**3GPP TSG RAN WG1 #110 R1-220xxxx**

**Toulouse, France, August 22nd – 26th, 2022**

**Agenda Item: 8.11**

**Source: Moderator (Apple)**

**Title: Moderator Summary of Reply LS to R1-2205728 (LS on IUC with non-preferred resource set, RAN2)**

**Document for: Discussion and Decision**

# Introduction

RAN2 sent an LS [1] on IUC with non-referred resource set with the following contents:

In RAN2#118-e meeting, RAN2 discussed the inter-UE coordination scenario in which UE B receives IUC Scheme 1 non-preferred resource set from UE A, but UE B does not perform sensing in the resource pool associated with the non-preferred resource set, e.g. UE B performs mode 2 random resource selection, etc. For this case, RAN2 has the following questions:

*Question 1: Is the scenario described above a valid scenario or not?*

*Question 2: If the answer to Q1 is yes, does resource exclusion based on non-preferred resource set needs to be performed by UE B or not?*

*Question 3:* *If the answer to Q2 is yes, then, in RAN1’s view, which specification (PHY or MAC) should capture the resource exclusion behavior?*

In this contribution, we discuss the IUC with non-preferred resource set for the LS from RAN2.

# Discussions

## Contribution summary

There are contributions from 12 companies, discussing the topic of IUC with non-preferred resource set [2]-[16]. Companies’ views are summarized in the following table.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Q1 | Q2 | Q3 |
| LG [2] | No (No RAN 1 agreement)  | No | N/A |
| ZTE [3] | Yes | No  | N/A |
| OPPO [4],[5] | Yes | No | N/A |
| Futurewei [6]  | Yes | Yes | MAC layer |
| CATT [7] | Yes | Yes | PHY layer |
| Xiaomi [8] | No (No RAN1 agreement) | No | N/A |
| Vivo [9] | Not valid, but possible. | Up to UE implementation | N/A |
| Samsung [10] | Yes | Yes | PHY layer  |
| Qualcomm [11] | Yes | Yes | MAC layer |
| Apple [12], [13]  | Yes | No | N/A |
| Huawei [14] | No (No RAN1 agreement) | No | RAN2 clarification to discard non-preferred resources  |
| Ericsson [15], [16] | Yes | Yes (for UE-B capable of sensing and resource selection) | PHY layer |

Regarding the response to Question 1, majority of the companies (8 out of 12) think the answer is YES. Some companies (4 out of 12) think there is no RAN1 agreement to handle the case where UE-B does not perform sensing but receives IUC scheme 1 with non-preferred resource set.

Overall, in moderator’s view, it is possible that the situation occurs where UE-B does not perform sensing but receives IUC scheme 1 with non-preferred resource set. For example, a condition triggered IUC containing a non-preferred resource set can be sent via unicast, groupcast or broadcast. If the IUC is sent in a resource pool supporting multiple resource allocation mechanisms (e.g., full sensing, partial sensing and random resource selection), then it is possible that a random resource selection UE-B receives this IUC.

The different responses to Question 1 depend on the definition of “valid scenario”. Some companies think it is “valid scenario” because this scenario may occur, while other companies think it is not a “valid scenario” since there is no RAN1 agreement to support/handle this scenario.

Regarding the response to Question 2, it is moderator’s observation that almost all companies think UE-B’s behavior has not been defined in the current specification when receiving IUC scheme 1 with a non-preferred resource set while not performing sensing in the resource pool associated with the non-preferred resource set. This is based on the following RAN1 agreement:

|  |
| --- |
| **Agreement**In scheme 1, at least following UE-B’s behavior in its resource (re-)selection is supported when it receives inter-UE coordination information from UE-A:* For preferred resource set, the following two options are supported:
	+ Option A): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set in combination with its own sensing result
			* UE-B uses in its resource (re-)selection, resource(s) not belonging to the preferred resource set when condition(s) are met
				+ FFS: Details of condition(s)
			* This option is supported when UE-B performs sensing/resource exclusion
			* FFS: Other details (if any)
	+ Option B): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based only on the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set
			* This option is supported at least when UE-B does not support sensing/resource exclusion
				+ FFS: Whether the support is conditional or UE capability
			* FFS: Other details (if any)
	+ FFS: Other option(s), and other details (if any)
* For non-preferred resource set,
	+ UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
			* FFS: Details including
				+ Whether/how UE-B can use in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set, definition of the overlap, and other details (if any)
				+ When UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
		- FFS: UE-B reselects in its resource (re-)selection, resource(s) to be used for its transmission when the resource(s) are fully/partially overlapping with the non-preferred resource set
	+ FFS: Other option(s), and other details (if any)
 |

Under the assumption that UE-B’s behavior is not defined in the current specification, companies’ views are diverged on whether and how to define UE-B’s behavior in this situation.

If this situation occurs, 6 companies (LG, ZTE, OPPO, Xiaomi, Apple, Huawei) think UE-B does not need to exclude the non-preferred resource set during its resource selection procedure. Instead, UE-B can simply ignore the non-preferred resource set and continue to perform random resource selection. This is because random resource selection is a MAC layer procedure without PHY layer processing of generating a set of candidate resources. On the other hand, the set of non-preferred resource sets is processed in the PHY layer (i.e., excluding non-preferred resource set in Step 6b) of clause 8.1.4). If resource exclusion based on non-preferred resource set needs to be performed by UE-B, then either MAC layer triggers PHY layer processing of generating a set of candidate resources under random resource selection procedure or MAC layer directly excludes the non-preferred resource set in the random resource selection procedure. Either of these approaches will have specification impact. Furthermore, the above RAN1 agreement defines only a single option for the case of non-preferred resource set, while it defines two options for the case of preferred resource set.

On the other hand, 5 companies (Futurewei, CATT, Samsung, Qualcomm, Ericsson) think UE-B needs to trigger resource selection based on its own sensing information and the set of non-preferred resource set. This is because the above RAN1 agreement mentions that UE-B uses sensing results (if available) together with the non-preferred resource set. This implies that if UE-B’s sensing results are unavailable, only the non-preferred resource set would be used.

vivo thinks it is up to UE-B’s implementation to determine whether to trigger a sensing procedure to collect enough sensing results. Then, UE-B could perform resource exclusion based on its sensing results as well as the non-preferred resource set. In this case, UE-B already has enough sensing results and the assumption “UE B does not perform sensing” no longer holds.

Regarding the response to Question 3, only part of the companies provided answers in their contributions depending on the answer to Question 2. Among the companies providing answers to Question 3 in their contributions, 3 companies (CATT, Samsung, Ericsson) think the PHY specification should capture the resource exclusion behavior. This is because the non-preferred resource set is handled by PHY layer in general. 2 companies (Futurewei, Qualcomm) think the MAC specification should capture the resource exclusion behavior. This is because the random resource selection is handled by RAN2 specification, and it is simpler to add exclusion based on the non-preferred resource set for the random selection to RAN2 specifications.

## (Closed) Round 1 discussion

*Question 1-1: Do you agree that the* ***scenario may occur*** *that UE-B receives IUC scheme 1 with a non-preferred resource set but UE-B does not perform sensing in the resource pool associated with the non-preferred resource set?*

|  |  |  |
| --- | --- | --- |
| Company | Answer to Question 1-1 | Comments |
| FUTUREWEI | Yes |  |
| OPPO | Yes |  |
| Samsung | Yes |  |
| DCM | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes |  |
| Nokia, NSB | Yes |  |
| ZTE,Sanechips | Yes |  |
| NEC | Yes  |  |
| CATT, GOHIGH | Yes |  |
| Huawei, HiSilicon | Does not occur | There are no agreements to support this operation during the normative phase. Note that non-preferred resources are excluded from UE-B’s sensing result, which necessarily has to exist in the first place, and is not produced by a random selection procedure which does not use sensing. |
| vivo | Yes | It may occur if the UE-B does not preform sensing but receives a non-preferred resource set due to, e.g., condition-based groupcast or broadcast IUC. |

*Question 1-2: If answer is Yes for Question 1-1, do you agree to respond to Question 1 as “The scenario described above is a* ***possible*** *scenario”.*

|  |  |  |
| --- | --- | --- |
| Company | Answer to Question 1-2 | Comments |
| FUTUREWEI | Yes |  |
| OPPO | Yes |  |
| Samsung | Yes |  |
| DCM | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes |  |
| Nokia, NSB | Yes |  |
| ZTE, Sanechips | Yes |  |
| NEC | Yes |  |
| CATT, GOHIGH | Yes |  |
| Huawei, HiSilicon | (No) |  |
| vivo |  | A scenario may occur does not necessarily mean that it is a valid scenario that should be supported by specification. |

*Question 2-1: Do you agree that UE-B’s behavior has not been defined (in the specification) when receiving IUC scheme 1 with a non-preferred resource set while not performing sensing in the resource pool associated with the non-preferred resource set?*

|  |  |  |
| --- | --- | --- |
| Company | Answer to Question 2-1 | Comments |
| FUTUREWEI | Yes |  |
| OPPO | Yes |  |
| Samsung | Yes |  |
| DCM | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Yes |  |
| Nokia, NSB | Yes |  |
| ZTE,Sanechips |  | The behavior can be implicitly derived. The specification already includes the handling of non-preferred resource set in RAN1 as part of the sensing procedure, thus in case there is no sensing performed, naturally the non-preferred resource set shall be left unused. The UE behavior is pretty clear. |
| NEC | Yes  |  |
| CATT, GOHIGH | Yes |  |
| Huawei, HiSilicon | Unsupported case | It has not been defined, but it is a case that is not supported. |
| vivo | Yes |  |

*Question 2-2: If answer is Yes for Question 2-1, which of the following alternatives is preferred?*

*Alt 1. UE-B does not perform resource exclusion based on non-preferred resource set.*

 *Note: UE-B continues to perform normal random resource selection.*

*Alt 2. UE-B performs resource exclusion based on non-preferred resource set.*

*Alt 3. It is up to UE-B implementation to trigger sensing procedure, and then to perform resource selection based on both sensing results and non-preferred resource set.*

|  |  |  |
| --- | --- | --- |
| Company | Answer to Question 2-2 | Comments |
| FUTUREWEI | Alt 2 | Alt 3 does not seem to correspond to the situation asked by RAN2. |
| OPPO | Alt 1 | Alt 1 is the behavior stipulated in the current specification, no new behavior should be introduced at this stage. |
| Samsung | Alt2 | This seems to be aligned with RAN1 agreements. |
| DCM | Alt 1 |  |
| Spreadtrum | Alt 1 |  |
| Intel | Alt 1 | Same understanding as OPPO |
| Ericsson | Alt.2 | Alt 2 gives the better performance regarding collision avoidance. If the UE does not perform resource exclusion based on the IUC information, the IUC information is wasted. |
| Xiaomi | Alt 1 | In RAN2 LS, the following wording is used “e.g. UE B performs mode 2 random resource selection”, so we suggest to add “e.g.” in the note:*Note: e.g. UE-B continues to perform normal random resource selection.*  |
| Qualcomm | Alt 2 | Alt 2 is in line with the RAN1 agreement:* For non-preferred resource set,
	+ UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
 |
| Nokia, NSB | Alt 2 |  |
| ZTE,Sanechips | Alt 1 | No spec. change as a note should be added to Alt 1 |
| NEC | Alt 2 | We had agreement as cited above that *UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information* |
| CATT, GOHIGH | Alt.2 | According to FL’s summary, the previous agreement has implicitly implied that if UE-B’s sensing results are unavailable, only the non-preferred resource set would be used.* + - *For non-preferred resource set,*
			* *UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information*

On the other hand, since the non-preferred resource set means that the resource set is not desired by UE-A, if UE-B just randomly select the transmission resource without considering the non-preferred resource set, UE-B may select the resource within the non-preferred resource set, it would degrade the performance. So we think the non-preferred resource set exclusion should be captured in the specification. |
| Huawei, HiSilicon | N/A | In case of explicit request, either UE-B requesting or UE-A delivering a non-preferred set is an error, and left unspecified.In case of condition based, since there are no agreements to involve non-preferred resources by such a UE-B, it can be clarified by specifying UE-B to discard such a non-preferred resource set. |
| vivo | Alt 3 with modification | It can be simply left to up implementation to handle this, e.g.,*It is up to UE-B implementation to handle this case.* |

*Question 3-1: In case UE-B performs resource exclusion based on non-preferred resource set, which specification (PHY or MAC) should capture the resource exclusion behavior?*

|  |  |  |
| --- | --- | --- |
| Company | Answer to Question 3-1 | Comments |
| FUTUREWEI | MAC | Not a strong preference, but looks like it would be very easy to do in MAC and likely the reason why RAN2 asked to question the way they did. |
| Samsung | PHY | It is more logical to include in the PHY specs as non-preferred resources are handled in the PHY specs.  |
| Ericsson | PHY | The PHY specification already captures the procedure for non-preferred resources. |
| Qualcomm | MAC | We prefer to capture in MAC spec since random selection is defined there. |
| Nokia, NSB | MAC |  |
| NEC | MAC | For random resource selection, based on the TS38.321 Clause 5.22.1, we understand that MAC layer itself determines the resource from the resources pool without involving physical layer |
| CATT, GOHIGH | We prefer PHY | From our understanding, the non-preferred resource set processing has been captured into PHY layer, it would be better to capture this resource exclusion in PHY layer too.Since no sensing results are available at UE-B, hence the received non-preferred resource set should be excluded directly from the initial candidate resource set in step 1) |
| Huawei, HiSilicon | See comment | If specifying to discard a condition-based non-preferred set, it can be in PHY. |
| vivo | MAC | It a UE does not perform sensing, PHY is not aware of resource selection triggered. |

If you have any other comments related to the LS, please use the following table to share.

|  |  |
| --- | --- |
| Company | Comments |
|  |  |

## Round 2 discussion

In Round 1 discussion, 14 out of 15 companies think the scenario that UE-B receives IUC scheme 1 with a non-preferred resource set but UE-B does not perform sensing in the resource pool associated with the non-preferred resource set may occur, and agree to respond to the first question by

“The scenario described above is a **possible** scenario”.

Huawei thinks this is not a possible scenario since there are no agreements to support this operation during the normative phase. As the moderator explained in Round 1, we only discuss whether the scenario will occur or not for Question 1-1 and Question 1-2, but leaving any specification related discussions in the remaining questions. With this explanation, the moderator hope that Huawei can accept the following proposal.

*Proposal 1: Regarding the first question in R1-2205728, RAN1’s response is “The scenario described above is a possible scenario.”*

Companies please provide the comments **only if** you have strong concern about the above proposal.

|  |  |
| --- | --- |
| Company | Comments |
|  |  |

Regarding Question 2-1, 14 out of 15 companies think UE-B’s behavior has not been defined in the specification when receiving IUC scheme 1 with a non-preferred resource set while not performing sensing the resource pool associated with the non-preferred resource set.

ZTE thinks the behavior can be implicitly derived, since the specification already includes the handling of non-preferred resource set in RAN1 as part of the sensing procedure. Hence, in the case of random resource selection, naturally the non-preferred resource set shall be left unused.

Moderator wants to mention the following specification in TS38.321:

|  |
| --- |
| 3> if configured by RRC, *interUECoordinationScheme1Explicit* or *interUECoordinationScheme1Condition* enabling reception of preferred resource set and non-preferred resource set and when the UE does not have own sensing result as specified in clause 8.1.4 of TS 38.214 [7] and if a preferred resource set is received from a UE:4> randomly select the time and frequency resources for one transmission opportunity from the resources belonging to the received preferred resource set for a MAC PDU to be transmitted to the UE providing the preferred resource set, according to the amount of selected frequency resources and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier.3> if configured by RRC, *interUECoordinationScheme1Explicit* or *interUECoordinationScheme1Condition* enabling reception of preferred resource set and non-preferred resource set and when the UE has own sensing result as specified in clause 8.1.4 of TS 38.214 [7] and if a preferred resource set is received from a UE: 4> randomly select the time and frequency resources for one transmission opportunity within the intersection of the received preferred resource set and the resources indicated by the physical layer as specified in clause 8.1.4 of TS 38.214 [7] for a MAC PDU to be transmitted to the UE providing the preferred resource set, according to the amount of selected frequency resources and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier. |

Basically, the UE’s MAC layer procedure does not include the case when UE does not have own sensing result but receives a non-preferred resource set. Hence, from UE’s MAC layer procedure point of view, UE-B’s behavior has not been defined.

Regarding Question 2-2, companies’ views are almost half-half split between Alt 1 and Alt 2. Only one company prefers Alt 3 with modifications (left to UE implementation).

One argument to support Alt 2 is that it is aligned with RAN1 agreement:

|  |
| --- |
| * For non-preferred resource set,
	+ UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
 |

In other words, if UE-B’s sensing result is unavailable, then only the received non-preferred resource set information is used in UE-B’s resource selection procedure.

Another argument to support Alt 2 is that the using the non-preferred resource set could enhance the performance of UE-B’s resource selection.

The main argument to support Alt 1 is that there are no existing agreements involving non-preferred resources by such a UE-B performing random resource selection, and there is no motivation to make a new agreement for this case in the maintenance phase. This argument is based on a different understanding of the same agreement:

|  |
| --- |
| **Agreement**In scheme 1, at least following UE-B’s behavior in its resource (re-)selection is supported when it receives inter-UE coordination information from UE-A:* For preferred resource set, the following two options are supported:
	+ Option A): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set in combination with its own sensing result
			* UE-B uses in its resource (re-)selection, resource(s) not belonging to the preferred resource set when condition(s) are met
				+ FFS: Details of condition(s)
			* This option is supported when UE-B performs sensing/resource exclusion
			* FFS: Other details (if any)
	+ Option B): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based only on the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set
			* This option is supported at least when UE-B does not support sensing/resource exclusion
				+ FFS: Whether the support is conditional or UE capability
			* FFS: Other details (if any)
	+ FFS: Other option(s), and other details (if any)
* For non-preferred resource set,
	+ UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
			* FFS: Details including
				+ Whether/how UE-B can use in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set, definition of the overlap, and other details (if any)
				+ When UE-B excludes in its resource (re-)selection, resource(s) overlapping with the non-preferred resource set
		- FFS: UE-B reselects in its resource (re-)selection, resource(s) to be used for its transmission when the resource(s) are fully/partially overlapping with the non-preferred resource set
	+ FFS: Other option(s), and other details (if any)
 |

For preferred resource set, two options are defined where Option A has the same descriptions as that for non-preferred resource set. However, only a single option is defined for the case of non-preferred resource set. This implies the similar case as Option B for preferred resource set is not defined for the non-preferred resource set case.

In moderator’s view, the key difference between the two camps is the understanding of the above agreement. The performance optimization is not the consideration in the maintenance phase. Hence, we need to align the understanding of the above agreement. The two alternatives are the sub-sequency of the corresponding understanding of the above agreement.

*Proposal 2: Regarding the second question in R1-2205728, RAN1 to down-select from the following alternative responses:*

*Alt 1. UE-B does not perform resource exclusion based on non-preferred resource set.*

 *Note: UE-B continues to perform normal random resource selection.*

*Alt 2. UE-B performs resource exclusion based on non-preferred resource set.*

If companies cannot converge to either of the alternatives, then a possible conclusion/response is “*There is no consensus in RAN1 on whether UE-B performs resource exclusion based on non-preferred resource set.*”

Companies please provide the comments.

|  |  |  |
| --- | --- | --- |
| Company | Supported alternatives | Comments |
|  |  |  |

Regarding Question 3-1, 3 companies think the PHY specification should capture the resource exclusion behavior. This is because the non-preferred resource set is handled by PHY layer in general. 4 companies think the MAC specification should capture the resource exclusion behavior. This is because the random resource selection is handled by RAN2 specification, and it is simpler to add exclusion based on the non-preferred resource set for the random selection to RAN2 specifications. 1 company thinks the PHY specification should capture the resource discarding behavior.

It is moderator’s view that if the answer to Question 2 of R1-2205728 is Yes, it is easier to capture it in MAC specification since random resource selection is mainly handled in MAC specification. Even it is handled in PHY specification, the change in MAC specification is still needed. Based on this, the following proposal is provided **just in case the answer to the second question in R1-2205728 is Yes**.

*Proposal 3: In case the answer to the second question in R1-2205728 is Yes, MAC specification should capture the resource exclusion behavior.*

Companies please provide the comments **only if** you have strong concern about the above proposal.

|  |  |
| --- | --- |
| Company | Comments |
|  |  |

# Conclusion

TBD

# References

1. R1-2205728 LS on IUC with non-preferred resource set RAN2, Apple
2. R1-2205846 Discussion on LS on IUC with non-preferred resource set LG Electronics
3. R1-2206092 About LS on IUC with non-preferred resource set ZTE, Sanechips
4. R1-2206279 Discussion on the LS on IUC with non-preferred resource set OPPO
5. R1-2206280 Draft reply LS on IUC with non-preferred resource set OPPO
6. R1-2206338 On the incoming RAN2 LS R1-2205728 on IUC and non-preferred resources FUTUREWEI
7. R1-2206343 Draft Reply LS on IUC with non-preferred resource set CATT, GOHIGH
8. R1-2206608 [Draft]Reply LS on IUC with non-preferred resource set Xiaomi
9. R1-2206708 Draft reply LS on IUC with non-preferred resource set vivo
10. R1-2206776 Draft Reply LS on IUC with non-preferred resource set Samsung
11. R1-2207167 Reply to RAN2 LS on IUC with non-preferred resource set Qualcomm Incorporated
12. R1-2207304 Discussion on RAN2 LS on IUC with Non-preferred Resource Set Apple
13. R1-2207305 Draft Reply LS to RNA2 on IUC with Non-preferred Resource Set Apple
14. R1-2207517 Discussion on LS on IUC with non-preferred resource set Huawei, HiSilicon
15. R1-2207557 [Draft] Reply LS on IUC with non-preferred resource set Ericsson
16. R1-2207558 Discussion on LS on IUC with non-preferred resource set Ericsson