPP RAN1’s response to Issue 1 that shorter sub-frames are under consideration in Release 14, and these shorter sub-frames may also be available to LAA systems. The definition and use of shorter sub-frames in LAA Release 14 will satisfy our concerns.

### There is consensus on Issue 7: “*Channel access that is obtained using special access mechanisms for high priority data should not be used to transmit lower priority data*” but final resolution is subject to the use of shorter sub-frames

IEEE 802 requested in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC) for *LAA Rel. 13, the minimum duration be approximated to the next occurring (partial) sub-frame boundary (one of 3/6/9/10/11/12/14 OFDM symbols).* IEEE 802 further requested, as a compromise, that *for future releases of LAA (starting with Rel. 14), 3GPP should define partial sub-frames with a finer granularity including the provision for a sub-frame with 1 OFDM symbol*.

3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770) by noting that *the choice of size of the partial subframes to be used is also a function of the specification impact for considering many different sizes, eNB and UE implementation complexity and also the incremental gains that can be obtained*. IEEE 802 is satisfied with 3GPP RAN1’s response at this time on the basis that *minimum duration needed to transmit* is always interpreted according to commonly understood definitions of *minimum*.

3GPP RAN1 again noted (similar to Issue 1) that *shorter sub-frames are under consideration in Release 14, and these shorter sub-frames may also be available to LAA systems.* The definition and use of shorter sub-frames in LAA Release 14 will satisfy IEEE 802’s concerns by reducing the inefficiencies inherent in longer sub-frames.

### There is not consensus on Issue 8: “*The maximum continuous transmission time should be limited to avoid blocking latency sensitive traffic on coexisting networks*”, but resolution can result from satisfactory RAN4 testing & deployment experience

IEEE 802 requested in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC) that *LAA Rel. 13 aligns with the agreement that was achieved at ETSI-BRAN* for maximum TXOP.

3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770) that while IEEE *RAN1 may consider alignment with all aspects of the ETSI BRAN specification including MCOT limits* it is *the responsibility of the eNB to comply with any regional regulations*.

IEEE 802 is disappointed with 3GPP RAN1’s position to not adapt the maximum TXOPs agreed in ETSI BRAN by stakeholders from both the 802.11 and LAA communities. The limits in EN 301 893 represent a hard fought compromise by all stakeholders that is likely to enhance fair sharing of the 5GHz band globally. Given these limits will be required in Europe and the many countries that align with European regulations, the adoption of these limits by 3GPP RAN1 into LAA has the added advantage for LAA of enabling a single global solution.

IEEE 802 notes that *RAN4 has decided on the development of a set of coexistence test cases including multi-node tests to verify the coexistence between LAA and IEEE 802.11 devices in various scenarios*. IEEE 802 requests that the question of the effect of maximum TXOP limits on LAA/802.11 coexistence be examined in these coexistence tests as well as actual deployment scenarios.

### There is not consensus on Issue 9: “*Adjustment of channel access contention window should be based on comparable indicators of congestion to ensure fairness between technologies*” but resolution can result from satisfactory RAN4 testing

IEEE 802 suggested in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC) that *extensive simulation and testing of LAA and 802.11 coexistence be conducted to determine whether fair sharing of the channel actually occurs in typical medium to high congestion environments*. This recommendation was based on the difficulty of predicting the interaction LAA and 802.11 given the many differences (and similarities) in their medium access mechanisms.

3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770) by addressing several technical sub-issues discussed in IEEE 802’s Liaison Statement, and finished by declining IEEE 802’s offer to work closely with 3GPP RAN1 on additional and extensive simulation and testing on the basis such work is unnecessary. IEEE 802 disagrees that such testing is unnecessary and believes the 3GPP RAN4 testing activities provides a suitable forum for such work. IEEE 802 also believes that targeted simulation work may also provide value in some cases.

In addressing the differences between immediate ACKs in LAA and 802.11, 3GPP RAN1 noted that *as part of a Rel-14 work item on shortened TTI and processing time [1], the minimum latency between the DL PDSCH and DL HARQ feedback for legacy 1ms TTI operation is to be reduced from the current 4ms for all frame structures (FS) including FS3 used for LAA*. This comment suggests this work item has been approved in 3GPP RAN, which conflicts with 3GPP RAN1’s comments related to Issue 7. IEEE 802 requests that 3GPP RAN1 clarify the status of the work item. IEEE 802 notes that we expect extending the work to LAA will result in an enhancement of LAA/802.11 coexistence.

### There is consensus and resolution of Issue 10: “*Adjustment of channel access contention window should be clearly defined*”

Issue 10 was declared resolved in IEEE 802’s Liaison Statement to 3GPP RAN1 dated 1 August 2016 (IEEE EC-16-0140-01-00EC). No further action is required.

### There is consensus and resolution of Issue 11: “*The channel access state machine during channel sensing should be clearly defined*”

Issue 11 was declared as resolved in IEEE 802’s Liaison Statement to 3GPP RAN1 dated 1 August 2016 (IEEE EC-16-0140-01-00EC). No further action is required.

### There is consensus on Issue 12: “T*he use of the back off mechanism should be clearly defined”* and it has been largely resolved

IEEE 802 highlighted two issues related to the backoff mechanism in its Liaison Statement dated 1 August 2016 (IEEE EC-16-0140-01-00EC).

In relation to the first issue, IEEE 802 requested clarification that LAA maintained slot synchronisation in cases *where the next transmission is ready after the post backoff is complete*. 3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770) that LAA can maintain slot synchronisation by *continuously monitoring the channel.* IEEE 802 agrees that this is an appropriate mechanism, and further requests confirmation that LAA actually undertakes this monitoring, at least most of the time.

In relation to the second issue, IEEE 802 noted an ambiguity in the way *a station with a frame that becomes ready after a previous post transmission backoff is allowed to transmit*. 3GPP RAN1 responded in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770) by noting a corresponding change to the LAA specification. IEEE 802 agrees this modification appears to resolve the issue and thanks 3GPP RAN1 for their action.

### There is not consensus on Issue 13: “*Issues related to ED threshold and coexistence between LAA and IEEE 802.11*” but resolution can result from satisfactory RAN4 testing

Issue 13 is addressed in a separate Liaison Statement from IEEE 802 (<insert reference>). There is not yet consensus on this issue, but resolution is possible based on the completion of suitable test plans by 3GPP RAN4 and the successful execution of those test plans with satisfactory results.

### Resolution of Issue 14: “*Continued dialog towards a future framework for efficient sharing of the 5 GHz band*” is waiting for a 3GPP RAN response

IEEE 802 indicated an *interest in a continued dialog towards a future framework for efficient sharing of the 5 GHz band* in its Liaison Statement dated 14 November 2016 (IEEE EC-16-0203-00-00EC). 3GPP RAN1 included a response to this request in its Liaison Statement to IEEE 802 dated November 2016 (R1-1613770), deferring the question to 3GPP RAN. IEEE is awaiting the response from 3GPP RAN.

1. transmission time intervals [↑](#footnote-ref-1)