**3GPP TSG-RAN WG2 Meeting #115 electronic R2-21xxxxx**

**E-Meeting, 16 – 27 August 2021**

**Source: vivo**

**Title:** **Summary of [AT115-e][706][V2XSL] SL PDCP out-of-order delivery configuration**

**Agenda Item:** **6.2.2**

**Document for:** **Discussion and Decision**

# Introduction

This contribution summarizes the below offline discussion:

* [AT115-e][706][V2X/SL] SL PDCP out-of-order delivery configuration (Vivo)

 **Scope:** Discuss R2-2108218 and R2-2108741, and decide whether anything is needed. If the issue is valid and the solution is needed, decide the solution and prepare the correction.

 **Intended outcome:** Discussion summary in R2-2108990 and agreeable 38.331 CR in R2-2108989 if needed. Will be approved by email.

 **Deadline:** 8/24 13:00pm UTC

# Preliminaries

To facilitate better understanding of the issue, rapporteur first kindly invites companies to briefly review the related preliminaries, as cited from TS 38.331 and TS 38.323, in the Annex. They are typically saying the following things:

* [From Table A-1] The TX UE shall set the sl-OutofOrderDelivery signaled in SLRB-Config (in PC5 RRC reconfiguration msg) according to the received sl-outofOrderDelivery included in sl-RadioBearerConfig (in Uu dedicated RRC signalling/SIB/pre-configuration);
* [From Table A-2] The RX UE shall establish the PDCP entity of the SL-DRB in accordance with the sl-OutOfOrderDelivery received in PC5 RRC reconfiguration message from the TX UE;
* [From Table A-3] The RX UE’s SL PDCP entity shall perform out-of-order delivery, if the sl-OutofOrderDelivery received from PC5 RRC reconfiguration message is set to true.

As preliminary information to support further discussion on the issue, the following observations are provided:

**Observation 1: In the current Spec:**

* **The TX UE shall set the sl-OutOfOrderDelivery flag in PC5 RRC reconfiguration message to the value that is received in Uu dedicated signalling/SIB/pre-configuration, and is NOT allowed to change that value autonomously;**
* **The RX UE shall establish the PDCP entity of an SL-DRB following the sl-OutOfOrderDelivery flag in PC5 RRC reconfiguration message received from the TX UE. If the flag is “true”, it shall perform PDCP out-of-order delivery at PDCP entity reception, w/o any room for the RX UE to decide whether to do that by itself.**

In a word, whether the RX UE performs out-of-delivery on the PDCP entity of an SL-DRB is finally decided by the TX UE’s gNB/pre-configuration.

**Observation 2: Whether a RX UE shall perform SL out-of-order delivery on the PDCP entity of an SL-DRB is currently decided by the TX UE’s gNB/pre-configuration.**

# Issue Identification

In [3], RAN2 is requested to confirm the issue for the case where the TX UE is in RRC\_IDLE/INACTIVE/OoC state and for the case where the TX UE is in RRC\_CONNECTED state. Let’s begin with the case where the TX UE of a unicast PC5 RRC connection is in RRC\_IDLE/INACTIVE/OoC state. Please have a look at the following Fig.1, which takes the case of an RRC\_IDLE/INACTIVE TX UE as an example.



Fig.1: RRC\_IDLE/INACTIVE TX UE

In above Fig.1, since the gNB cannot get the capability of the RX UE (i.e. UE2), then as long as the gNB sets the *sl-OutOfOrderDelivery* flag to “true” on any SL-DRB configuration in SIB12 (which is then forwarded faithfully by the TX UE to the RX UE), there is the risk for the clash to appear that the RX UE has to follow the TX UE SIB’s configuration to perform out-of-order delivery at the PDCP entity of the related SL-DRB (e.g. at SL-DRB2), but the RX UE itself is actually incapable of PDCP out-of-order delivery operation at all. In the example of the above, the SL-DRB2 does not work. Actually, a PC5 RRC connection with an OoC RX UE faces the same situation (i.e. as long as an SL DRB configuration in pre-config sets *sl-OutOfOrderDelivery* to true, the above clash may happen), since pre-configured parameters cannot be set based on individual peer UE’s capability.

**Question 1: For unicast with the TX UE in RRC\_IDLE/INACTIVE/OoC, do you agree the following problem exists?**

* *As long as the sl-OutOfOrderDelivery flag of an SL-DRB configuration is set to “true” in SIB/pre-configuration, there can be the clashing that the Rx UE is configured to execute PDCP out-of-order delivery on the related SL-DRB by the TX UE, but the Rx UE cannot comply due to the lack of this capability?*
1. Yes.
2. No. The *sl-OutOfOrderDelivery* cannot be set to “true” for any SL-DRB configuration included in SIB/pre-configuration.
3. No. Please kindly provide an explanation on why such a problem does not exist w/o the way in Option B.

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| **Company** | **Option Selection** | **Comments if any** |
| OPPO | B | SIB and Pre-configuration should be based on the mandatory UE capability, so that it would not be set as true. |
| vivo | A or B | As commented online, we can accept that this flag is not included in SIB/pre-configuration, as the problem led by lack of capability seems to be something anyway hardly to be overcome. For the SIB/pre-configuration case, the remaining issue is whether we need to capture this understanding somewhere (if B is finally adopted). This does not look like the typical case of NW implementation that the NW can configure the parameter value following purely its willingness, but looks like some special cases that the NW cannot configure the parameter anyway. By contrast, this case is a bit like the “Conditional presence” in the Spec, saying something like that a field cannot be configured in some cases. If B is finally adopted, we tentatively try to see if a similar description is needed in this case, i.e. the flag can only be configured in dedicated signaling. (This is to be discussed in Q3/4). |
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Then let’s further come to the case of an RRC\_CONNECTED TX UE in unicast. Please kindly take a look at the below Fig.2.



Fig.2: RRC\_CONNECTED TX UE

Note that, although now the TX UE forwards the RX UE’s capability to the gNB, which then knows whether the RX UE is capable of PDCP out-of-order delivery as a AS capability, the problems here are mainly two folded as follows:

* When the two UEs initiate a PC5 QoS flow and the TX UE requests the dedicated SL-DRB configuration for it from the gNB, mainly the PC5 QoS profile related information is provided to the gNB. From the reported PC5 QoS parameters alone, the gNB may not have sufficient information to deduce whether the upper layer protocols of the Service/Application corresponding to the requested PC5 QoS flow can do Reordering or not (so as to decide whether PDCP is allowed to do out-of-delivery accordingly).
* Also, the gNB may not be able to get other service/App characteristic related information from the CN as in Uu, mainly because PC5 SL-DRB configuration request is based on UE reporting in RAN, instead of relying on the CN procedure as in Uu, in which case the CN is not aware of what PC5 services/Apps the two UEs are currently initiating and requesting SL-DRB configurations for (at least in the current Spec).

Per above two points, as long as the gNB sets the *sl-OutOfOrderDelivery* flag to “true” on any SL-DRB configuration in dedicated signaling to the TX UE (which is then forwarded faithfully by the TX UE to the RX UE), there may still be the risk that although the RX UE can do the PDCP out of order delivery at the related SL-DRB (e.g. at SL-DRB2), the upper layer protocols (e.g. Transportation layer, App layers, etc.) of the PC5 QoS flow mapped to this SL-DRB cannot perform reordering, so that the out-of-order delivered AS packets by PDCP still fail to be decoded in the upper layers. In the above example, though PDCP entity of SL-DRB2 works, its upper layer protocols fail, so the data transfer on SL-DRB still does not work. Rapporteur would like to check views among companies on whether the problem exists.

**Question 2: For unicast with the TX UE in RRC\_CONNECTED, do you agree the following problem exists?**

* *As long as the sl-OutOfOrderDelivery flag of an SL-DRB configuration is set to “true” in dedicated signaling, there can be the clashing that the Rx UE is configured to execute PDCP out-of-order delivery on the related SL-DRB by the TX UE, but the Rx UE’s upper layer protocols associated with the SL-DRB cannot do reordering, so the out-of-order delivered packets from PDCP finally fail to be decoded?*
1. Yes.
2. No. The *sl-OutOfOrderDelivery* cannot be set to “true” for any SL-DRB configuration included in dedicated signaling.
3. No. Please kindly provide an explanation on why such a problem does not exist w/o the way in Option B.

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| **Company** | **Option Selection** | **Comments if any** |
| OPPO | C | On the one hand, we are not sure about the need of the said “service/APP character”, since in Uu interface, what gNB can get is merely Uu QoS info like 5QI, so the situation here is the same for PC5, i.e., gNB can get the capability + PC5 QoS info to make the decision.Or if indeed as mentioned by rapporteur, this issue exists (from network vendor perspective), we do not think it is reasonable for gNB to still enable out-of-order delivery for the corresponding SL-DRB unless it is a wrong config. In any case, network implementation can handle this.  |
| vivo | Just to clarify | We just want to clarify the issue in our mind, considering also OPPO’s comment. First, we share OPPO’s view that such service/APP characteristic related information, e.g. whether the service/APP can do “reordering” at upper layer protocols, may not be in the RAN/CN Spec for Uu either (as far as we know). As a result, we understand that for Uu the gNB may be aware of whether the upper layer protocols of the service/APP related to a DRB can do reordering or not also based on implementation specific manner (perhaps some exchange between the gNB and the CN nodes/server without specified signaling).However, here what we’d like to say is that in Uu the initiation of a QoS flow can be at the NW side with possible UE request initiating a CN procedure (e.g. PDU session related operations); in this case, the *NW can know what service/APP the UE is actually requesting*, and thus determine whether upper-layer reordering is capable or not for the requested QoS flow and tell the gNB via possible implementation specific manner. But for SL DRB requesting here, the gNB only gets the PC5 QoS parameters from the UE, so that *the RAN/CN may not be able to know what PC5 service/App this PC5 QoS flow actually belongs to* (e.g. just a simple example, if two PC5 QoS flows reported to the gNB are with the same PC5 QoS profile, and one is associated with a service/APP capable of upper-layer reordering but the other not, how can the NW distinguish them?). The above two yellow highlighted parts are the difference between PC5 and Uu we’d like to point out.Anyway, if companies think there are some other magic ways that anyway can enable the RAN/CN to know whether a PC5 QoS flow requested can do the upper-layer reordering with whatever UE reporting and/or internal NW exchange, we are fine to follow the majority.  |
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# Solution

Solution-wise, there were some voices during online discussion that the above clashing mentioned can be solved by NW implementation. From Rapporteur’s point of view, due to the lack of peer UE’s capability and/or the lack of the knowledge on the peer UE’s upper layer capabilities on reordering at the RAN/pre-configuration side, the safest way for NW implementation that the Rapporteur can imagine is to never (pre)configure this *sl-OutOfOrderDelivery* flag for any SL-DRB configuration, which is equivalent to saying that this parameter in RRC is of no use. However, Rapporteur is also eager/excited to see whether there is really some smart NW implementation ways that can still keep this parameter useful in the Spec and at the same time solve the potential unexpected cases as shown in Section 3. Therefore, Rapporteur invites companies’ views on whether/how the above issues discussed in Section 3 can be addressed by NW implementation.

**Question 3: Do you think the issues as discussed in Section 3 can be solved by NW implementation? If yes, how?**

1. Yes. The NW never configures this *sl-OutOfOrderDelivery* flag for any SL-DRB configuration in SIB/pre-configuration.
2. Yes. The NW never configures this *sl-OutOfOrderDelivery* flag for any SL-DRB configuration in dedicated signaling
3. Yes for the RRC\_CONNECTED TX UE case; the gNB can retrieve PC5 service/App character related information (e.g. whether upper layer protocols of the requested PC5 QoS flows support re-ordering) from the CN via NW implementation, so to configure this flag adaptively.
4. No. If this option is selected, please indicate the case(s) that you don’t think should/can be addressed via NW implementation.

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| **Company** | **Option Selection** | **Comments if any** **(If you select different options for different cases, please indicate the applicable case for each option)**  |
| OPPO | up to network implementation and no spec impact needed | As mentioned above, network implementation can solve this w/o any need of spec impact. |
| vivo | D or A with comment | We think the best way is to have some guidelines in the Spec for all the RRC\_CONNECTED/IDLE/INACTIVE/OoC cases (i.e. Option D)But if companies would just like to go for implementation specific way, we are fine but just wonder if the conditional presence of this flag (i.e. never in SIB/pre-configuration) need to be described somewhere as mentioned in Q1 (i.e. Option A with comment). |
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After clarifying the potential ways of NW implementation to give people clearer understanding, there may be some companies thinking that NW implementation can solve this issue, and some other thinking not. It was also discussed online on Tuesday regarding whether some guideline to NW configuration is needed, if a majority of companies want to go with some NW implementation ways in some specific cases. For example, if the lack of peer UE’s capability is regarded as an issue that needs the NW to never set this flag in SIB/pre-configuration, maybe it is better to add some descriptions in the Spec functioning as the guideline for the configuration in some special cases. The final companies’ preferences are collected as in the following question:

**Question 4: Which of the following option(s) is your preference(s) to address the SL out-of-order delivery configuration issue discussed in this document?**

1. Dummify the *sl-OutOfOrderDelivery* flag.
2. Clarify via a NOTE that how to set the value of the parameter *sl-OutOfOrderDelivery* in PC5 RRC message is up to TX UE implementation, if the sl-OutOfOrderDelivery is configured in pre-configuration or network configuration.
3. Clarify via a NOTE that whether to perform SL PDCP out-of-order delivery is up to Rx UE implementation, when it is configured by the TX UE with *sl-OutOfOrderDelivery = true*.
4. Add some descriptions in the Spec on when this *sl-OutOfOrderDelivery* flag cannot be set to true, as some guidelines for NW-configuration/pre-configuration. If selected, please provide the intended description.
5. Leave this issue to NW implementation as the options selected in Question 3 w/o Spec change.
6. Others.

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| **Company** | **Selection** | **Comments if any** |
| OPPO | E | Same comment as in Q3 |
| vivo | (A or B or C) or D | If clarification at the UE side can be agreed, we are open to either A or B or C. If the issue is solved based on NW implementation, our preference is D and we’d like to propose to add a clarification about this flag at least for the SIB/pre-configuration case. Perhaps touching Need Code itself is not preferred with possible NBC concerns; we propose to directly clarify this in the field description as follows. – *SL-PDCP-Config*The IE *SL*-*PDCP-Config* is used to set the configurable PDCP parameters for a sidelink radio bearer.***SL-PDCP-Config* information element**-- ASN1START-- TAG-SL-PDCP-CONFIG-STARTSL-PDCP-Config-r16 ::= SEQUENCE { sl-DiscardTimer-r16 ENUMERATED {ms3, ms10, ms20, ms25, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200, ms250, ms300, ms500, ms750, ms1500, infinity} OPTIONAL, -- Cond Setup sl-PDCP-SN-Size-r16 ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2 sl-OutOfOrderDelivery ENUMERATED { true } OPTIONAL, -- Need R ...}-- TAG-SL-PDCP-CONFIG-STOP-- ASN1STOP

| ***SL-PDCP-Config* field descriptions** |
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| ***sl-DiscardTimer***Value in ms of *discardTimer* specified in TS 38.323 [5]. Value *ms50* corresponds to 50 ms, value *ms100* corresponds to 100 ms and so on. |
| ***sl-OutOfOrderDelivery***Indicates whether or not outOfOrderDelivery specified in TS 38.323 [5] is configured. This field should be either always present or always absent, after the radio bearer is established. This field is absent in the SL-PDCP-Config which is included in SIB12 or pre-configuration***.*** |
| ***sl-PDCP-SN-Size***PDCP sequence number size for unicast NR sidelink communication, 12 or 18 bits, as specified in TS 38.323 [5]. For groupcast and broadcast NR sidelink communication, only 12 bits is applicable, as specified in 9.1.1.5. |

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| **Conditional Presence** | **Explanation** |
| *Setup* | The field is mandatory present in case of sidelink DRB setup via dedicated signaling and in case of sidelink DRB configuration via system information and pre-configuration; otherwise the field is optionally present, need M. |
| *Setup2* | The field is mandatory present in case of sidelink DRB setup via dedicated signaling and in case of sidelink DRB configuration via system information and pre-configuration for RLC-AM and RLC-UM for unicast NR sidelink communication; otherwise the field is not present, Need M. |

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# Conclusions

To be decided…

# References

1. TS 38.331, V16.5.0
2. TS 38.323, V16.4.0
3. R2-2108218 Discussion on SL PDCP out-of-order delivery configuration vivo

# Annex: Related citation from [1] and [2]

**Table A-1: TX UE setting of SLRB configuration in RRCReconfigurationSidelink [1].**

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| 5.8.9.1.2 Actions related to transmission of *RRCReconfigurationSidelink* messageThe UE shall set the contents of *RRCReconfigurationSidelink* message as follows:1> for each sidelink DRB that is to be released, according to sub-clause 5.8.9.1a.1.1, due to configuration by *sl-ConfigDedicatedNR,* *SIB12*, *SidelinkPreconfigNR* or by upper layers:2> set the *SLRB-PC5-ConfigIndex* included in the *slrb-ConfigToReleaseList* corresponding to the sidelink DRB;1> for each sidelink DRB that is to be established or modified, according to sub-clause 5.8.9.1a.2.1, due to receiving *sl-ConfigDedicatedNR,* *SIB12* or *SidelinkPreconfigNR*:2> set the *SLRB-Config* included in the *slrb-ConfigToAddModList*, according to the received *sl-RadioBearerConfig* and *sl-RLC-BearerConfig* corresponding to the sidelink DRB;1> set the *sl-MeasConfig* as follows:2> If the frequency used for NR sidelink communication is included in *sl-FreqInfoToAddModList* in *sl-ConfigDedicatedNR* within *RRCReconfiguration* message or included in *sl-ConfigCommonNR* within SIB12:3> if UE is in RRC\_CONNECTED:4> set the *sl-MeasConfig* according to stored NR sidelink measurement configuration information for this destination;3> if UE is in RRC\_IDLE or RRC\_INACTIVE:4> set the *sl-MeasConfig* according to stored NR sidelink measurement configuration received from *SIB12*;2> else:3> set the sl-MeasConfig according to the sl-MeasPreconfig in SidelinkPreconfigNR;1> start timer T400 for the destination associated with the sidelink DRB;1> set the *sl-CSI-RS-Config*;1> set the *sl-LatencyBoundCSI-Report*,NOTE 1: How to set the parameters included in *sl-CSI-RS-Config* and *sl-LatencyBoundCSI-Report* is up to UE implementation.The UE shall submit the *RRCReconfigurationSidelink* message to lower layers for transmission. |

**Table A-2: RX UE SL-DRB establishment based on reception of *RRCReconfigurationSidelink* [1].**

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| 5.8.9.1a.2.2 Sidelink DRB addition/modification operationsFor the sidelink DRB, whose sidelink DRB addition conditions are met as in sub-clause 5.8.9.1a.2.1, the UE capable of NR sidelink communication that is configured by upper layers to perform NR sidelink communication shall:1> for groupcast and broadcast; or1> for unicast, if the sidelink DRB addition was trigggered due to the reception of the *RRCReconfigurationSidelink* message; or1> for unicast, after receiving the *RRCReconfigurationCompleteSidelink* message, if the sidelink DRB addition was triggered due to the configuration received within the *sl-ConfigDedicatedNR,* *SIB12*, *SidelinkPreconfigNR* or indicated by upper layers:2> if an SDAP entity for NR sidelink communication associated with the destination and the cast type of the sidelink DRB does not exist:3> establish an SDAP entity for NR sidelink communication as specified in TS 37.324 [24] clause 5.1.1;2> (re)configure the SDAP entity in accordance with the *sl-SDAP-ConfigPC5* received in the *RRCReconfigurationSidelink* or *sl-SDAP-Config* received in *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR*, associated with the sidelink DRB;2> establish a PDCP entity for NR sidelink communication and configure it in accordance with the *sl-PDCP-ConfigPC5* received in the *RRCReconfigurationSidelink* or *sl-PDCP-Config* received in *sl-ConfigDedicatedNR,* *SIB12*, *SidelinkPreconfigNR*, associated with the sidelink DRB;2> establish a RLC entity for NR sidelink communication and configure it in accordance with the *sl-RLC-ConfigPC5* received in the *RRCReconfigurationSidelink* or *sl-RLC-Config* received in *sl-ConfigDedicatedNR,* *SIB12*, *SidelinkPreconfigNR*, associated with sidelink DRB;2> if this procedure was due to the reception of a *RRCReconfigurationSidelink* message:3> configure the MAC entity with a logical channel in accordance with the *sl-MAC-LogicalChannelConfigPC5* received in the *RRCReconfigurationSidelink* associated with the sidelink DRB, and perform the sidelink UE information procedure in sub-caluse 5.8.3 for unicast if need;2> else:3> configure the MAC entity with a logical channel associated with the sidelink DRB, by assigning a new logical channel identity, in accordance with the *sl-MAC-LogicalChannelConfig* received in the *sl-ConfigDedicatedNR*, *SIB12*, *SidelinkPreconfigNR*.NOTE 1: When a sidelink DRB addition is due to the configurationby *RRCReconfigurationSidelink*, it is up to UE implementation to select the sidelink DRB configuration as necessary transmitting parameters for the sidelink DRB, from the received *sl-ConfigDedicatedNR* (if in RRC\_CONNECTED), *SIB12* (if in RRC\_IDLE/INACTIVE), *SidelinkPreconfigNR* (if out of coverage) with the same RLC mode as the one configured in *RRCReconfigurationSidelink*.[…] |

**Table A-3: RX UE’s PDCP out of delivery operation [2]**

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| 5.2.4 Sidelink receive operationFor sidelink reception of the SLRB, the UE shall follow the procedures in clause 5.2.2 with following modification:- perform the header decompression using ROHC as specified in clause 5.7.5, if SDU Type is IP. |
| 5.2.2 Receive operation5.2.2.1 Actions when a PDCP Data PDU is received from lower layersIn this clause, following definitions are used:[…]If the received PDCP Data PDU with COUNT value = RCVD\_COUNT is not discarded above, the receiving PDCP entity shall:- store the resulting PDCP SDU in the reception buffer;- if RCVD\_COUNT >= RX\_NEXT:- update RX\_NEXT to RCVD\_COUNT + 1.- if *outOfOrderDelivery* is configured:- deliver the resulting PDCP SDU to upper layers after performing header decompression using EHC.- if RCVD\_COUNT = RX\_DELIV:- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV;- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value > RX\_DELIV;- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:- stop and reset *t-Reordering*.- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:- update RX\_REORD to RX\_NEXT;- start *t-Reordering*. |

Note that in the field description of *sl-OutOfOrderDelivery* in *RRCReconfigurationSidelink*, it is already clarified in [1] that this field (with “sl-” prefix) just indicates the above yellow *outOfOrderDelivery* (w/o “sl-” prefix) in TS 38.323 for SL reception case. See below

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| ***sl-OutOfOrderDelivery***Indicates whether or not outOfOrderDelivery specified in TS 38.323 [5] is configured. This field should be either always present or always absent, after the sidelink radio bearer is established. |