3GPP TSG RAN WG1 #101 R1-2004663

**e-Meeting, May 25th – June 5th, 2020**

**Source: Moderator (Nokia)**

**Title: Summary#1 for AI 7.2.4.6 QoS management**

**Agenda item: 7.2.4.6**

**Document for: Discussion and Decision**

# Introduction

In this contribution we summarize the remaining issues raised in contributions in NR V2X QoS Management (agenda item 7.2.4.6).

# Candidate issues for email discussion

Email thread budget: Up to 2

The following issues were addressed in the contributions reviewed in preparing this document:

Issue 1.2: CR – treatment of resources reserved, but not used due to HARQ feedback and/or pre-emption

Issue 1.3: Semi-persistent resource reservation disabled by congestion control

Issue 1.4: CBR reporting in cross-RAT scenarios

Issue 1.5: CBR-based sidelink power control in mode 1

Issue 3.1: QoS-based Resource Pool Segregation/Prioritization

Feature lead recommendation:

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| Issue 1.2: CR – treatment of resources reserved, but not used due to HARQ feedback and/or pre-emption | Email discussion |
| Issue 1.5: CBR-based power control in mode 1 | Only 2 companies expressed views on this. Do other companies think that the intention of the spec is clear? If so, what is your interpretation? |

Company input on the identification of email discussion topics:

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| **Company** | **Prioritized issues** | **Comments (e.g. do you think that issue 1.5 is clear in TS 38.213?)** |
| Nokia, NSB | Thread#1: 1.2Thread#2: 1.5 | No need to discuss 1.5 next week if a common understanding emerges this week |
| vivo | Thread#1: 1.2 | Agree with FL’s proposal on Thread#1.For issue 1.5, the current RRC spec is clear that CBR based power control is not allowed in mode-1: the SL-CBR configuration (for TX power restriction) can only be configured for mode-2 in RRC.For other issues, issue 1.4 and 3.1 should be discussed in RAN2. No need to discuss issue 1.3. |
| ZTE, Sanechips | Thread#1: 1.2Thread#2: 1.5 | Agree with FL’s proposals.For issue 1.5, we think it can be left to RAN2 to determine whether the maximumtransmitPower-SL to be provided to mode 2 only or both mode 1 and mode 2. To clarify the description in 38.213, we are also okay to discuss it in email. |
|  Apple | Thread#1: 1.2Thread#2: 1.5 | For Issue 1.5, depending on discussion outcome, a TP for TS38.213 may be needed for clarification. |
| Samsung | Thread#1: 1.2 | For issue 1.5, we have the same understanding with vivo. In RRC, *maximumtransmitPower-SL* is available only in Mode2 (*SL-UE-SelectedConfig-r16*) and thus CBR-based sidelink power control in mode 1 is not supported. |
| OPPO | Thread#1: 1.2 | For issue 1.5, we tend to share the same view as vivo and Samsung. It is  |
| CATT | Thread#1: 1.2Thread#2: 1.5 | Agree FL’s proposal |
| Ericsson | Thread#1: 1.2 | In our view, there is no need to discuss Issue 1.5 |
| Huawei/HiSilicon | None | Issue 1.2: As explained in our Tdoc R1-2003499, we think the current spec is clear and technically reasonable, so no spec change is needed and no need to discuss this issue.Issue 1.5: We share similar view with vivo/Samsung/etc. According the running CR of TS 38.331 (R2-2004072), *sl-MaxTxPower* is available only in Mode2 (*SL-UE-SelectedConfig-r16*). No more discuss is needed.Issue 1.3: not essential |
| Futurewei | Thread#1: 1.2 | We do not see the need to discuss 1.5 |
| LG Electronics | None | From our perspective, it seems that Issue 1.2 is not critical one in terms of specification completion. For Issue 1.5, in case of LTE V2X, we think that CBR based SL power control was applied only to Mode 4 since the relevant power control equation is specified only for Mode 4 in TS 36.213. In this sense, Issue 1.5 doesn’t seem to be critical one. |
| Intel | ED1: 1.2 | We think clarification on 1.2 as discussed in the summary from FL is desirable. Otherwise multiple interpretations may exist.  |
| Bosch | Thread#1: 1.2Thread#2: 1.3 (see comments) | We also agree with the FL proposal 1.2Issue 1.3: for most of V2X applications, we see the benefit for periodic resource reservation. However, it is not clear how a UE can re-evaluate a previously selected period or select a new period if congestion happens. In our understanding, when congestion increases, with SPS reservation enabled, a higher chance of half-duplex problem and consecutive collisions appears. Hence, specifying periods restriction or disabling SPS for some CBR values may be beneficial.  |

# Issues

Note: Issue numbering is the same as in the previous meeting, hence gaps in numbering appear for issues which have been settled.

## Topic 1: Sidelink Congestion Control

### Issue 1.2: CR – treatment of resources reserved, but not used due to HARQ feedback and/or pre-emption

#### Background

One remaining issue is how resources which have been reserved but have not been used or will not be used due to HARQ feedback or have been pre-empted should be counted in channel occupancy ratio (CR).

This aspect is not directly covered by the existing agreements that LTE CR is the baseline, since the LTE sidelink does not support HARQ feedback or pre-emption.

The current CR definition in TS 38.215 counts resources “used for … transmissions in slots [n-a, n-1] and granted in slots [n, n+b]”. Hence, for the past segment of the evaluation window, slots [n-a, n-1], it is clear that resources which have been reserved but released or pre-empted are not counted, since they have not been used for transmission.

For the future segment of the evaluation window, slots [n, n+b], the current definition counts all the resources **granted** for transmissions. So the first question to answer is what, in the presence of the new features of HARQ feedback and pre-emption, the meaning of “granted” is. The grant here is the “configured sidelink grant” defined in TS 38.321.

##### Pre-emption

For the case of pre-emption, [Huawei, HiSilicon] point out that according to TS 38.321 the pre-empted UE clears the grant when it detects pre-emption:

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| *(copied from TS 38.321)*5.22.1.2 TX resource (re-)selection check…1> if a sidelink transmission is scheduled by any received SCI indicating a higher priority than the prority of the logical channel and expected to overlap with a resource of the configured sidelink grant, and a measured result on SL-RSRP associated with the sidelink transmission is higher than [threshold]:2> clear the configured sidelink grant associated to the Sidelink process, if available;2> trigger the TX resource (re-)selection. |

Hence it seems clear that future pre-empted resources are not counted in CR evaluation.

##### Release of resources due to HARQ feedback

For this case RAN1 have agreed that usage of HARQ feedback for release of unused resource(s) is supported:

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| Agreements**:*** NR V2X Mode-2 supports resource reservation for feedback-based PSSCH retransmissions by signaling associated with a prior transmission of the same TB
	+ FFS impact on subsequent sensing and resource selection procedures
	+ At least from the transmitter perspective of this TB, usage of HARQ feedback for release of unused resource(s) is supported
		- No additional signaling is defined for the purpose of release of unused resources by the transmitting UE
		- FFS the behavior of the receiver UE(s) of this TB and other UEs
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There are two points of view on this issue:

On the one hand, one can argue that, for the future segment of the evaluation window, CR is supposed to capture the expected resource occupancy as closely as possible. From that point of view, resources which the UE knows will not be occupied, should not be counted as occupied. Moreover, the term “release” could imply that the released unused resource(s) should not be considered part of the configured sidelink grant.

On the other hand, it can be argued that an incentive against excessive resource reservation is beneficial; e.g. in the case of HARQ feedback, if for a unicast link the initial TX of a TB is almost always successful, but the UE always reserves 2 retransmissions then one can argue that the UE is “greedy” and should be penalized by counting the reserved, but almost always unused, resources in CR.

#### Views expressed in contributions

Should future resources which have been released due to HARQ feedback be counted in the evaluation of CR?

Yes: [Nokia, NSB], [vivo], [Huawei, HiSilicon], [LGE], [OPPO]

No: [ZTE, Sanechips], [CATT], [Apple], [InterDigital], [Ericsson]

Up to UE implementation: [Samsung] – this, in my reading, goes further than the other proposals and gives the UE the freedom to assume that all future retransmission resources will be released and hence do not need to be counted in CR.

#### Feature lead view

Should be discussed to finalize the specification.

### Issue 1.3: Semi-persistent resource reservation disabled by congestion control

#### Views expressed in contributions

[InterDigital] propose that congestion control can disable semi-persistent resource reservation. This is opposed by [ZTE], [CATT].

#### Feature lead view

Not critical. No evaluation results demonstrating benefit.

### Issue 1.4: CBR reporting in cross-RAT scenarios

#### Views expressed in contributions

[OPPO] proposed support for reporting NR sidelink CBR of Type 1 CG resources to the eNB.

[ZTE, Sanechips] proposed support for reporting LTE sidelink CBR to the gNB for RRC\_CONNECTED UEs.

#### Feature lead view

Measurement reporting is a RAN2 topic, this can be discussed by RAN2.

### Issue 1.5: CBR-based sidelink power control in mode 1

#### Background

For the LTE V2X sidelink, CBR-based sidelink power control was only applied in resource allocation mode 3. The current specification in TS 38.213 on the other hand appears to apply CBR-based sidelink power control regardless of resource allocation mode:

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| $P\_{PSSCH}(i)=min\left(P\_{CMAX},P\_{MAX,CBR},min\left(P\_{PSSCH,D}\left(i\right),P\_{PSSCH,SL}(i)\right)\right)$ [dBm]where- $P\_{CMAX}$ is defined in [8-1, TS 38.101-1]- $P\_{MAX,CBR}$ is determined by a value of *maximumtransmitPower-SL* based on a priority level of the PSSCH transmission and a CBR range that includes a CBR measured in slot $i-N$ [6, TS 38.214]; if *maximumtransmitPower-SL* is not provided, $P\_{MAX,CBR}=0$  |

Above I wrote that this **appears** to apply CBR-based sidelink power control regardless of resource allocation mode: It is not immediately obvious if the intention is that

* CBR-based sidelink power control can actually be applied in mode 1; or
* for mode 1 the parameter *maximumtransmitPower-SL* cannot be provided, hence CBR-based sidelink power control in mode 1 is actually not supported.

#### Views expressed in contributions

[Nokia, NSB] propose to make an explicit agreement that CBR-based power control can be applied in both resource allocation modes.

[Apple] propose that $P\_{MAX,CBR} $be set to infinity for mode 1.

#### Feature lead view

It would be useful to check if there is a common understanding of the intention. If RAN1 does not address this then the decision is de facto up to RAN2 – if *maximumtransmitPower-SL* can be provided to a mode 1 UE then CBR-based sidelink power control is supported in mode 1.

## Topic 3: QoS

### Issue 3.1: QoS-based Resource Pool Segregation/Prioritization

#### Background

R12 ProSe sidelink supported resource segregation based on QoS by associating a priority list with each transmit resource pool (priority-based resource pool selection). No such mechanism was defined for the LTE V2X sidelink, the LTE V2X sidelink was designed to support transmission of all QoS levels in the same resource pool and it defined mechanisms to take QoS into account for procedures such as resource selection and congestion control. For the LTE V2X sidelink there is no AS mechanism to map a QoS level to specific resource pools. However, there is a higher layer configuration mechanism which allows mapping a service to specific carrier frequencies (TS 24.385); so, if e.g. a service has stringent QoS requirements then that higher layer mechanism allows mapping that service to one or more specific carriers.

#### Views expressed in contributions

In the current meeting, this topic was addressed in one contribution:

* [InterDigital]: A resource pool can be configured with an allowed QoS for the data that can be transmitted using that resource pool

#### Feature lead view

Resource pool selection is a RAN2 topic, this can be discussed by RAN2.

# References

1. RP-200129, “Revised WID: 5G V2X with NR sidelink”
2. TR 37.885, Study on evaluation methodology of new Vehicle-to-Everything V2X use cases for LTE and NR
3. TR 38.885, Study on NR Vehicle-to-Everything (V2X)

Background

WI Objectives

At RAN#83, a new work item “5G V2X with NR sidelink” (5G\_V2X\_NRSL) was approved ‎[1]. Two of the objectives are relevant for the present agenda item:

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| 1. NR sidelink: Specify NR sidelink solutions necessary to support sidelink unicast, sidelink groupcast, and sidelink broadcast for V2X services, considering in-network coverage, out-of-network coverage, and partial network coverage.* …
* Congestion control [RAN1, RAN2]

4. Specify support for QoS management [RAN2, RAN3, RAN1] |

Earlier Agreements

The following relevant agreements have been reached in previous meetings:

QoS

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| Agreements:From RAN1 perspective, at least the following QoS-related parameters relevant to physical layer studies are considered: * Priority
* latency
* reliability
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| Agreements:RAN1 studies further how to use * priority,
* latency,
* reliability,
* minimum required communication range (as defined by higher layers) if agreed to use

in the physical layer aspects of at least * resource allocation and
* congestion control and
* resolution of in-device coexistence issues and
* power control
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In the Sidelink resource allocation mode 2 agenda item, the following working assumption was reached:

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| Working assumption:* An indication of a priority of a sidelink transmission is carried by SCI payload
	+ This indication is used for sensing and resource (re)selection procedures
	+ This priority is not necessarily the higher layer priority
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| Agreements:* For the priority indication in 1st stage SCI:
	+ Up to RAN2 on how to define the mapping between the priority indication and the corresponding QoS
	+ Size is 3 bits (as a working assumption)
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Sidelink Congestion Control

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| Agreements:* Introduce at least one congestion metric for NR sidelink
	+ FFS details – to be done in WI phase (if included)
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| Agreements:* Congestion control is supported at least for sidelink mode 2
	+ Note: details of congestion control can be covered in the work item phase, not in this SI.
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| **Conclusion**:* It is deemed beneficial to report Sidelink Congestion Metrics(s) to a gNB
	+ Consequently, it is recommended to specify the corresponding details in the WI phase
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| Agreements:Support at least NR CBR as congestion metric for NR sidelink congestion control. * LTE CBR is the baseline for defining NR CBR.
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| Agreements:* LTE V2X sidelink congestion control is the starting point for defining NR sidelink congestion control.
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| Agreements:* Higher-layer reporting of CBR to the gNB is supported for RRC\_CONNECTED UEs.
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| Agreements:* For PSCCH/PSSCH multiplexing option 3, one CBR measurement over a resource pool is defined.
	+ PSFCH resources, if (pre)configured, are excluded from this CBR measurement.
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| Agreements:Define NR sidelink Channel Occupancy Ratio (CR) measurement.* LTE CR is the baselines
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| Agreements:* Congestion control can restrict the values of at least the following PSSCH/PSCCH TX parameters per resource pool:
	+ Range of MCS for a given MCS table supported within the resource pool
	+ Range of number of sub-channels
	+ Upper bound of number of (re)transmissions – already agreed in mode 2 AI
	+ Upper bound of TX power (including zero TX power)
* Congestion control can set an upper bound on channel occupancy ratio (CR), CRlimit.
* Ranges/bounds of the transmission parameters and CRlimit are functions of QoS and CBR.
* In addition to congestion control (in use or not in use), the above parameters can be restricted by reusing the same mechanism as in LTE
	+ For speed, further discussion on absolute vs. relative speed
	+ FFS other parameter(s) that can be restricted
	+ FFS whether or not to tie the speed with a UE capability
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| Agreements:Lookup table links CBR range with values of the transmission parameters and CRlimit for each value of the indication of a priority of a sidelink transmission carried by SCI payload (as per WA from RAN1#98), Lookup table is (pre)configured. Details up to RAN2. * Up to 16 (as a working assumption) CBR ranges are supported
	+ The working assumption will be automatically confirmed in RAN1#99 if no further input
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| Agreements:* Sidelink RSSI (SL-RSSI) measurement is used for CBR estimation
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| Agreements:A sidelink resource is busy for the purpose of CBR measurement if Sidelink RSSI measured by the UE in that resource exceeds a (pre-)configured threshold. |

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| Agreements:The CBR measurement time window size is 100 ms and 100 slots by (pre-)configuration.CR window size is { 1000 ms, 1000 slots } by (pre)-configuration |

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| Agreement:* The future segment of the CR evaluation window reuses the same behaviour as in the LTE V2X sidelink.
	+ FFS whether additional constraints on UE’s choice of values for a and b are needed
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| Agreement: For the constraints on past/future window in CR evaluation:1. n+b shall not exceed the last transmission opportunity of the grant for the current transmission
2. b >= 0
3. b < (a+b+1)/2

 Notes:* in the first bullet point above, LTE’s “should” has been replaced by “shall”
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| Agreement:* UE evaluates CR and applies CR\_limit for every (re)transmission.
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| Agreement: * The CBR processing time is given by UE capability according to the following table

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| **µ**  | Congestion process time 1 (slots) | Congestion processing time 2 (slots) |
| 0 | 2 | 2 |
| 1 | 2 | 4 |
| 2 | 4 | 8 |
| 3 | 8 | 16 |

* A UE shall only apply a single CBR/CR processing time capability in SL.
* CR processing time is the same as CBR processing time.
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| Agreement:* The slot index in the definition of CBR is the physical slot index.

Agreement:* The slot index in the definition of CR is the physical slot index.
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TX Parameter Restrictions

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| Agreements:* Only TX parameter restriction based on absolute speed can be (pre)configured in Rel-16.
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| Agreement:* In addition to congestion control (in use or not in use), the following PSSCH/PSCCH TX parameters per resource pool can be restricted by reusing the same mechanism as in LTE:
	+ Range of MCS for a given MCS table supported within the resource pool
	+ Range of number of sub-channels
	+ Upper bound of number of (re)transmissions

Note: This reverts the agreement made in RAN1#98b, which included “Upper bound of TX power” in the set of TX parameters that can be restricted using this mechanism. |

Appendix: Contributions used as basis for the summary

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| [R1-2003314](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003314.zip) | Remaining details of QoS management for sidelink | Nokia, Nokia Shanghai Bell |
| [R1-2003384](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003384.zip) | Remaining issues on QoS management for sidelink | vivo |
| [R1-2003499](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003499.zip) | Remaining details of QoS management for NR sidelink | Huawei, HiSilicon |
| [R1-2003553](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003553.zip) | Remaining issues on QoS | ZTE, Sanechips |
| [R1-2003567](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003567.zip) | Discussion on QoS management for NR sidelink | LG Electronics |
| [R1-2003619](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003619.zip) | Remaining issues on QoS management in NR V2X | CATT |
| [R1-2003878](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003878.zip) | On QoS Management for NR Sidelink | Samsung |
| [R1-2004077](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004077.zip) | Remaining open issues on QoS | OPPO |
| [R1-2004220](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004220.zip) | Remaining Issues of Sidelink QoS Management | Apple |
| [R1-2004297](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004297.zip) | Remaining Issues on Congestion control and QoS Management for NR-V2X | InterDigital, Inc. |
| [R1-2004549](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004549.zip) | QoS management for NR sidelink | Ericsson |
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R1-2003314 Nokia, Nokia Shanghai Bell

**Proposal 1: CBR-based power control is applied in both resource allocation modes.**

**Proposal 2: For CR evaluation, past resources which had been reserved, but then released due to HARQ feedback or pre-empted, are not counted.**

**Proposal 3: For CR evaluation, do not amend the specification to support that future resources which had been reserved, but then released due to HARQ feedback or pre-empted, are not counted.**

R1-2003384 vivo

***Proposal 1: The reserved but not used* *resources are still counted for CR evaluation, i.e., further enhancement for* *CR evaluation is not needed.***

R1-2003499 Huawei, HiSilicon

**Observation 1: For the past segment of the evaluation window, i.e., slots [n-a, n-1], the current definition of CR does not count resources which are reserved but not used due to HARQ feedback** **or pre-emption.**

Note: No text proposal is needed since the behavior in Observation 1 has already been specified in TS 38.215.

**Observation 2: For the future segment of the evaluation window, i.e., slots [n, n+b], resources which have been reserved by an SCI transmission but released due to HARQ feedback are, in the existing definition of CR, counted among the “granted” resources in the future segment.**

Note: No text proposal is needed since the behavior in Observation 2 has already been specified in TS 38.215.

**Observation 3: For the future segment of the evaluation window, i.e., slots [n, n+b], resources which have been reserved by an SCI transmission but not used due to pre-emption** **are, in the existing definition of CR, not counted among the “granted” resources in the future segment.**

Note: No text proposal is needed since the behavior in Observation 3 has already been specified in TS 38.215.

R1-2003553 ZTE, Sanechips

Observation 1: The resources reserved by previous SCI but released due to ACK feedback are not counted in CR evaluation.

Proposal 1: Both NR SL-CBR and LTE SL-CBR can be reported to the gNB for RRC\_CONNECTED UEs.

Proposal 2: Rel-16 V2X does not support the function of disabling semi-persistent resource reservation by congestion control.

R1-2003567 LG Electronics

***Proposal: No special handling is needed for the resources reserved but not used (e.g., due to HARQ feedback) in the CR valuation.***

R1-2003619 CATT

***Proposal 1: The future reserved resource but released due to ACK feedback is excluded from the CR evaluation.***

***Proposal 2: It is unnecessary to explicitly disable the SPS resource reservation due to congestion control, and it is left for UE implementation.***

R1-2003878 Samsung

***Proposal 1:*** *The followings are proposed for CR evaluation:*

* *In evaluating SL CR, the UE shall assume the transmission parameter used at slot n is reused according to the existing grant(s) in slot [n+1, n+b] without packet dropping* *if SL HARQ feedback is disabled.*
* *In evaluating SL CR, the UE shall assume the transmission parameter used at slot n is reused according to the existing grant(s) in slot [n+1, n+b] and the existing grant(s) can be released by the UE if SL HARQ feedback is enabled.*

R1-2004077 OPPO

***Proposal 1: It is proposed to also support CBR reporting of Type 1 CG resources to LTE eNB.***

***Proposal 2: No update is needed to the existing CR definition due to reserved but unused resources in the future segment of the CR computation.***

R1-2004220 Apple

***Proposal 1:*** *In evaluating sidelink CR, the reserved but released resources, due to HARQ ACK feedback or pre-emption, are not counted as granted or used.*

***Proposal 2:*** *The value* $P\_{max\\_CBR}$ *in the PSSCH transmit power formula is set to infinite for mode 1.*

R1-2004297 InterDigital, Inc.

**Proposal 1:** *The reserved resources but then released are not counted in CR evaluation.*

**Proposal 2:** *Congestion control considers disabling of semi-persistent resource reservation when CBR is greater than a threshold.*

**Proposal 3:** *A resource pool can be configured with an allowed QoS for the data that can be transmitted using that resource pool.*

R1-2004549 Ericsson

Proposal 1 Do not count reserved-but-not-used resources in CR evaluation.