**3GPP TSG-RAN WG2 #124 *R2-231xxxx***

**Chicago, USA, November 2023**

Agenda Item: 7.15.X

Source: OPPO

Title: Summary of [POST123bis][113][V2X/SL] QoS flows mapping to carriers (OPPO)

Document for: Discussion, Decision

# Introduction

This is for the following email discussion.

* [POST123bis][113][V2X/SL] QoS flows mapping to carriers (OPPO)

**Scope:** Discuss whether there is any problem (including inter-operability issue, ignoring NW configuration, etc.), if feasible or not, and pros and cons for each option. The discussion will focus idle/inactive/OOC.

**Intended outcome:** Discussion summary.

**Deadline:** Long

# Discussion

During 123bis, the following issue has been discussed

**QoS flows mapping to carriers**

[Vivo]: Three options have been discussed for idle/inactive/OOC:

* Option1: UE establish multiple SLRBs to avoid different carrier for QoS flow ids in a SLRB
* Option2: Intersection among QoS flow ids belonging to a SLRB is considered in LCP
* Option3: No further enhancement based on running CR

[Nokia]: For RRC connected, option1 seems already feasible because we just agreed to include flow-to-carrier mapping for each destination into SUI message. [Qualcomm]: have strong concern with option2, e.g. multiple carriers are not guaranteed, whenever the upper layer adds new service type it should update it to the lower layer. [OPPO]: Can we see companies’ view? [IDC]: Option2 and option3 are actually same. Option2 is just for better clarification. Option3 is inherited sentence from LTE V2X as it was. [LG]: Do not think option2 and option3 are same. Prefer either option1 or option3. [Apple]: Option1 means that UE does not follow network configuration, which is not acceptable.

=> We’ll decide one of three options. No more new option is considered.

=> Comeback Friday.

Option1: Huawei, LG, Vivo, Xiaomi, Nokia, Qualcomm (6)

Option2: IDC, Ericsson, Lenovo, Apple (4)

Option3: CATT, ZTE, ASUSTek, OPPO, NEC (5)

It seems beneficial to firstly further analyze the pros/cons for each option, before final conclusion.

## Option-1

During 123bis, there were some offline discussion on option-1, it would be good to further check the Pros/Cons of it.

**Q1-1a: What is the advantage(s) of option-1 in your view?**

**- Pros-1: ensure every flow being delivered via the expected carrier**

**- Pros-2: ensure every mapped carrier being usable and not excluded due to intersection method - Others**

|  |  |  |
| --- | --- | --- |
| Company | Pros | Comment |
| Xiaomi | Pros-1 and see comment | In our understanding, the key poin is to avoid to map the flows having no frequency intersection to the same RB, for example, (flow1, f1, f2) and (flow2, f3) should not be mapped to the same RB. This solution can solve the issue from the root.  In addition, if each flow having totally the same frequency can be mapped to the same RB, then pro-1 can be achieved, for example, (flow1, f1, f2), (flow2, f1, f2), (flow3, f1, f2, f3), then if flow 1 and flow 2 are mapped to a RB while flow 3 mapped to one RB, then each flow can be delivered via the expected carrier. With this, there is no need to consider the intersection as proposed by option 2  But if flows having at least intersection are allowed to be mapped to the same RB, e.g., flow 1, flow 2 and flow 3 to the same RB, then for flow 3, only grants from f1 and f2 can be utilized, which reduces the expected carrier for flow 3. With this, intersection of option 2 is still needed on top of option 1. |
| Apple | Pros-1 |  |
| LG | Pros-1 |  |
| Huawei, HiSilicon | Pros/1 | To obtain the benefit of SL CA, each QoS flow shall be delivered via the expected carrier which is indicates by upper layer. Furthermore, the agreement that introducing flow-to-carrier mapping for each destination into SUI message is to obtain such benefit for RRC\_CONNECTED UEs, i.e. the gNB shall configure multiple SLRBs to avoid different carrier for multiple QoS flows. For RRC\_INACTIVE/RRC\_IDLE/OOC UEs, since the NW has no carrier(s) for each QoS flow, the UE should establish multiple SLRBs to avoid different carrier for multiple QoS flows based on a same SLRB configuration. In general, RRC\_INACTIVE/RRC\_IDLE/OOC UEs shall have similar CA based communication performance compared to RRC\_CONNECTED UEs, to ensure each QoS flow being delivered via the expected carrier.  Regarding Using Option 2 on top of Option 1, it is possible however the no/only one intersection carrier would be avoided already by Option 1. |
| vivo | Pros-1 and Pros-2 | Agree with Xiaomi’s analysis. If we would like to make option-1 work independently from option-2, then we may design it as ‘only for each flow having totally the same frequency can be mapped to the same RB’, then we would not need any further solution on intersection carrier aspect.  Also, we understand the options are mainly discussed based on For RRC\_INACTIVE/RRC\_IDLE/OOC UEs scenario. For CONNECTED UE, anyway the UE can rely on proper network configuration, and we may not need any option at all. |
| CATT | Pros-1/2 with comments | These Pros are at the sacrifice of more UE/NW complication, i.e. at the worst case, only 1-to-1 mapping between flows and SLRBs can be supported, w/o any two flows able to be mapped to the same SLRB. |
| Nokia | Pros-1, Pros-2 | This is the cleanest way of respecting Qos flow to carrier mapping. We have the same understanding as Huawei that if NW knows QoS flow to carrier mapping, i.e., via SUI message in RRC\_CONNECTED, the gNB shall configure the SL RB properly, i.e., not assign to the same SL RB if the flow is mapped to different carriers. The question in RRC\_IDLE/INACTIVE and OoC is more like how to achieve this in the UE side when the gNB does not have full knowledge or is not reachable, which we see as a flexibility granted by the gNB but not violatation.  In addition, MAC layer is designed in a way that QoS flow is not visible and only concerns the logical channel, which we think also important design principle to keep. |
| Ericsson | Pros-1 |  |
| InterDigital | Pros 1 and Pros 2 | We think the key of Pros 2 is that if there are QoS flows that are mapped to the same SLRB configuration (using legacy), then since only a single SLRB can be created, one of the two flows cannot be transmitted. The network cannot know the flow to carrier mapping in IDLE/INACTIVE/OOC, and cannot avoid this situation. Therefore, option 1 avoids this case by allowing multiple SLRBs to be created with the same configuration but on different carriers. |
| Qualcomm | Pros 1 and Pros 2 |  |
| Lenovo | Pros-1 and probably Pros-2, see comments | We understand the original option 1 is to map different QoS flow to different SLRB as long as their mapped carriers are different. On the other hand, only those QoS flows with exactly same associated carrier(s) can be mapped to the same SLRB. In this case, both pros-1 and pros-2 can be achieved.  If as another understanding, option 1 is to “avoid to map the flows having no frequency intersection to the same RB”, then only pros-1 can be achieved. |

**Q1-1b: What is the disadvantage(s) of option-1 in your view?**

**- Cons-1: It leads to a UE behavior igoring the network (pre)configuration for SDAP (i.e., flow-to-bearer mapping)**

**- Cons-2: Inter-operability issue since in legacy, the UE would respect the SDAP configuration from network (pre)configuration**

**- Cons-3: currently there is no enough LCID space (16 for SL DRB) to carry QoS flow (64 at most, since flow-ID is of 6-bit) in an one-to-one manner**

**- Cons-4: It will cause misalignment on understanding of SLRB mapping between gNB and UE (esp. UE in RRC\_CONNECTED), which will make gNB difficulty to configure duplication.**

**- Cons-5: It may lead to different UE behaviors on SDAP (i.e. flow-to-bearer mapping) for different RRC states**

**- Cons-6: It leads to cross-WG incompatibility issue as PC5 QoS-to-SLRB mapping is also specified in TS 24.588. A joint discussion wth other WG would be required and further delay the work.**

**- Others**

|  |  |  |
| --- | --- | --- |
| Company | Cons | Comment |
| Xiaomi |  | Regarding 1, we think UE may not ignore the NW configuration since even more than 1 RB is established, the configuration still follows NW. UE just establish two RBs but both follows the SDAP/PDCP/RLC/MAC configuration from NW.  Regarding 2, is there any issue if R16 UE follows the legacy configuration and new UE establish more than one RB? For the case when a legacy UE communicates with a new UE, as long as for unicast, the TX can configure the RX through PC5-RRC with the SLRB, there is no inter-operability for unicast. For BC/GC, there may be some issue if TX UE and RX UE have different understanding on the QoS flow to RB mapping, e.g., RX UE may deliver the RB to a differnet PDCP if not aligned with TX UE.  Regarding 3, we are wondering if there is that many QoS flow for a DST and also if we allow flows having at least intersection are allowed to be mapped to the same RB, e.g., flow 1, flow 2 and flow 3 to the same RB, the LCID should be enough. |
| Apple | Cons-1/Cons-2/Cons-3/Cons-4/Cons-5/Cons-6 | On Cons-1, we emphasize that the configued mapping is a SEQUENCE of QoS profiles, not just a single one QoS profile or a single QFI in sl-SDAP-config.  sl-Mappedqos-Flows-r16 CHOICE {  sl-MappedQoS-FlowsList-r16 SEQUENCE (SIZE (1..maxNrofSL-QFIs-r16)) OF SL-QoS-Profile-r16,  sl-MappedQoS-FlowsListDedicated-r16 SL-MappedQoS-FlowsListDedicated-r16  }  Obviously, with option 1, if the TX UE could use one single Uu SLRB Config to create two SLRBs, these two SLRBs (support only one Qos flow) created by TX UE are not matching the SLRB ConfigIndex (support a sequence of multiple QoS flows) provided in Uu interface, but “invented” by UE itself. If this is allowed, then UE can be allowed to have many “novel” way to interpret the NW configuration. We think that it is quite a fundamental change for RRC design, and should not cross this line.  On Cons-2, when a Rel-18 gNB configures SLRB and SDAP mapping, it needs to differentiate legacy UE, Rel-18 UE without SL capability and Rel-18 UE with SL capability. It puts a new burden for gNB and may introduce multiple followed maintainance issues.  On Cons-3, it means extra MAC spec change to increase LCID space for SL DRB (4-19 in current MAC spec).  On Cons-4, please note that RAN2#123 agreed that RRC\_CONNECTED UEs report the flow-to-carrier mapping in SUI, and rely on NW configured per-LCH carrier set and duplication enable indication. However, if the UE is allowed to use one single Uu SLRB Config to create two or more SLRBs, it will cause misalignment between gNB and UE, and thereby gNB is difficulty to provide a proper duplication configuration. It means the agreed flow-to-carrier mapping report in SUI is not sufficient, and other info (e.g. UE actual SDAP mapping) needs to be reported to able gNB work.  To resolve the issue in Cons-4, we think one solution is that option 1 is only applied to IDLE/INACTIVE/OOC UEs (rather than CONNECTED UEs). But it will cause different UE behaviors depending on its RRC state (as shown as Cons-5), which should be avoided.  Finally, we think the PC5 Qos Profile to SLRB mapping is also coded as “AS configuration” component in CT1 spec 24.588 as shown below.    Thus, if RAN2 decide to allow UE to not follow the SLRB mapping rules specified in CT1 spec, RAN2 need discuss with CT1 altogether, and cannot be solely decided by RAN2. Thus, we add Cons-6 above. |
| Huawei, HiSilicon | See comments | Regarding Cons-1, it should be noted that, legacy UE already can establish multiple SLRB for different pairs of source L2 ID and destination L2 ID based on one SLRB configuration in RRC\_INACTIVE/RRC\_IDLE/OOC, this is already supported since Rel-16, where the SLRB configuration is not associated with specific pair of source L2 ID and destination L2 ID in RRC\_INACTIVE/RRC\_IDLE/OOC and the UE still does follow the PDCP/RLC/MAC configuration from NW.  Regarding Cons-2, if it is considered that the UE does not respect the SDAP configuration from NW, then the legacy UE would be considered as not respecting the SDAP configuration for NW either for the similar behaviour, as UE can establish multiple SLRB for different pairs of source L2 ID and destination L2 ID based on one SLRB configuration in RRC\_INACTIVE/RRC\_IDLE/OOC since Rel-16. In fact, in this case the NW provide a "not-useable" SDAP configuration since the NW has no knowledge on carrier for each QoS flow in RRC\_INACTIVE/RRC\_IDLE/OOC case. Therefore it does not means the UE is to ignore the SDAP configuration, rather it should regarded as UE handling for “not-useable SDAP configuration” case.  Regarding Cons-3, it does not means that the UE shall establish each SLRB for each QoS flow, if multiple QoS flows are associated with the same carrier(s), these multiple QoS flows should be mapped into a same SLRB with one LCID. We understand that, the case more than 16 QoS flows associating with different carriers are unlikely to occur, and the reserved LCID can be reused in this case (although we think this is really corner case). Lastly similar case may happen for RRC\_CONNECTED if there are really a lot of QoS flows associating with different carrier(s), so it is not specific disadvantage for RRC\_INACTIVE/RRC\_IDLE/OOC.  Regarding Cons-4, such mechanism is only applied for RRC\_INACTIVE/RRC\_IDLE/OOC, it is not related to RRC\_CONNECTED.  Regarding Cons-5, this is already supported since Rel-16, the UE can establish multiple SLRBs for different pairs of source L2 ID and destination L2 ID based on one SLRB configuration in RRC\_INACTIVE/RRC\_IDLE/OOC.  Regarding Cons-6, it is RAN2 specific issue, we can inform other WGs if needed after the conclusion is made. |
| vivo |  | For Cons-1, it is based on how companies understand the SDAD configuration and we agree with xiaomi that the configuration still follows NW. the NW provides SLRB-Uu-ConfigIndex-r16 associated with SLRB in SDAP configuration and the UE actually uses SLRB-PC5-ConfigIndex-r16 on PC5 SLRB configuration so there is anyway some ‘invention’ at UE side which is actually allowed in sidelink.  For Cons-2, TX can configure the SLRB to RX via PC5-RRC so not sure about the real problem.  For Cons-3, agree with Xiaomi and Huawei that the UE does not need to establish so many SLRBs as there are some repetitive QoS flows and also, we don’t think the real number of QoS flows would be as much as 64.  For Cons-4/5, the discussion should be mainly for IDLE/INACTIVE/OOC UEs as for CONNECTED UE, anyway the UE can rely on proper network configuration, and we may not need any option for enhancement at all.  For Cons-6, not see the need to involve other WGs, as we understand this is only affecting RRC/SDAP spec. |
| CATT | Cons-2/Cons-4 with comment | For option-1, the inter-operability issue in Cons-2 is objectively existing, as long as there’s already been Rel-16/17 NW/UE implementation supporting NR SL via the legacy understanding (e.g. only one SLRB can be configured serving all the mapped flows). To avoid this inter-operability issue, Rel-18 UEs have to implement two ways of SLRB configuration, one fitting Rel-16/17 legacy way (when served by Rel-16/17 NW including only legacy SLRB config in SIB), the other fitting Rel-18 new way. Rel-18 NWs also have to implement two sets of SLRB configuration, one set fitting the Rel-16/17 UEs in its coverage, the other set serving the new Rel-18 UE supporting SL CA (only visible to Rel-18 UEs).  Also, towards Cons-4, we do not accept to change any CONNECTED UE behavior. |
| Nokia |  | Cons-1: SL-RadioBearerConfig includes SL DRB configuration index, i.e., slrb-Uu-ConfigIndex, and sl-SDAP-Config in SL RB configuration indicates how to map SL QoS flows to SL DRB by using this SL DRB configuration. Thus, creating more than one SL RBs by using single SL RB configuration is considered already allowed behaviour than a violation.  Cons-2: Does this mean inter-operatbility between legacy UE and R18 UE? For UC, we don’t see any problem because TX UE will anyway configure the SL RB via PC5-RRC for RX UE. Even for BC/GC, there is no problem because the receiving UE will know that different RBs are established when receiving the very first packet using an LCID.  Cons-3: It is unlikely that every QoS flow is mapped to different carriers and needs to mapped to different SL RBs. If it is a problem in RRC\_IDLE/INACTIVE and OoC, the same problem would occur in RRC\_CONNECTED as the gNB will configure different SL RB for QoS flows mapped to different carriers.  Cons-4: In RRC\_CONNECTED, option 1 means that gNB configures the SL RB properly based on the QoS flow to carrier mapping reported via SUI message and the UE just follows it.  Cons-5: It is true but hard to understand what the real problem is there. |
| Ericsson | cons 1,2,3,4,5,6 | The discussion should be limited to UE in RRC\_IDLE/RRC\_INACTIVE and OOC. There is no enhancement/new option needed for UE in RRC CONNECTED.  For cons-2, as CATT mentioned there is indeed inter-operability issue, such issue would affect NW implementation. In our view, such impact to the NW implementation shall be absolutely avoided. |
| InterDigital | Mostly specification impact and change of bearer modelling | On Cons1 – we don’t think NW configuration is ignored. If multiple bearers are created mapping the same QoS flows to those two bearers, we are leaving it upto UE (based on carrier restriction) to decide which flows end up to which bearer. So the bearer configuration and SDAP configuration is now interpreted as the allowed QoS flows and not the required QoS flows.  We think all other Cons stem from the assumption that the SDAP configuration is a “required” configuration. So although there is some change in the modelling of the bearer, and we think this needs to be clarified in the specification, nothing is really broken. Option 1 therefore seems to have the biggest specification impact, which is the main drawback. |
| Qualcomm | Mostly spec impact. | Also share Huawei’s view |
| Lenovo | Cons-1/Cons-2/Cons-4/Cons-5/Cons-6 | sl-MappedQoS-Flows-r16 CHOICE {  sl-MappedQoS-FlowsList-r16 SEQUENCE (SIZE (1..maxNrofSL-QFIs-r16)) OF SL-QoS-Profile-r16,  For above SDAP configuration for IDLE/INACTIVE/OOC UEs, our understanding is that all those QoS flows, within the listed QoS profile, are mapped to the same SL-DRB. For example, there are QoS flow 1 with QoS profile 1, and QoS flow 2 with QoS profile 2, and QoS profile 1/2 are in the configured list sl-MappedQoS-FlowsList, then QoS flow 1 and flow 2 should be mapped to the same SL-DRB according to such SDAP configuration. Otherwise if UE copy the configuration and QoS flow 1 mapped to the SL-DRB1, but QoS flow 2 mapped to the SL-DRB2, this will cause for specific SLRB, there only has one mapped QoS profile which is different as configured in SDAP configuration. We see such kind of UE implementation is different as the NW configuration. We think this is the most severe problem of such option. |

During 123bis, some draft TP is being circulated, to show the potential impact to R2 spec, which is attached in the Annex-1.

But good to re-evaluate it based on the Pros/Cons analysis above.

**Q1-2: Do you agree that the main impact to R2 spec is as shown in Annex-1? If no, please clarify the missing part.**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | Yes with comment | We are wondering if we need to have normative text change if option 1 is adopted, maybe we just have a note to up to UE implementation to establish more than one RB if QoS flows are mapped to different carriers. How to determine “different” can be up to UE, e.g., not totally the same or has at least one different frequency |
| Apple | See comments | 1. For all alternatives of TP, extra MAC spec change is required to increase LCID space for SL DRB (4-19 in current MAC spec).  2. In all alternatives of TP, what is " different from the carrier frequenc(ies)" needs further to specfy whether/how partial overlapping is applied. For example, we assume 2 QoS flows are mapped to one existing SLRB with 8 carriers {f1,f2,f3,f4,f5,f6,f7,f8} usable. Then, if a new QoS flow is assocaited with 7 carriers {f1,f2,f3,f4,f5,f6,f7}, is it really necessary and efficient to establish a new SLRB just for 1 out of 8 carriers being different (i.e. for f8 only)?  3, In all alternative of TP, it is very confusing about the meaning of “carrier frequenc(ies) associated with the sidelink DRB”, which is a newly invented concept in need of further examiniation. As SLRB-ConfigIndex configued by NW does not have any frequency attached, how does one or more frequency are associated with a SLRB by an IDLE/INACTIVE UE has to be fully explained in detail (other than a NOTE). Also, a normaitve step to asosciate a SLRB to a QoS flow is mising in the TP, and how does UE use this information to generate SL-SDAP-configPC5 for PC5-RRC signaling is also missing.  4. The proposed TP seems also introduce new changes about how UE handle dedicated SLRB configurations (via SL-configDedicatedNR) in RRC\_CONNECTED state, which we think needs to be avoided. To differentation the CONNECTEd case will further complicate the spec.  5. As we mentioned in Cons-4 of Q1-2a, we think the agreed flow-to-carrier mapping report in SUI is not sufficient, and other info (e.g. UE actual SDAP mapping for one SLRB) needs to be reported to gNB, to alleviate the misalignment between gNB and UE. |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes | If companies cannot reach consensus on normative text, we think it is acceptable to use a NOTE to clarify the intended UE behavior to establish multiple SLRBs to avoid different carrier for QoS flow ids in a SLRB.  For the LCID issue, we don’t see a need to increase the space of it as commented in Q1-1b. |
| CATT | No | To address the inter-operability issue, a new set of SLRB configurations need to be introduced in SIB as non-critical extension, used exclusively by the Rel-18 UEs supporting SL CA. |
| Nokia | Yes | We may need to restrict it to RRC\_INACTIVE/IDLE and OoC. NOTE is also fine because we understand that it is already supported behaviour for R16 UE. |
| InterDigital | Yes |  |
| Qualcomm | Yes |  |
| Lenovo | See Comments | We think option 1 is a kind of UE implementation and a NOTE is sufficient. |

And then finally, it boils down to two questions, whether option-1 is feasible (**not preferred or not, but just about feasibility**), and whether there is strong objection for this option.

**Q1-3a: Is option-1 is technically feasible?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | Yes |  |
| Apple | No | The foremost meaning of “technical feasible“ is that the solution is a legitimiate design following technical design principle(s) for 3GPP communication systems. As Option 1 allows UE to ignore ASN.1 syntax and NW-configured mapping rules freely by itself, we deem Option 1 as “infeasible”. |
| LG | Yes |  |
| Huawei, HiSilicon | Yes | Details can be found in Annex-1 for SLRB addition procedure in TS 38.331. We can consider other changes if really needed although we don't think any those changes would be "show-stopper". All in all, we are of course not aiming at UE behaviour to ignore neither ASN.1 rules nor network configurations. |
| vivo | Yes | We don’t think option 1 means ‘ignoring network configurations’, but only about the sidelink UE’s behaviour based on correct understanding of network SDAP configuration. |
| CATT | See comments | At least “No” for the CONNECTED UEs. For IDLE/INACTIVE UEs, it is feasible only when the inter-operability issue is addressed. |
| Nokia | Yes | As replied above, we don’t think the specification change in Annex-1 is to violate the gNB configuration or ignore ASN.1. |
| Ericsson | No | Agree with Apple and CATT (on inter-operability issue) |
| Qualcomm | Yes |  |
| Lenovo | No | Please see our comments for Q1-1b |

**Q1-3b: Is option-1 acceptable? (i.e., if No, meaning it is unacceptable)**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | Yes |  |
| Apple | No | We think it is the most important 3GPP principle that UE shall respect and follow the network (pre)configuration. Option 1 essentially means the UE is allowed some grey area to challenge this principle. Such a design should be avoided as much as possible. |
| LG | comments | If option 3 is not acceptable, option 1 is preferred. |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |
| CATT | No for CONNECTED UEs | For IDLE/INACTIVE UEs, we can follow the majority with the prerequisite to ensure no inter-operability issue. |
| Nokia | Yes | As the scope of the email discussion already mentioned, it is only for RRC\_IDLE/INACTIVE and OoC UE. |
| Ericsson | No |  |
| InterDigital | Yes |  |
| Qualcomm | Yes |  |
| Lenovo | No | Please see our comments for Q1-1b |

## Option-2

During 123bis, there were some offline discussion on option-2, it would be good to further check the Pros/Cons of it.

**Q2-1a: What is the advantage(s) of option-2 in your view?**

**- Pros-1: Secure higher layer flow-to-carrier mapping without changing legacy SDAP behavior**

**- Pros-2: ensure every flow being delivered via the expected carrier**

**- Others**

|  |  |  |
| --- | --- | --- |
| Company | Pros | Comment |
| Apple | Pros-1 |  |
| CATT | Pros-1 |  |
| Nokia | Pros-1 |  |
| Ericsson | Pros-1 |  |
| InterDigital | Pros-1 |  |
| Qualcomm | Pros-1 |  |
| Lenovo | Pros-1 and Pros-2 | The intersection is mainly to ensure the flow is delivered via the correct carrier, especially when multiple QoS flows with different associated carriers are mapped to the same SLRB. Otherwise in this case, a QoS flow maybe delivered via the wrong carrier. |

**Q2-1b: What is the disadvantage(s) of option-2 in your view?**

**- Cons-1: the intersection operation may lead to a reduced carrier set to deliver V2X traffic**

**- Cons-2: the no-intersection issue anyway cannot be solved**

**- Others**

|  |  |  |
| --- | --- | --- |
| Company | Cons | Comment |
| Xiaomi | 1 and 2 | We still think option 2 and option 1 are handling different issues. Even with option 1, option 2 may still be needed, e.g., in the example raised above in Q1-1a. The key point is if we want to solve the no intersection issue or not, if so, option 2 can not solve it. Option 2 only works when there is intersection. |
| Apple | Cons-1 with comments | On Cons-1, we agree. However, the root cause of this cons is because flow-to-carrier mapping and SDAP configuration are from 2 different entities without sufficient coordination (i.e. flow-to-carrier mapping is from V2X layer while SDAP configuration is from gNB). Since the two mappings are not fully coordinated, this issue can't be avoided in our view. Meanwhile how much reduction depends on how difference of the allowed carriers of different QoS flowed mapped to one SLRB. Please note that current NW may obtain prior informatin on IDLE/INACTIVE/OOC UEs to determine its SIB12/preconfiguration. According to 23.502 and 29.522 (copied below), before deploying the service into UE, service vendors will send some necessary information to 5GC.   |  | | --- | | 23.502:  The AF request sent to the NEF contains the information as below:  1)- Service Description.  Service Description is the information to identify a service the Service Parameters are applied to. The Service Description in the AF request can be represented by the combination of DNN and S-NSSAI, an AF-Service-Identifier or an External Application Identifier.  2) **Service Parameters**.  Service Parameters are the service specific information which needs to be provisioned in the Network and delivered to the UE in order to support the service identified by the Service Description.  29.522:  - service parameters for at least one of the following:  1) V2X service parameters via:  a) configuration parameters for V2X communications over PC5 within the "paramOverPc5" attribute; and  b) configuration parameters for V2X communications over Uu within the "paramOverUu" attribute; |   Thus, we think NW can ensure at least paritial overlapping, and thereby the no-intersection case (i.e. Cons-2) is not expected to happen. |
| LG | Cons-1 |  |
| Huawei, HiSilicon | Cons-1 and Cons-2 | Regarding Cons-1, the UE can not obtain the benefits of SL CA for RRC\_INACTIVE/RRC\_IDLE/OOC, which degrades the communication performance in RRC\_INACTIVE/RRC\_IDLE/OOC compared to RRC\_CONNECTED.  Regarding Cons-2, the communication will get stuck as an error case, as there is no carrier can be used. The consequence of this would be at least error handling behaviour needs to be considered with even more effort and we think it as unacceptable. |
| vivo | Cons-1 and Cons-2 | Option2 seems an incomplete solution to us. It would degrade the CA performance (Cons-1) while cannot solve the problem anyway (Cons-2) so we don’t take it as a good choice. |
| CATT |  | We think, if RAN2 can make the assumption that the applicable carriers for the same PC5 QoS PROFILE are always the same (e.g. realized via proper implementation), the “no-intersection” problem can also be resolved by NW configuration in the SIB. If RAN2 can make such an assumption and conclude that it can be realized by implementation, we nform SA2 of our assumption, tasking them to confirm such implementation. Then, option-2 can be agreed. |
| Nokia | Cons-1, Cons-2 | Before going into the details, it is not clear if option 2 is A) to determine the allowed carrier(s) for a LCH based on a flow-to-carrier mapping in a static manner regardless of actual data that is available for transmission, or B) to determine the allowed carrier(s) for a LCH based on an actual data that is available for transmission.  Cons-1: Reducing usable carriers would decrease the benefit of CA in RRC\_INACTIVE/IDLE and OoC, which seems neither the intention nor the expected consequence when flow-to-carrier mapping is introduced in SA2. If option 2 is the B) of the above question, option 2 may reduce transmission opportunity unnecessarily because there may be a case that SL data is available for a subset of QoS flows that are mapped to the same carriers, in which case transmitting the data via the intersect carrier of those QoS flows would be beneficial and more aligned with SA2 intention.  Cons-2: If it is okay use any carrier or default carrier in case of no-intersection, we don’t see a point of using only the intersection carrier. It may be rather safe or easier to use union of the carriers. |
| Ericsson | Cons-1 | Agree with Apple that cons-2 is unlikely to occur. |
| InterDigital | Cons1 with comment | In general, we don’t think QoS flows with very similar QoS requirements will be mapped to different carriers. Therefore, it may be possible that Cons2 is a corner case or may possibly never happen. |
| Qualcomm | Cons1 and Cons2 | Especially for V2X use case, an emergency event may trigger many messages which need to be delivered timely with associated carriers for the service type. |
| Lenovo | Cons-1 | Agree with Apple |

During 123bis, some draft TP is being circulated, to show the potential impact to R2 spec, which is attached in the Annex-2 (including both normative text-based approach and NOTE-based approach)

But good to re-evaluate it based on the Pros/Cons analysis above.

**Q2-2: Do you agree that the main impact to R2 spec is as shown in Annex-2? If no, please clarify the missing part.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | Yes |  |
| Apple | Yes | Proponent.  We think Alternative CR1 (i.e. a NOTE) is sufficient. |
| LG | Yes |  |
| vivo | Yes with comments | According to Option-2, the TP is not clear that whether the subset of frequencies associated with all the PC5 QoS flows refers to an ‘intersection’ subset. |
| CATT | Yes | If Option-2 is agreed, the Spec impact is no more than adding another LCP restriction. But if the no-intersection case is inevitable, some clarification may be needed on intended UE behaviour when such case happens. |
| Nokia | Comment | The current changes would not allow transmission of LCH data if there is no intersection carrier.  In addition, depending on further details of option 2. If the determination of the allowed carrier(s) for a LCH is based on the actual SL data that is available for transmission, it may need to be specified further how the MAC entity knows which QoS flows are mapped to a certain LCH, e.g., by looking into the SDAP header. |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
| Qualcomm | Yes |  |
| Lenovo | Yes |  |

And then finally, it boils down to two questions, whether option-2 is feasible (**not preferred or not, but just about feasibility**), and whether there is strong objection for this option.

**Q2-3a: Is option-2 is technically feasible?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | It depends | If the targeted scenario is QoS flows assocated to the same RB having some intersection, then it is feasible; while for the no intersection case, it is not feasible. |
| Apple | Yes | Proponent. |
| LG | comments | Agree with Xiaomi |
| vivo |  | Agree with Xiaomi |
| CATT | Comments | We think if we can make the assumption as we showed in Q2-1b, it is feasible. Otherwise, it depends on how people regard the “no-intersection” case – whether prohibiting related SLRB transmission in this case is seen as a showstopper for this option. |
| Nokia | No | Feasibility would mean that at least there is no hole of an operation. Considering Cons-2, we are not sure whether it is feasible, i.e., always work. |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
| Qualcomm | NO |  |
| Lenovo | Yes |  |

**Q2-3b: Is option-2 acceptable? (i.e., if No, meaning it is unacceptable)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | It depends | See reply above. |
| Apple | Yes | Proponent. |
| vivo | No | As it cannot solve the problem anyway (Cons-2) |
| CATT |  | We want to see first how people are supposed to deal with the “no intersection” case, if it is inevitable. |
| Ericsson | Yes |  |
| InterDigital | Yes | We think the “no intersection case” may not happen in practice and it would be easier to specify option 2. However, if companies can show that the no intersection case is possible, then it may be safer to go with option 1. |
| Qualcomm | NO |  |
| Lenovo | Yes |  |

## Option-3

If R2 cannot converge on either option-1 or option-2, option-3 is result automatically, but then it would be good to align the understanding in case of option-3.

**Q3-1: In case of option-3, do you agree to conclude that**

**- Option-1: R2 not pursue further optimization to enforce flow-to-carrier mapping, for RRC\_IDLE/RRC\_INACTIVE/OOC scenarios, and the case where there are multiple QoS flows mapped to a same SLRB**

**- Others**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | Yes | If we can not reach consensus, we are fine to not solve this and leave to UE implementation. |
| Apple | Yes with clarification | As mentioned in Q1-3b, we have strong concern on option 1. It essentially means the UE is allowed some grey area to challenge the most important 3GPP principle. Such grey area should not be allowed. Thus, option 1 is not acceptable to us.  If RAN2 can't converge on option-1 vs option-2, we think it is much more important to keep the 3GPP principle than making SL CA work. Thus, we prefer to clealy conclude that **RAN2 do not enforce flow-to-cairrier mapping in AS layer in Rel-18, and notify SA2 this conclusion and potential impacts for SL unicast CA support in Rel-18.** |
| LG | Yes with comments | In fact, the background for these options (option 1 and option 2) was the assumption that QoS flow was not visible at the MAC layer.  But this assumption is wrong.  In R17 SL DRX, RAN2 introduced an operation in which the MAC entity selects the SL DRX configuration for each QoS profile in GC/BC.  If QoS flow is not visible in MAC, this GC/BC SL DRX operation must be redesigned.  Therefore, under the assumption that the QoS flow is visible in the MAC, correct allowed carrier decision of the RRC Connected/Idle/Inactive/OoC UE can be guaranteed without modifying the text of the current running CR.  Howerver, if RAN2 prefers allowed carrier decision based on SLRB configuration of dedicated RRC/SIB/Preconfiguraiton, RRC connected/Idle/Inactive/OoC UE can rely on SLRB configuration of network / pre-configuration. However, in the case of an RRC idle/inactive/OoC UE, if there is no carrier mapped to the QoS flow in the default SLRB configuration, as first mentioned, UE can simply determines the carrier mapped to the QoS flow indicated from the V2X layer as an allowed carrier. (because the QoS flow is visible in the MAC layer.).  Therefore, the text of current running CR can cover all these cases without any modification. However, if we slightly update the sentence to suit the QoS flow-based modeling introduced in NR, we can modify it as follows.  In case of NR sidelink on multiple carrier frequencies, only consider QoS flow associated with sidelink logical channels which meet the following conditions and only consider one sidelink logical channel among sidelink logical channels corresponding to same PDCP entity, if duplication is activated as specified in TS 38.323 [4];  - allowed on the carrier where the SCI is transmitted for NR sidelink, if the carrier is configured by upper layers according to TS 38.331 [5] and TS 23.287 [19];  - having a priority whose associated [*sl-threshCBR-FreqReselection*] is no lower than the CBR of the carrier when the carrier is (re-)selected in accordance with 5.22.1.11.  I think the above-modified text can cover both option 1 and option 2.  Any other correction is not needed.  [Rapp] I can understand this change can be interpreted as a way to implement option-2. But for option-1, seems the change to RRC spec is evitable? And it would be clearer to me if we see this approach as one way of option-2 (or option-1 if clarified), instead of option-3 (which means neither option-1 nor option-2 is adopted). |
| Huawei, HiSilicon | No | The problems is not solved, which is unacceptable as RAN2 simply ignores SA2 approach of flow to carrier mapping.  [Rapp] Well, please note that this question was asked for the case that “If R2 cannot converge on either option-1 or option-2”, rather than “RAN2 simply ignore”. |
| vivo | No with comments | Agree with Huawei. We are also skeptical that the current spec can already support this flow to carrier mapping, as the carrier selection and QoS handling (including flow-to-DRB mapping) are independently designed.  The risk should be carefully considered e.g. If option-3 is the final result and we inform SA2 ‘**R2 not pursue further optimization to enforce flow-to-carrier mapping**’, what if they have strong concerns and tell us it is not acceptable from their perspective?  So, we understand even if we go option-3, we should still have the plan B (option 1 or 2) in case SA2 cannot live with option 3.  [Rapp] Well, I do not quite understand the comment “tell us it is not acceptable”, since that if R2 cannot converge on a solution (as replied to Huawei above), this would be the result automatically. |
| CATT |  | We assume that if this issue cannot be addressed, it means flow-to-carrier mapping cannot be supported in AS by Rel-18 NR SL communication, and the V2X layer can only implement DST-to-carrier mapping (i.e. all flows sharing same sets of carriers). This is the worst case. |
| Nokia | Comments | Not sure about LG’s comment. Our understanding is that SL DRX is mapped to QoS profile, i.e., not for QoS flow itself. Option 3 means that flow-to-carrier mapping is not supported only for RRC\_INACTIVE/IDLE and OoO cases. For RRC\_CONNECTED, it is still possible by the gNB implementation that different SL RBs are established for the QoS flows mapped to different carriers. |
| Ericsson | Yes |  |
| InterDigital | No | We don’t think it is acceptable to ignore a requirement from SA2. |
| Qualcomm | Yes w. comment | If option is not agreed. |
| Lenovo | Yes | If we cannot reach consensus, we are fine to not solve this and leave to UE implementation. But as other company comments, we understand this option cannot guarantee QoS flow delivered via the correct carrier as V2X layer indication, which should be informed to SA2 |

## Others

**Q4: Do you agree to notify SA2 on the R2 conclusion for this issue?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Xiaomi | See comments | We are wondering if the QoS flow to carrier mapping only applies to UC or BC/GC as well, according to the existing running CR, it is not clarified that UE only reports this mapping for UC, so we think this aspect should be further checked with SA2. |
| Apple | Yes |  |
| LG | Yes |  |
| vivo | Yes with comments | Regarding Xiaomi’s comment, we are supportive to ask SA2 if the the flow-to-carrier mapping is also applicable to GC/BC since their answer may have further impact on the RRC running CR.  Moreover, we are also ok to notify R2 decisions on how to implement the flow-to-carrier mapping, with assumption that there is no further action to SA2 on the R2 conclusion for this issue. |
| CATT | Yes | Especially when RAN2 cannot support such fine granularity of per flow applicable carriers, SA2 needs to be informed that their conclusion is technically infeasible from AS perspective. |
| Nokia | Yes | Our understanding is that QoS flow to carrier mapping is also applied to BC/GC (internal check).  We agree that SA2 need to be informed of RAN2 conclusion. |
| Ericsson | Yes |  |
| InterDigital | Yes with comments | We think the only thing needed is ask whether the flow to carrier mapping is appliable to BC/GC. However, there is no need to indicate which method (option 1 or option 2) is selected, since this is in RAN2 scope. |
| Qualcomm | Yes with comment | If option 3 is agreed |
| Lenovo | Yes |  |

1. Xxx.

# Conclusion

We have the following proposals:

[Proposal 1 Xxx.](#_Toc148446647)

# Annex-1: TP for Option-1

alternative CR0

5.8.9.1a.2.1 Sidelink DRB addition/modification conditions

For NR sidelink communication, a sidelink DRB addition is initiated only in the following cases:

1> if any sidelink QoS flow is (re)configured by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* and is to be mapped to one sidelink DRB*,* which is not established, or is established but associated with different allowed frequenc(ies); or

1> if any sidelink QoS flow is (re)configured by *RRCReconfigurationSidelink* and isto be mapped to a sidelink DRB, which is not established;

For NR sidelink communication, a sidelink DRB modification is initiated only in the following cases:

1> if any of the sidelink DRB related parameters is changed by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* or *RRCReconfigurationSidelink* for one sidelink DRB*,* which is established;

alternative CR1

5.8.9.1a.2.1 Sidelink DRB addition/modification conditions

For NR sidelink communication, a sidelink DRB addition is initiated only in the following cases:

1> if any sidelink QoS flow is (re)configured by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* and is to be mapped to one sidelink DRB*,* which is not established; or

1. if any sidelink QoS flow is (re)configured by *RRCReconfigurationSidelink* and isto be mapped to a sidelink DRB, which is not established; or
2. if any sidelink QoS flow is (re)configured by sl-ConfigDedicatedNR, SIB12, SidelinkPreconfigNR and is to be mapped to a sidelink DRB, which is established and the carrier frequenci(es) associated with the sidelink QoS flow are different from the carrier frequenc(ies) associated with the sidelink DRB; or
3. if any sidelink QoS flow is (re)configured by RRCReconfigurationSidelink and is to be mapped to a sidelink DRB, which is is established and the carrier frequenc(ies) associated with the sidelink QoS flow are different from the carrier frequenc(ies) associated with the sidelink DRB;
4. NOTE: The carrier frequenc(ies) associated with the sidelink DRB are the carrier frequenc(ies) of QoS flow mapped to the sidelink DRB.

For NR sidelink communication, a sidelink DRB modification is initiated only in the following cases:

1> if any of the sidelink DRB related parameters is changed by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* or *RRCReconfigurationSidelink* for one sidelink DRB*,* which is established;

alternative CR2

5.8.9.1a.2.1 Sidelink DRB addition/modification conditions

UE shall establish different sidelink DRB for different QoS flow associated with different carrier frequenc(ies) among multiple QoS flows, if the multiple sidelink QoS flows are configured to one sidelink DRB configuration.

For NR sidelink communication, a sidelink DRB addition is initiated only in the following cases:

1> if any sidelink QoS flow is (re)configured by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* and is to be mapped to one sidelink DRB*,* which is not established; or

1. if any sidelink QoS flow is (re)configured by *RRCReconfigurationSidelink* and isto be mapped to a sidelink DRB, which is not established;

For NR sidelink communication, a sidelink DRB modification is initiated only in the following cases:

1> if any of the sidelink DRB related parameters is changed by *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR* or *RRCReconfigurationSidelink* for one sidelink DRB*,* which is established;

# Annex-2: TP for Option-2

alternative CR0

5.22.1.4.1.2 Selection of logical channels

<Text Removed>

- allowed on the carrier where the SCI is transmitted for NR sidelink, if the carrier is configured by upper layers according to TS 38.331 [5] and TS 23.287 [19];

- a LCH is allowed in a carrier based on whether this selected carrier is within a subset of frequencies associated with all the PC5 QoS flows allowed to be mapped to this LCH based on RRC configuration.

- having a priority whose associated [*sl-threshCBR-FreqReselection*] is no lower than the CBR of the carrier when the carrier is (re-)selected in accordance with 5.22.1.11.

alternative CR1

5.22.1.4.1.2 Selection of logical channels

<Text Removed>

- allowed on the carrier where the SCI is transmitted for NR sidelink, if the carrier is configured by upper layers according to TS 38.331 [5] and TS 23.287 [19];

NOTE: A LCH is allowed in a carrier based on whether this selected carrier is within a subset of frequencies associated with all the PC5 QoS flows allowed to be mapped to this LCH based on RRC configuration.

- having a priority whose associated [*sl-threshCBR-FreqReselection*] is no lower than the CBR of the carrier when the carrier is (re-)selected in accordance with 5.22.1.11.