**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**

**- Others**

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| --- | --- | --- |
| 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 2But 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 |  |
|  |  |  |

**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 | Pros | 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. |
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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. |
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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 |  |
|  |  |  |

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

|  |  |  |
| --- | --- | --- |
| 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. |
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## 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**

**- Others**

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| --- | --- | --- |
| Company | Pros | Comment |
| Apple | Pros-1 |  |
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**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 | Pros | 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; andb) 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 |  |
|  |  |  |
|  |  |  |

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 |  |
|  |  |  |

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 |
|  |  |  |

**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.  |
|  |  |  |
|  |  |  |

## 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 puruse 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. |
|  |  |  |

## 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 |  |
|  |  |  |

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.