**3GPP TSG-RAN WG2 Meeting #125bis *R2-240xxxx***

**Changsha, China, April 15-19, 2024**

**Agenda item: 7.9.3**

**Source: Huawei, HiSilicon**

**Title: Report of [Post125][417][Relay] Rel-18 relay RRC open issues (Huawei)**

**Document for: Discussion**

# Introduction

This is to summarize the following post email discussion:

* [Post125][417][Relay] Rel-18 relay RRC open issues (Huawei)

 Scope: Discuss the remaining open issues for Rel-18 relay in 38.331 and converge where possible.

 Intended outcome: Report to next meeting

 Deadline: Long

In this email discussion, we focus on the RIL related issues which are still open.

Contact points:

|  |  |
| --- | --- |
| Company | Email address |
| Apple | zhibin\_wu@apple.com |
| ASUSTeK | lider\_pan@asus.com |
| OPPO | lengbingxue@oppo.com |
| MediaTek | ming-yuan.cheng@mediatek.com |
| LG | Seoyoung. |
| Lenovo | Wulh5@lenovo.com |
| Nokia | Gyorgy.wolfner@nokia.com |

# Discussion

## 2.1 U2U

### 2.1.1 QoS and SLRB configuration in connected state for L2 U2U operation

In current specification, the E2E procedure of L2 U2U SLRB configuration for connected state includes the following steps.

* Step 1. QoS split procedure between Remote UE1 and Relay UE.
* Step 2. Remote UE1 obtains SRAP configuration (as well as E2E DRB configuration, first-hop RLC configuration).
* Step 3. Remote UE1 sends QoS to DRB mapping (as well as first-hop RLC configuration) to Relay UE.
* Step 4. Relay UE obtains SRAP configuration (as well as second-hop RLC configuration).
* Step 5: Remote UE1 configures Remote UE2 for E2E configuration, and Relay UE configures Remote UE2 with second-hop RLC configuration.

Companies seem to have different understanding on the signalling design. In order to explain the intention of asn.1 in the current specification and allow companies to check whether it is correct/sufficient, the related asn.1 codes are copied from the agreed CR in R2-2402042. In addition, the related RILs (J107, H693, Z755, A622, O409, O418, H686, K002, H064, O428) are mapped to the corresponding step for detailed discussion.

#### Step 1. QoS split procedure between Remote UE1 and Relay UE.

##### Step 1a. Remote UE1->Relay UE: *UEInformationRequestSidelink*

UEInformationRequestSidelink-r18-IEs ::= SEQUENCE {

 sl-E2E-QoS-ConnectionListPC5-r18 SEQUENCE (SIZE (1.. maxNrofSL-Dest-r16)) OF SL-E2E-QoS-ConnectionPC5-r18 OPTIONAL, -- Need N

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

SL-E2E-QoS-ConnectionPC5-r18 ::= SEQUENCE {

 sl-DestinationIdentityRemoteUE-r18 SL-DestinationIdentity-r16,

 sl-QoS-InfoList-r18 SEQUENCE (SIZE (1..maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-Info-r16

}

SL-QoS-Info-r16 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r16 SL-QoS-FlowIdentity-r16,

 sl-QoS-Profile-r16 SL-QoS-Profile-r16 OPTIONAL

}

##### Step 1b. Relay UE->Remote UE1: *UEInformationResponseSidelink*

UEInformationResponseSidelink-r18-IEs ::= SEQUENCE {

 sl-SplitQoS-InfoListPC5-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIs-r16)) OF SL-SplitQoS-InfoPC5-r18 OPTIONAL, -- Need N

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

SL-SplitQoS-InfoPC5-r18 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r18 SL-QoS-FlowIdentity-r16,

 sl-SplitPacketDelayBudget-r18 INTEGER (0..1023)

}

**Observation 1: Each QoS folow ID (i.e. QFI) in bright green is linked to one target Remote UE’s L2 ID in yellow.**

#### Step 2. Remote UE obtains SRAP configuration (as well as E2E DRB configuration, first-hop RLC configuration).

Here we only discuss connected state only which has Uu dedicated siganaling impact.

##### Step 2a. Remote UE1->NW: *SidelinkUEInformationNR*

SL-TxResourceReqL2-U2U-r18 ::= SEQUENCE {

 sl-DestinationIdentityL2-U2U-r18 SL-DestinationIdentity-r16 OPTIONAL,

 sl-TxInterestedFreqListL2-U2U-r18 SL-TxInterestedFreqList-r16,

 sl-TypeTxSyncListL2-U2U-r18 SEQUENCE (SIZE (1..maxNrofFreqSL-r16)) OF SL-TypeTxSync-r16,

 sl-CapabilityInformationSidelink-r18 OCTET STRING OPTIONAL,

 sl-U2U-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofRemoteUE-r17)) OF SL-U2U-Info-r18 OPTIONAL,

 ...

}

SL-U2U-Info-r18 ::= SEQUENCE {

 sl-U2U-Identity-r18 CHOICE {

 sl-TargetUE-Identity-r18 SL-DestinationIdentity-r16,

 sl-SourceUE-Identity-r18 SL-SourceIdentity-r17

 },

 sl-E2E-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-Info-r16 OPTIONAL,

 sl-PerHop-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-SplitQoS-Info-r18 OPTIONAL,

 sl-PerSLRB-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSLRB-r16)) OF SL-PerSLRB-QoS-Info-r18 OPTIONAL

}

SL-QoS-Info-r16 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r16 SL-QoS-FlowIdentity-r16,

 sl-QoS-Profile-r16 SL-QoS-Profile-r16 OPTIONAL

}

SL-SplitQoS-Info-r18 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r18 SL-QoS-FlowIdentity-r16,

 sl-SplitPacketDelayBudget-r18 INTEGER (0..1023) OPTIONAL,

 ...

}

SL-PerSLRB-QoS-Info-r18 ::= SEQUENCE {

 sl-RemoteUE-SLRB-Identity-r18 SLRB-Uu-ConfigIndex-r16,

 sl-QoS-ProfilePerSLRB-r18 SL-QoS-Profile-r16 OPTIONAL

}

##### Step 2b. NW->Remote UE1: RRCReconfiguration-> SL-L2RemoteUE-Config-r17

SL-L2RemoteUE-Config-r17 ::= SEQUENCE {

…

 sl-U2U-RelayUE-ToAddModList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-U2U-RelayUE-ToAddMod-r18 OPTIONAL, -- Need N

 sl-U2U-RelayUE-ToReleaseList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-DestinationIdentity-r16 OPTIONAL -- Need N

…

}

…

SL-U2U-RelayUE-ToAddMod-r18 ::= SEQUENCE {

 sl-L2IdentityRelay-r18 SL-DestinationIdentity-r16,

 sl-PeerRemoteUE-ToAddModList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-PeerRemoteUE-ToAddMod-r18 OPTIONAL, -- Need N

 sl-PeerRemoteUE-ToReleaseList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-DestinationIdentity-r16 OPTIONAL, -- Need N

 ...

}

SL-PeerRemoteUE-ToAddMod-r18 ::= SEQUENCE {

 sl-TargetUE-Identity-r18 SL-DestinationIdentity-r16,

 sl-SRAP-ConfigU2U-r18 SL-SRAP-ConfigU2U-r18,

 ...

}

…

SL-SRAP-ConfigU2U-r18 ::= SEQUENCE {

 sl-MappingToAddMod-U2U-List-r18 SEQUENCE (SIZE (1..maxSL-LCID-r16)) OF SL-MappingConfig-U2U-r18 OPTIONAL, -- Need N

 sl-MappingToRelease-U2U-List-r18 SEQUENCE (SIZE (1..maxSL-LCID-r16)) OF SLRB-Uu-ConfigIndex-r16 OPTIONAL -- Need N

}

SL-MappingConfig-U2U-r18 ::= SEQUENCE {

 sl-RemoteUE-SLRB-Identity-r18 SLRB-Uu-ConfigIndex-r16,

 sl-EgressRLC-ChannelPC5-r18 SL-RLC-ChannelID-r17,

 ...

}

**Observation 2: In the SUI reported by Remote UE1, the QoS flow ID of E2E QoS and first-hop QoS is not necessarily the same as the one sent to Relay UE in step 1a, but the Remote UE should remember the mapping, so that it can know the E2E SLRB configuration identified by slrb-PC5-ConfigIndex in SLRB-Config and sl-RemoteUE-SLRB-Identity in SL-SRAP-ConfigU2U is to cover which E2E QoS flows. The network provides the aligned slrb-PC5-ConfigIndex in SLRB-Config and sl-RemoteUE-SLRB-Identity in SL-SRAP-Config for the same E2E SLRB.**

#### (J107, H693, Z755, A622, O409) Step 3. Remote UE1 sends QoS to DRB mapping (as well as first-hop RLC configuration) to Relay UE.

Remote UE1->Relay UE: *RRCReconfigurationSidelink*

RRCReconfigurationSidelink-r16-IEs ::= SEQUENCE {

 slrb-ConfigToAddModList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-Config-r16 OPTIONAL, -- Need N

slrb-ConfigToReleaseList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-PC5-ConfigIndex-r16 OPTIONAL, -- Need N

…

}

SLRB-Config-r16::= SEQUENCE {

 slrb-PC5-ConfigIndex-r16 SLRB-PC5-ConfigIndex-r16,

 sl-SDAP-ConfigPC5-r16 SL-SDAP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-PDCP-ConfigPC5-r16 SL-PDCP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-RLC-ConfigPC5-r16 SL-RLC-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-MAC-LogicalChannelConfigPC5-r16 SL-LogicalChannelConfigPC5-r16 OPTIONAL, -- Need M

 ...

}

SL-SDAP-ConfigPC5-r16 ::= SEQUENCE {

 sl-MappedQoS-FlowsToAddList-r16 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-PQFI-r16 OPTIONAL, -- Need N

 sl-MappedQoS-FlowsToReleaseList-r16 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-PQFI-r16 OPTIONAL, -- Need N

 sl-SDAP-Header-r16 ENUMERATED {present, absent},

 ...

}

The intention of current specification is to rely on legacy PC5-RRC signalling (*RRCReconfigurationSidelink*) defined in Rel-16, and not to introduce any new signalling following RAN2#124 agreement.

|  |
| --- |
|  - The Tx Remote UE informs the flow-to-SLRB mapping (i.e., SDAP configuration) to the relay UE via PC5-RRC. - The Tx Remote UE informs the SLRB configuration index (i.e., slrb-PC5-ConfigIndex) to the relay UE via PC5-RRC. |

However, as raised by several RILs (J107, H693, Z755, A622, O409), the legacy signalling does not work/is suitable, due to the following reasons:

1. The PQFI included in the *sl-SDAP-ConfigPC5* has no corresponding meaning in relay UE, as it is generated by TX UE (i.e., source remote UE) implementation, and this PQFI is U2U destination agnostic (not related to any target U2U remote UE’s end-to-end flow). Hence, relay UE cannot match this ID to any QFIs reported in *UEInformationRequestSidelink*.
2. There is no SDAP entity in U2U relay UE, so such configuration looks awkward from the signalling design perspective. As a result, lengthy and dedicated procedure texts are supposed to be added into the legacy texts to describe how a L2 U2U relay UE to handle this SDAP-config differently from the legacy direct link case.

To address the above issues in ASN.1, some alternatives are provided in RILs/RIL papers.

1. **Alternative 1**: to include flow-to-SLRB mapping in the current *UEInformationRequestSidelink*, provided by R2-2400951 (alternative 1).

|  |
| --- |
| ExampleUEInformationRequestSidelink-r18 ::= SEQUENCE {…SL-E2E-QoS-ConnectionPC5-r18 ::= SEQUENCE { sl-DestinationIdentityRemoteUE-r18 SL-DestinationIdentity-r16, sl-E2E-QoS-SLRBListPC5-r18 SEQUENCE (SIZE (1.. maxNrofSLRB-r16)) OF SL-E2E-QoS-SLRBPC5}SL-E2E-QoS-SLRBPC5-r18 ::= SEQUENCE { sl-e2eRBIndex SLRB-PC5-ConfigIndex-r16, sl-e2eQoS-InfoList-r18 SEQUENCE (SIZE (1..maxNrofSL-QFIsPerDest-r16)) OF SL-e2eQoS-Info-r18}SL-e2eQoS-Info-r18 ::= SEQUENCE { sl-QoS-FlowIdentity-r18 SL-PQFI-r16, sl-QoS-Profile-r16 SL-QoS-Profile-r16 } |

Or an alternative implementation is to just directly associated SLRB-PC5-ConfgiIndex in the same level as the destination:

|  |
| --- |
| UEInformationRequestSidelink-r18-IEs ::= SEQUENCE { sl-E2E-QoS-ConnectionListPC5-r18 SEQUENCE (SIZE (1.. maxNrofSLRB-r16)) OF SL-E2E-QoS-ConnectionPC5-r18 OPTIONAL, -- Need N lateNonCriticalExtension OCTET STRING OPTIONAL, nonCriticalExtension SEQUENCE {} OPTIONAL}SL-E2E-QoS-ConnectionPC5-r18 ::= SEQUENCE { sl-DestinationIdentityRemoteUE-r18 SL-DestinationIdentity-r16, sl-e2eRBIndex SLRB-PC5-ConfigIndex-r16, sl-QoS-InfoList-r18 SEQUENCE (SIZE (1..maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-Info-r16} |

The intention is to let the Relay UE easily understand the BEARER which the e2e flow is mapped to. This approach concentrates all QoS-split related parameters in a single PC5-RRC procedure. But this requires some change in the E2E procedure. For instances, the Remote UE first reports E2E QoS to obtain the flow-to-SLRB mapping like in step2, and then trigger QoS split procedure like in step1, after which the Remote UE2 needs to do step2 again to obtain the first-hop RLC configuration.

1. **Alternative 1-1**: On top of alternative 1, considering the flow-to-SLRB mapping is already given to Relay UE, Relay UE could directly perform per-SLRB level QoS split but not per-QoS level split, provided by R2-2400951 (alternative 2). From asn.1 perspective, this would introduce changes on UEInformationRequestSidelink, UEInformationResponseidelink, and QoS reporting part in current SUI.
2. **Alternative 2**: to introduce an explicit mapping list in the current *RRCReconfigurationSidelink* including SLRB index and associated QFI which have the same meaning as in step1, provided by R2-2400412, R2-2401110 (Option 2) and R2-2401117.

|  |
| --- |
| ExampleRRCReconfigurationSidelink ::= SEQUENCE {… slrb-MappingConfigToReleaseList-r18 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-PC5-ConfigIndex-r18 OPTIONAL, -- Need N  slrb-MappingConfigToAddModList-r18 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-MappingConfig-r18 OPTIONAL, -- Need NSLRB-MappingConfig-r18::= SEQUENCE { slrb-PC5-ConfigIndexU2U-r18 SLRB-PC5-ConfigIndex-r16, sl-MappedQoS-FlowsToAddListU2U-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-FlowIdentity-r16 OPTIONAL, -- Need N sl-MappedQoS-FlowsToReleaseListU2U-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-FlowIdentity-r16 OPTIONAL, -- Need N ...} |

It is worth noting that the “slrb-PC5-ConfigIndexU2U-r18” in this IE is assigned by Remote UE1 for a certain E2E SLRB, which will be included in SRAP header for subsequence UP data transmission. In this case, the Relay UE needs to link the SRAP configuration (which is to be received in step 4) to the same E2E SLRB.

1. **Alternative 3**: to introduce an explicit mapping list including SLRB index, target Remote UE2’s L2 ID and PQFI, provided by R2-2401110 (Option 1-1, and Option 1-2).

|  |
| --- |
| ExampleRRCReconfigurationSidelink ::= SEQUENCE {…SLRB-MappingConfig-U2U-r18 SEQUENCE {sl-DestinationIdentityRemoteUE-r18 SL-DestinationIdentity-r16,slrb-MappingConfigList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SLRB-MappingConfig-r18}SLRB-MappingConfig-r18::= SEQUENCE {slrb-PC5-ConfigIndex-r18 SLRB-PC5-ConfigIndex-r16, sl-MappedQoS-FlowsToAddList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-PQFI-r16 OPTIONAL, -- Need N sl-MappedQoS-FlowsToReleaseList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-PQFI-r16 OPTIONAL, -- Need N ...} |

The alternative 3 is very similar to alternative 2, but the issue is Relay UE needs to merge the SLRB-level QoS for second-hop, based on the flow-to-SLRB mapping as well as the split QoS in step1, but there is no connection between the PQFI here and QFI in step 1. So, if we go with this alternative 3, the signalling structure in step 1 needs to be changed as well.

The rapporteur understands at this stage we should select a solution with minimized potential asn.1 change from feasible alternatives, i.e. alternative 2, but would like to check companies views.

**Question 1: Among the above alternatives (1, 1-1, 2, 3), which one is the preferred signalling design approach to convey QoS flow-to-SLRB mapping information from source Remote UE to Relay UE?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Alternatives (1, 1-1, 2, 3)** | **Comments** |
| **Apple** | **Alt 1 (preferred) or** **Alt 1-1** | **For Alternative 1, we want to point out the rapporteur’s view of Alt 1’s drawback of triggering Step 2 twice is just for CONNECTED UE’s SUI procedure, not for IDLE/INACTIVE UE. It is also obvious that SUI would be triggered by tons of different conditions based on current 38.331 spec, so minimizing the SUI triggering is not a really meaningful objective to pursue here. SUI is already such an all-inclusive signalling, so its transmissions and overhead would be hardly altered by choosing either Alt.1 or 2.****We think Alt 1 has some clear advantages as below:**1. **Less Signalling overhead. For the TP change, SLRB-index can be simply inserted in UEInformaitonReqSL, and there is no need to change in UEInformationRsp signalling. So, this is much less overhead compared to Alt 2 which need to introduce a whole new IE.**
2. **For relay UE, the usage of UEInformationRequestSidelink signalling will put all information about per-destination e2e QoS flow in one place instead of spreading them in two different PC5t-RRC signalling, this gives relay UE chance to utilize all the relevant information to make best QoS split decisions. If we follow Alt 2, the relay UE may need make QOS-split information blindly w/o knowing the QoS flow-to-e2eBearer mapping.**
3. **It reduces the PC5-RRC message transmissions. Whenever, there is a new PQFI generated in remote UE, there will be two PC5-RRC messages triggered in Alt 2 (UEInformationRequestSL + RRCReconfgiSL). So, Alt 1 only has half the signalling overhead then Alt 2 in PC5 interface.**
4. **It keeps RRCReconfiguraitonSidelink message “cleaner” and not involved/tangled with per-U2U-target destination e2e configurations. Based on the proposed ASN.1 for Alt 2, when Relay UE receives the QFI information in RRCReconfigurationSL message, it still has to wait for the reception of UEInformationReqSL message to understanding the QOS flow destination, so this will make the procdure text for relay UE complicated in 5.8.9.1.**

**For Option 1-1, to be fair, it reverts the early agreement about relay UE conducting per-flow QOS split, although per-RB split will greatly simplify the ASN.1 signalling (and also corresponding procedure texts). We are fine to follow majority view if companies do not want to revert an earlier agreement.** |
| **ASUSTeK** | **Alt 2** | **We share the same view as the Rapp that at this stage we should select a solution with minimized potential asn.1 change.** |
| **OPPO** | **Alt 1** | **Alt 1 is preferred. For the spec impact, we understand the impact is not that big, so should be fine.** |
| **LG** | **Alt 1** | **We prefer Option 1. It makes easy for the Relay UE to understand the mapping between e2e bearer and the QoS-flow-identity(s).** |
| **Lenovo** | **Alt1** | **Alt1 is simple way which make specification clear.** |
| **Nokia** | **Alt 2 is preferred** | **We think that Alt-2 is the most straight-forward option that requires no fundamental change in the agreed procedure.****Alt-1 means that Remote UE in RRC\_CONNECTED should contact gNB twice (1st time to get QoS flow to SLRB mapping, 2nd time to get the config for the 1st hop considering split PDB). This is not only an ASN.1 issue, as it would require some changes in the procedure at stage 2 level.****(Note that ASN.1 stability is not a target before ASN.1 freeze, NBC changes are OK.)** |
|  |  |  |

#### Step 4. Relay UE obtains SRAP configuration (as well as second-hop RLC configuration).

##### (O418, H686, K002) Step 4a. Relay UE->NW: *SidelinkUEInformationNR*

SL-TxResourceReqL2-U2U-r18 ::= SEQUENCE {

 sl-DestinationIdentityL2-U2U-r18 SL-DestinationIdentity-r16 OPTIONAL,

 sl-TxInterestedFreqListL2-U2U-r18 SL-TxInterestedFreqList-r16,

 sl-TypeTxSyncListL2-U2U-r18 SEQUENCE (SIZE (1..maxNrofFreqSL-r16)) OF SL-TypeTxSync-r16,

 sl-CapabilityInformationSidelink-r18 OCTET STRING OPTIONAL,

 sl-U2U-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofRemoteUE-r17)) OF SL-U2U-Info-r18 OPTIONAL,

 ...

}

SL-U2U-Info-r18 ::= SEQUENCE {

 sl-U2U-Identity-r18 CHOICE {

 sl-TargetUE-Identity-r18 SL-DestinationIdentity-r16,

 sl-SourceUE-Identity-r18 SL-SourceIdentity-r17

 },

 sl-E2E-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-Info-r16 OPTIONAL,

 sl-PerHop-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSL-QFIsPerDest-r16)) OF SL-SplitQoS-Info-r18 OPTIONAL,

 sl-PerSLRB-QoS-InfoList-r18 SEQUENCE (SIZE (1.. maxNrofSLRB-r16)) OF SL-PerSLRB-QoS-Info-r18 OPTIONAL

}

SL-QoS-Info-r16 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r16 SL-QoS-FlowIdentity-r16,

 sl-QoS-Profile-r16 SL-QoS-Profile-r16 OPTIONAL

}

SL-SplitQoS-Info-r18 ::= SEQUENCE {

 sl-QoS-FlowIdentity-r18 SL-QoS-FlowIdentity-r16,

 sl-SplitPacketDelayBudget-r18 INTEGER (0..1023) OPTIONAL,

 ...

}

SL-PerSLRB-QoS-Info-r18 ::= SEQUENCE {

 sl-RemoteUE-SLRB-Identity-r18 SLRB-Uu-ConfigIndex-r16,

 sl-QoS-ProfilePerSLRB-r18 SL-QoS-Profile-r16 OPTIONAL

}

…

SL-RLC-ModeIndication-r16 ::= SEQUENCE {

 sl-Mode-r16 CHOICE {

 sl-AM-Mode-r16 NULL,

 sl-UM-Mode-r16 NULL

 },

 sl-QoS-InfoList-r16 SEQUENCE (SIZE (1..maxNrofSL-QFIsPerDest-r16)) OF SL-QoS-Info-r16

}

Related to the SUI reported by Relay UE, one issue mentioned by O418 is that the source Remote UE’s L2 ID is not useful, so it can be removed, which seems to be true.

**Question 2: Does company agree to remove *sl-SourceUE-Identity* from *SidelinkUEInformationNR* as suggested by O418?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **No** | **My understanding is that the e2e U2U QoS-flows are directional from source->target, so when relay UE reports this QoS flow information in** sl-E2E-QoS-InfoList-r18 **or** SL-SplitQoS-Info-r18 **to its serving gNB, the gNB need configure the corresponding SRAP mapping per source remote UE, if the source remote UE identity is not shared, gNB does not understand where the QoS flow is originated.****[OPPO] To clarify, the U2U Relay UE only need to report sl-PerSLRB-QoS-InfoList-r18, but doesn’t need to report the sl-E2E-QoS-InfoList-r18 or SL-SplitQoS-Info-r18.** |
| **ASUSTeK** | **No** | **We share the same view as Apple. Besides, it is noted that the current *SL-L2RelayUE-Config* includes *sl-SRAP-ConfigU2U* and *sl-SourceUE-Identity* so that the relay UE can know which source remote UE the SLRB-to-PC5 Relay RLC channel mapping (indicated by *sl-SRAP-ConfigU2U*) is associated with. Without *sl-SourceUE-Identity* included in *SidelinkUEInformationNR,* the gNB cannot provide *sl-SourceUE-Identity* in the *SL-L2RelayUE-Config* (in the *RRCReconfiguration* in response to reception of *SidelinkUEInformationNR* from the relay UE)*.*** |
| **OPPO** | **Yes** | **Firstly, the gNB of the U2U Relay UE doesn’t need to care about the source remote UE’s L2 ID since it just need to provide the RLC configuration of each bearer based on the reported per-SLRB QoS in sl-PerSLRB-QoS-InfoList-r18, and this configuration has no relationship with which source UE the bearer is associated with.****Besides, the source remote UE’s L2 ID is meaningless to the gNB of relay UE since the relay and source remote UE are very likely in different coverage/RRC state, which means the gNB has no context of the source remote UE and its L2 ID.** **For ASUSTeK’s comment on sl-SRAP-ConfigU2U, it is designed aligned with SUI report, i.e., it is the result of source remote UE’s L2 ID is included in SUI not the reason of including source remote UE’s L2 ID in SUI.****[ASUSTeK] In R16 sidelink communication, the destination UE ID is used for distinguishing different destination UEs because a UE may communicate with multiple destination UEs. In this situation, the gNB may not have context of the destination UE and its L2 ID. Similarly, the source remote UE ID is used for distinguishing different source remote UEs in L2 U2U Relay, considering that multiple source remote UEs may communicate with one target remote UE via the same relay UE.****In L2 U2U Relay, the *sl-RemoteUE-SLRB-Identity* included in *SL-L2RelayUE-Config* may be reused by different source remote UEs. Thus, the gNB needs to include *sl-SourceUE-Identity* in the *SL-L2RelayUE-Config* so that the relay UE can associate the SLRB-to-PC5 Relay RLC channel mapping (indicated by *sl-SRAP-ConfigU2U*) with the right source remote UE. With the SLRB-to-PC5 Relay RLC channel mapping associated with the right source remote UE, the relay UE can then determine the egress PC5 Relay RLC channel when receiving an SRAP PDU with UE ID and RB ID from the source remote UE. To support that, the relay UE needs to include *sl-SourceUE-Identity* in the *SL-U2U-Inf*o for the gNB to indicate the right source remote UE to the relay UE.****If the *sl-SourceUE-Identity* is removed from both *SidelinkUEInformationNR* and *RRCReconfiguration*, we are wondering how the relay UE associates the SLRB-to-PC5 Relay RLC channel mapping with the right source remote UE.****[OPPO] Thanks for the discussion, the bearer ID reported to the NW from the U2U Relay UE doesn’t need to be the same value received from the source remote UE, i.e., the relay UE can re-index the bearer across multiple source remote UEs, as long as the bearer ID is aligned between relay UE and gNB, there is no unclear part. This is just the same as we did in R16 SL for QoS flow report.****[ASUSTeK] Thank you for your feedback! In fact, the *sl-RemoteUE-SLRB-Identity* in the *SidelinkUEInformationNR* is now set to the same value as the *SLRB-PC5-ConfigIndex* received in *RRCReconfigurationSidelink* message from the L2 U2U Remote UE according to clause 5.8.3.3 in the current RRC specification.****Besides, in our understanding the maximum number of SLRBs per UE in R16/R17 is 512 = 16 (max number of SLRBs per destination) x 32 (max number of destinations). In other words, this can support a UE to communicate with 32 destination UEs. It seems you propose that the relay UE can re-index the SLRB ID used to communicate with its gNB. In the scenario of L2 U2U Relay, multiple source remote UEs may communicate with multiple target remote UEs via one relay UE. We are not sure whether the current space of maximum number of SLRBs per UE (i.e. 512) can support such scenario.** |
| **LG** | **No** | **We has the same understanding as Apple.** |
| **Lenovo** | **No** | **Slightly prefer to keep. How to use it can be left for gNB. Maybe, it can be useful for (mode2) resource configuration/modification.** |
| **Nokia** | **No** | **We agree with the comments above that without the source UE ID, the gNB cannot provide the U2U configuration as it is specified now:**SL-SourceRemoteUE-ToAddMod-r18 ::= SEQUENCE { sl-SourceUE-Identity-r18 SL-SourceIdentity-r17, sl-SRAP-ConfigU2U-r18 SL-SRAP-ConfigU2U-r18, ... }**We think that without the SourceRemoteUE ID the E2E bearer cannot be identified (E2E bearer ID is only unique within the scope of the Remote UEs).** |
|  |  |  |

The other issue is about the RLC mode in SUI reported by Relay UE mentioned by H686, since in the legacy signaling QoS flow list is mandatory in SL-RLC-ModeIndication, but in L2 U2U, Relay UE is not aware which QoS flows are mapped to the first-hop RLC channel. To address this, a new IE including only RLC mode can be introduced.

**Question 3: Does company agree to introduce new IE including only RLC mode but not QoS flow list in SUI as proposed by H686?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **Yes** | **Agree with the rapporteur** |
| **ASUSTeK** | **Yes** |  |
| **OPPO** | **Yes** |  |
| **LG** | **Yes** |  |
| **Lenovo** | **Yes** |  |
| **Nokia** | **Yes** |  |
|  |  |  |

Related to the RLC configuration, K002 propose to include both of source and target Remote UE capability of RLC, to let NW provide proper RLC configuration (e.g. SN length) on the second hop aligned with the first hop.

**Question 4: Does company agree to include both of source and target Remote UE (per-hop) capability, to let NW provide proper RLC configuration (e.g. SN length) on the second hop aligned with the first hop as proposed by K002?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **No** | **We think this is an optimizaiton. Even if SN length is not aligned, nothing is really broken.** |
| **ASUSTeK** | **Yes** | **Currently, there are two types of SN length for RLC AM i.e. long SN length (18 bits) and short SN length (12 bits). AM\_Window\_Size is set to 131072 when an 18 bit SN is used and AM\_Window\_Size is set to 2048 when a 12 bit SN is used. In case the first hop’s SN length is configured with 18 bits while the second hop’s SN length is configured with 12 bits, the L2 U2U Remote UE may transmit much more RLC PDUs to the L2 U2U Relay UE before being acknowledged than the amount of RLC PDUs the L2 U2U Relay UE can transmit to the peer L2 U2U Remote UE. As a result, data packets may accumulate in the L2 U2U Relay UE, which may cause problem to the L2 U2U Relay UE. On the other hands, the first hop’s SN length may be configured with 12 bits and the second hop’s SN length may be configured with 18 bits. In this situation, configuring the second hop’s SN length with 18 bits would cause signalling overhead unnecessarily. Thus, we think SN lengths on both hops should be aligned to avoid potential problem in the L2 U2U Relay UE and signalling overhead.** |
| **OPPO** | **No** | **Agree with Apple that this is optimization** |
| **LG** | **No** |  |
| **Lenovo** | **No** |  |
| **Nokia** | **No** |  |
|  |  |  |

##### Step 4b. NW->Relay UE: RRCReconfiguration-> SL-L2RelayUE-Config-r17

SL-L2RelayUE-Config-r17 ::= SEQUENCE {

…

 sl-U2U-RemoteUE-ToAddModList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-U2U-RemoteUE-ToAddMod-r18 OPTIONAL, -- Need N

 sl-U2U-RemoteUE-ToReleaseList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-DestinationIdentity-r16 OPTIONAL -- Need N

…

}

SL-U2U-RemoteUE-ToAddMod-r18 ::= SEQUENCE {

 sl-L2IdentityRemoteUE-r18 SL-DestinationIdentity-r16,

 sl-SourceRemoteUE-ToAddModList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-SourceRemoteUE-ToAddMod-r18 OPTIONAL, -- Need N

 sl-SourceRemoteUE-ToReleaseList-r18 SEQUENCE (SIZE (1..maxNrofSL-Dest-r16)) OF SL-SourceIdentity-r17 OPTIONAL, -- Need N

 ...

}

SL-SourceRemoteUE-ToAddMod-r18 ::= SEQUENCE {

 sl-SourceUE-Identity-r18 SL-SourceIdentity-r17,

 sl-SRAP-ConfigU2U-r18 SL-SRAP-ConfigU2U-r18,

 ...

}

…

SL-SRAP-ConfigU2U-r18 ::= SEQUENCE {

 sl-MappingToAddMod-U2U-List-r18 SEQUENCE (SIZE (1..maxSL-LCID-r16)) OF SL-MappingConfig-U2U-r18 OPTIONAL, -- Need N

 sl-MappingToRelease-U2U-List-r18 SEQUENCE (SIZE (1..maxSL-LCID-r16)) OF SLRB-Uu-ConfigIndex-r16 OPTIONAL -- Need N

}

SL-MappingConfig-U2U-r18 ::= SEQUENCE {

 sl-RemoteUE-SLRB-Identity-r18 SLRB-Uu-ConfigIndex-r16,

 sl-EgressRLC-ChannelPC5-r18 SL-RLC-ChannelID-r17,

 ...

}

#### (H064, O428) Step 5: Remote UE1 configures Remote UE2 for E2E configuration, and Relay UE configures Remote UE with second-hop RLC configuration.

##### Step 5a: Remote UE1->Remote UE2: *RRCReconfigurationSidelink->* sl-SDAP-ConfigPC5 + sl-PDCP-ConfigPC5

RRCReconfigurationSidelink-r16-IEs ::= SEQUENCE {

 slrb-ConfigToAddModList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-Config-r16 OPTIONAL, -- Need N

slrb-ConfigToReleaseList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-PC5-ConfigIndex-r16 OPTIONAL, -- Need N

…

}

SLRB-Config-r16::= SEQUENCE {

 slrb-PC5-ConfigIndex-r16 SLRB-PC5-ConfigIndex-r16,

 sl-SDAP-ConfigPC5-r16 SL-SDAP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-PDCP-ConfigPC5-r16 SL-PDCP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-RLC-ConfigPC5-r16 SL-RLC-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-MAC-LogicalChannelConfigPC5-r16 SL-LogicalChannelConfigPC5-r16 OPTIONAL, -- Need M

 ...

}

H064 proposes to clarify that the source Remote UE1 needs to make sure the same SLRB index is configured to Relay UE and target Remote UE2. Then for source remote UE and relay UE, how to set the QoS flow ID and E2E bearer ID in SUI and obtain the bearer configuration for this E2E DRB in connected state is left to UE implementation, there is no limitation that Uu SLRB ID/QoS flow ID have to be the same as used in PC5 configuration, however, the Remote UE and Relay UE must maintain the association between the configuration received from Uu interface and the configuration received from PC5 connection for the same end-to-end DRB.

**Question 5: Does company agree to clarify that source remote UE needs to make sure the same SLRB index is configured to Relay UE and target Remote UE. The relay UE maintains the association between the SLRB ID/index reporting to network and the E2E SLRB indicated in QoS flow to SLRB mapping received from source remote UE as proposed by H064?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **No** | **For source remote UE, the e2e SLRB-PC5-config index is available (in both remote UEs) only after e2e SL DRB is established and will be used as BEAER ID in SRAP header.** **Then between source remote UE and L2 U2U relay UE, the SLRB-config is not even supposed to be present because there is no SL-DRB between those two, only PC5 Relay RLC channel needs to be configured from source remote UE to relay UE. We do not even understand why step 5a involves SDAP-config and PDCP-config. There is no SLRB config needed and only sl-RLC-ChannelToReleaseListPC5-r17 is reused. So, there is no problem. And the relay UE does not need to associate this PC5 relay RLC channel configuration with any BEARER ID in SRAP because it is just an ingress RLC channel.** |
| **ASUSTeK** | **Yes** | **We think SLRB index alignment is needed for 2nd hop SLRB-to-PC5 Relay RLC channel mapping.** |
| **OPPO** | **See comment** | **We agree the intention, but the detailed change seems related to the conclusion of Q1 on how the relay UE obtains the QoS flow to DRB mapping from the source remote UE** |
| **LG** | **Yes** | **We understand that maintaining the same SLRB index is required for the mapping between e2e SLRB and RLC channel of the 2nd-hop.** |
| **Nokia** | **Yes** |  |
|  |  |  |

O428 points out that in the current RRC specification, the IE SLRB-Uu-ConfigIndex is numbered by gNB rather than UE, so it’s not suitable to be reported by Relay UE, thus propose to introduce a new ID to replace it. The rapporteur understands the intention, but tend to think a easier way is to modify the IE description to allow UE to use this IE but not to create a duplicated IE.

**Question 6: Does company agree to clarify that IE SLRB-Uu-ConfigIndex can be reported by Relay UE instead of introducing a new duplicated IE to address the issue mentioned in O428?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **No** | **Frist report SLRB-Uu-configIndex is wrong as this is not the same SLRB index provided by SIB12.** **We think this should be simply changed to SLRB-PC5-ConfigIndex as we assume the aggregated split-QOS per SLRB is associated with an established SL-DRB end-to-end, which has been shared by remote UE in UEInformationReqSL message.** |
| **OPPO** | **No** | **We think use a new IE is easier and cleaner and reuse SLRB-Uu-ConfigIndex may cause more issues since it is not normal to use the same IE for UL report and DL configuration.** |
| **LG** | **No** | **Making new IE looks simple.** |
| **Lenovo** | **No** | **Slightly prefer to have a new IE.** |
| **Nokia** | **No strong view** | **Both options can work** |
|  |  |  |

##### Step 5b: Relay UE->Remote UE2: *RRCReconfigurationSidelink->* sl-RLC-ConfigPC5+ sl-MAC-LogicalChannelConfigPC5

RRCReconfigurationSidelink-r16-IEs ::= SEQUENCE {

 slrb-ConfigToAddModList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-Config-r16 OPTIONAL, -- Need N

slrb-ConfigToReleaseList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SLRB-PC5-ConfigIndex-r16 OPTIONAL, -- Need N

…

}

SLRB-Config-r16::= SEQUENCE {

 slrb-PC5-ConfigIndex-r16 SLRB-PC5-ConfigIndex-r16,

 sl-SDAP-ConfigPC5-r16 SL-SDAP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-PDCP-ConfigPC5-r16 SL-PDCP-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-RLC-ConfigPC5-r16 SL-RLC-ConfigPC5-r16 OPTIONAL, -- Need M

 sl-MAC-LogicalChannelConfigPC5-r16 SL-LogicalChannelConfigPC5-r16 OPTIONAL, -- Need M

 ...

}

### 2.2 Local ID release

As mentioned by A619, in current CR, the local ID release is enabled from asn.1 and procedural point of view, but it is not clear when to trigger this. This issue was discussed in R2-2400950 and R2-2400412. Both contributions think the local ID only needs to be released upon E2E failure and E2E release. The difference seems to be whether the Relay UE initiate release procedure to let Remote UE to release the local ID or let Relay UE and Remote UEs release the local ID locally without the explicit procedure.

**Question 7a: Which option is preferred, explicit release or local release of the local ID upon E2E failure/release?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Explicit release or local release** | **Comments** |
| **Apple** | **Local release** | **We think explicit release procedure shall be pursued by SA2 in PC5-S signalling when an e2e Link is released. So, it is fine for AS layer to agree on local release** |
| **ASUSTeK** | **Local release** | **We prefer local release.** |
| **OPPO** | **Local release** | **Agree with Apple that when E2E link is released, all the link related configurations should be released locally as in legacy.** |
| **LG** | **Local release** | **Same view as Apple. Explicit signalling doesn’t need at AS layer.**  |
| **Lenovo** | **Local release** | **Agree with Apple** |
| **Nokia** | **Local release** |  |
|  |  |  |

**Question 7b: Besides E2E failure/release, are there any other triggers of local ID release?**

|  |  |
| --- | --- |
| **Company**  | **Comments** |
| **Apple** | **Triggered by upper layers. ProSe layet can trigger local ID relase when an end-to-end link is released by PC5-S.** |
| **ASUSTeK** | **No. In our understating, E2E release triggered by upper layers has been covered in the current RRC Specification.** |
| **LG** | **No.**  |
| **Nokia** | **No** |
|  |  |

### 2.1.3 U2U discovery

The most difficult discussion in last RAN meeting is whether to introduce a L3 specific indication in SIB12 to let L3 Remote/Relay UE know the network supports L3 discovery. Majority companies support this indication. And to make progress, some companies come up with a compromised solution, i.e. making the discovery configuration in SIB12 as an implicit indication of L3 discovery.

**Question 8: For L3 U2U discovery indication in SIB12, which option is preferred?**

* **Option1: an explicit indication of L3 discovery**
* **Option2: present of U2U discovery configuration means support of L3 U2U discovery, otherwise, it means no support of L3 U2U discovery.**
* **Option3: others**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Option** | **Comments** |
| **Apple** | **Option 2** | **There is no need for NW to make the U2U relay discovery configuration absent while support L3 U2U.**  |
| **OPPO** | **Option 1** | **Option 1 is clearer and allows the flexibility of deployment of L2/3 U2U for both UE and network and it is also aligned with R17 U2N design.****Option 2 mandate the network to provide the U2U threshold configuration in SIB message if the network supports L3 U2U Relay. And The support of L2 and L3 U2U operation for IDLE/INACTIVE UEs are coupled with each other since threshold configuration is common for L2/3 U2U, which means for IDLE/INACTIVE UEs, the L2 U2U operation can be performed even it is not supported by the network.** |
| **LG** | **Option 2** | **We think option 2 can be shown implicitly whether the gNB support L3 U2U relay or not. Explicit indication doesn’t need in this case.**  |
| **Lenovo** | **Option 2** |  |
| **Nokia** | **Option 1** |  |
|  |  |  |

For U2U discovery, another issue is how to differentiate U2U Remote/relay UE from U2N Remote/Relay UE. R2-2400639 proposes to indicate whether the SUI is for U2U relay UE or U2U remote UE, since the dedicated discovery configurations (i.e. AS condition thresholds) are provided in the condition of acting as U2U Relay/Remote UE. Therefore, the Network needs to distinguish whether the SUI concerning discovery transmission is from U2U Relay or U2U Remote UE to provide dedicated U2U discovery/relay (re)selection configuration.

The TP proposed in R2-2400639 is as follows:

|  |
| --- |
| SidelinkUEInformationNR-v1800-IEs ::= SEQUENCE { sl-CarrierFailureList-r18 SL-CarrierFailureList-r18 OPTIONAL, sl-TxResourceReqL2-U2U-r18 SL-TxResourceReqL2-U2U-r18 OPTIONAL, sl-PosRxInterestedFreqList-r18 SL-InterestedFreqList-r16 OPTIONAL,sl-PosTxResourceReqList-r18 SL-TxResourceReqList-r16 OPTIONAL,ue-Type-r18 ENUMERATED {U2UrelayUE, U2UremoteUE} OPTIONAL, nonCriticalExtension SEQUENCE {} OPTIONAL} |

**Question 9a: To differentiate the SUI is for U2U relay or remote discovery, do you agree to add ue-type indication as U2UrelayUE and U2UremoteUE?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **OPPO** | **Yes** | **Since the network needs to know whether to provide SL-RelayUE-ConfigU2U or SL-RemoteUE-ConfigU2U configuration.** |
| **Nokia** | **Yes** |  |
|  |  |  |
|  |  |  |

Another aspect is that for U2U discovery resource request in SUI, we reused Rel-17 signalling, then the network can not know the request is for U2U or U2N, so it cannot check the correct UE authorization information and cannot manage the radio resource for the correct service type. This issue was raised by Nokia during CR discussion, and O419 provide two options in R2-2400639.

Option-1: Introduce new list for R18 U2U Relay discovery transmission report.

|  |
| --- |
| SL-TxResourceReqDisc-v1800::= SEQUENCE { sl-DestinationIdentityDisc-v1800 SL-DestinationIdentity-r16, sl-CastTypeDisc-v1800 ENUMERATED {broadcast, groupcast, unicast, spare1}, sl-TxInterestedFreqListDisc-v1800 SL-TxInterestedFreqList-r16, sl-TypeTxSyncListDisc-v1800 SEQUENCE (SIZE (1..maxNrofFreqSL-r16)) OF SL-TypeTxSync-r16, sl-DiscoveryType-v1800 ENUMERATED {L2-U2Urelay-r18, L3-U2Urelay-r18},...} |

Option-2: Reuse the old list with an addition indication on discovery type as L2/L3 U2U Relay discovery indication, and further clarify the use of sl-DiscoveryType-r17, i.e., if ‘*relay*’ is indicated in sl-DiscoveryType-r17 and sl-DiscoveryType-v1800 is present, the requested discovery resource is for U2U Relay:

|  |
| --- |
| SL-TxResourceReqDisc-r17 ::= SEQUENCE { sl-DestinationIdentityDisc-r17 SL-DestinationIdentity-r16, sl-SourceIdentityRelayUE-r17 SL-SourceIdentity-r17 OPTIONAL, sl-CastTypeDisc-r17 ENUMERATED {broadcast, groupcast, unicast, spare1}, sl-TxInterestedFreqListDisc-r17 SL-TxInterestedFreqList-r16, sl-TypeTxSyncListDisc-r17 SEQUENCE (SIZE (1..maxNrofFreqSL-r16)) OF SL-TypeTxSync-r16, sl-DiscoveryType-r17 ENUMERATED {relay, non-Relay},...,[[sl-DiscoveryType-v18xy ENUMERATED {L2-U2U-r18, L3-U2U-r18},]]} |

**Question 9: To differentiate the SUI is for U2U discovery or U2N discovery, which option for O419 is preferred?**

* **Option1: introduce a new list for R18 U2U Relay discovery Tx resource request in SUI, including L2/L3 U2U Relay indication like for R17 U2N.**
* **Option2: reuse the existing U2N list with new indications for L2/L3 U2U Relay.**
* **Option3: others**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Option** | **Comments** |
| **Apple** | **Neither** | **We do not think the authorization needs to be checked based on discovery request. In other words, either L2 U2U relay UE or L3 U2U relay UE need obtain authorization to conduct discovery. The authorizaiton only applies to L2 U2U communication.** |
| **OPPO** | **See comment** | **We understand besides the discovery-type indicate, we need to first discuss the UE-type since the dedicated discovery configurations for U2U Relay UE and U2U Remote UE are provided in the condition of acting as U2U Relay/Remote UE, i.e., the Network needs to distinguish whether the SUI concerning discovery transmission is from U2U Relay or U2U Remote UE to provide dedicated U2U discovery/relay (re)selection configuration.****If the UE-type is agreed, we can further discuss whether the discovery-type (no matter option-1/2) is needed on top of UE-type.** |
| **Nokia** | **Option 2, but only a single type “U2U-R18”** | **We think something is needed to distinguish U2U discovery from U2N discovery. Our view is that it is enough to have a single value just to indicate that it is U2U discovery (no need to differentiate L2 from L3)**sl-DiscoveryType-v18xy ENUMERATED {U2U-r18} OPTIONAL |
|  |  |  |
|  |  |  |

## 2.2 MP

### 2.2.1 N3C MP

As confirmed by the R2#124 agreement, the UAI is used to report N3C candidate relay UEs in current specification.

|  |
| --- |
| For scenario 2, the remote UE reports C-RNTI(s) of candidate relay UE(s) to gNB via the existing UEAssistanceInformation message for indirect path addition/change. |

The procedural text of otherConfig for UAI reporting is missing, and H659 propose to add the procedural text. But this RIL was flagged, and some other alternatives are provided in R2-2400426. The intention is to reduce the measurement delay by including N3C support in RRCSetup or system information.

The rapporteur understands the intention and proposed solution is quite like EMR, for which there are also new indication (i.e. *idleModeMeasurementsNR*) is included in SIB1. In this case, the rapporteur would like check company views on whether to have the similar SIB indication for N3C relay measurement. FFS SIB1 or other SIB.

**Question 10: Do companies agree to add a new indication in SIB for support of N3C MP?**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **Yes with comment** | **We are fine to let NW indicate the support of Scenario 2 in SIB, but this is not to be in SIB12, as SIB12 is only for Sidelink-related IE.** |
| **OPPO** | **Yes** |  |
| **MediaTek** | **Yes** | **Agree with Apple, the N3C support is not sidelink-related, SIB12 is not suitable. As rapporteur indicated that it can be in SIB1.** |
| **LG** | **Yes** |  |
| **Lenovo** | **Yes** |  |
| **Nokia** | **Yes** |  |
|  |  |  |

Another left issue for N3C MP is that whether to add N3C indirect path addition/change failure reporting procedure. Please note this does not require new signalling considering the failure reporting message is applicable to both of SL MP and N3C MP, the additional work is only to add some procedural text.

**Question 11: Do companies agree to add procedural text for N3C indirect path addition/change failure as proposed by C234, C235? (No asn.1 impact)**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Yes/No** | **Comments** |
| **Apple** | **No strong view** | **We can also assume the indirect path is ideal and not going to fail. Then, we only capture the exceptional case (indirect path failure) case as a NOTE.**  |
| **LG** | **No strong view** |  |
| **Lenovo** | **Yes** |  |
| **Nokia** | **No strong view** | **Have the same understanding as Apple.** |
|  |  |  |

### 2.2.2 s-MeasureConfig handling for SL relay measurement

Since Rel-17, it was agreed that s-MeasureConfig is not applicable to relay related measurement events. However, as indicated by J062, there is no procedural text to explain whether this is achieved by network, i.e. not providing configuration or let UE handle the configuration if any.

R2-2401211 provides two options:

* Option 1: left to gNB’s implementation, e.g. not configure s-MeasureConfig in relay operation, and perform fullConfig to remove s-MeasureConfig if configured in non-relay operation;
* Option 2: if the UE is acting as a L2 U2N Remote UE, it doesn’t follow s-MeasConfig.

**Question 12: For s-MeasConfig issue raised by J062, which option is preferred?**

* **Option1: left to gNB’s implementation, e.g. not configure s-MeasureConfig in relay operation, and perform fullConfig to remove s-MeasureConfig if configured in non-relay operation.**
* **Option2: specify UE behaviour, i.e. if the UE is acting as a L2 U2N Remote UE, it doesn’t follow s-MeasConfig.**
* **Option3: others**

|  |  |  |
| --- | --- | --- |
| **Company**  | **Option** | **Comments** |
| **Apple** | **None with comment** | **If this is a Rel-17 issue, can we discuss this in next meetng based on CR?** |
| **OPPO** | **Option-1** | **Since it is a Rel-17 issue, Option-1 is preferred to avoid NBC change.** |
| **LG** | **Option-1** | **Option-1 seems no NBC change.** |
| **Lenovo** | **Option 1** | **Left to gNB implementation.** |
| **Nokia** | **Comment** | **If we want to clarify something, then this should be clarified in Rel-17, this is not a Rel-18 issue** |
|  |  |  |

## 2.3 Others

**Question 13: Any other issues need to be discussed?**

|  |  |
| --- | --- |
| **Company**  | **Comments** |
| **OPPO** | **The issue discussed in O425 on SRAP configuration to be used by L2 U2U Remote UE and Relay UE during RRC re-establishment.****In the current RRC specification, the sl-L2RelayUE-Config or sl-L2RemoteUE-Config will be released during RRC connection re-establishment. We need to discuss which configuration should be used in that case, there are 2 options:****Option-1: Use dedicated configuration for U2U Relay during RRC re-establishment procedure, which means the release of sl-L2RelayUE-Config and sl-L2RemoteUE-Config during RRC re-establishment should not be applied to L2 U2U relay;****Option-2: Use the configuration in SIB12 like IDLE/INACTIVE UEs, which is similar to the use of exceptional pool for SL communication.** |
| **ASUSTeK** | **Issue 1**: Clause 5.8.9.3a specifies end-to-end PC5 connection failure related actions performed by L2 U2U Remote UE. The L2 U2U Remote UE releases the end-to-end DRBs for this end-to-end PC5 connection according to clause 5.8.9.1a.1, which in turn triggers the PC5 Relay RLC channel release as specified in clause 5.8.9.7.1 (i.e. release the RLC entity and the corresponding logical channel).5 cases are considered in clause 5.8.9.3a i.e. (1) upon detection of end-to-end PC5 connection failure due to per-hop PC5 link failure; (2) upon detection of end-to-end PC5 connection failure due to per-hop PC5 link release; (3) upon T400 expiry for an end-to-end PC5 connection (4) upon integrity check failure indication from sidelink PDCP entity; and (5) upon detection end-to-end PC5 connection failure due to reception of *NotificationMessageSidelink* indicating PC5 RLF from the L2 U2U Relay UE for a specific destination.For Cases (1 & 2), since per-hop PC5 link failure/release occurs to the PC5 link between the L2 U2U Remote UE and the L2 U2U Relay UE, the L2 U2U Remote UE can just release all the PC5 Relay RLC channels associated with the PC5 link. However, since the PC5 link between the L2 U2U Remote UE and the L2 U2U Relay UE is still available for Cases (3 - 5), there is a need for the L2 U2U Remote UE (i.e. Tx UE) to send a *RRCReconfigurationSidelink* message to the L2 U2U Relay UE (i.e. Rx UE) to release the PC5 Relay RLC channel if there is no other end-to-end SL DRB associated with this PC5 Relay RLC channel. So, we think the L2 U2U Remote UE’s behavior in clause 5.8.9.7.1 should be corrected to reflect different UE behaviors for Cases (1 & 2) and Cases (3 - 5) e.g. the L2 U2U Remote UE shall release the PC5 Relay RLC channel for Cases (3 - 5) after receiving the *RRCReconfigurationCompleteSidelink* message from the L2 U2U Relay UE. It is noted that another *RRCReconfigurationSidelink* message is sent by the L2 U2U Remote UE (i.e. Tx UE) to the peer L2 U2U Remote UE (i.e. Rx UE) to release the end-to-end DRB. The related text proposal is summarized in Issue 4.**Issue 2**: In case an end-to-end SL DRB is released due to no associated sidelink QoS flow in the L2 U2U Remote UE as specified in clause 5.8.9.1a.1.1, the L2 U2U Remote UE (i.e. Tx UE) also needs to send a *RRCReconfigurationSidelink* message to the L2 U2U Relay UE (i.e. Rx UE) to release the PC5 Relay RLC channel if there is no other end-to-end SL DRB associated with this PC5 Relay RLC channel. This case also needs to be considered in clause 5.8.9.7.1. The related text proposal is summarized in Issue 4.**Issue 3**: Similar situation as Issue 2 should be considered for the L2 U2U Relay UE behavior if no sidelink QoS flow indicated by source L2 U2U Remote UE is mapped to the end-to-end sidelink DRB for transmission as specified in clause 5.8.9.1a.1.1. Clause 5.8.9.7.1 also needs to be modified to reflect this. E.g. the L2 U2U Relay UE (i.e. Tx UE) needs to send a *RRCReconfigurationSidelink* message to the peer L2 U2U Remote UE (i.e. Rx UE) to release the PC5 Relay RLC channel if there is no other end-to-end SL DRB associated with this PC5 Relay RLC channel. The related text proposal is summarized in Issue 4.**Issue 4**: Clause 5.8.9.3b specifies end-to-end PC5 connection failure/release related actions performed by L2 U2U Relay UE. The L2 U2U Relay UE considers the end-to-end DRBs for this end-to-end PC5 connection is released, which in turn triggers the PC5 Relay RLC channel release according to clause 5.8.9.7.1 (i.e. release the RLC entity and the corresponding logical channel).3 cases are considered in clause 5.8.9.3b i.e. (1) upon detection of end-to-end PC5 connection failure due to per-hop PC5 link failure; (2) upon detection of end-to-end PC5 connection failure due to per-hop PC5 link release; (3) upon reception of *RemoteUEInformationSidelink* indicating end-to-end connection release or failure for a specific destination.For Cases (1 & 2), the per-hop PC5 link failure/release occurs to the PC5 link between the L2 U2U Remote UE and the L2 U2U Relay UE. In this situation, there is a need for the L2 U2U Relay UE (i.e. Tx UE) to send a *RRCReconfigurationSidelink* message to the peer L2 U2U Remote UE (i.e. Rx UE) to release the PC5 Relay RLC channel if there is no other end-to-end SL DRB associated with this PC5 Relay RLC channel. We think the L2 U2U Relay UE’s behavior in clause 5.8.9.7.1 should also be corrected to reflect this.For Case (3), the end-to-end connection failure/release occurs to the end-to-end connection between the L2 U2U Remote UE and the peer L2 U2U Remote UE. In this situation, there is a need for the L2 U2U Relay UE (i.e. Tx UE) to send a *RRCReconfigurationSidelink* message to each of the L2 U2U Remote UE (i.e. Rx UE1) and the peer L2 U2U Remote UE (i.e. Rx UE2) to release the PC5 Relay RLC channels if there is no other end-to-end SL DRB associated with the PC5 Relay RLC channels. We think the L2 U2U Relay UE’s behavior in clause 5.8.9.7.1 should also be corrected to reflect this.Potential text proposal for clause 5.8.9.7.1 to solve the above 4 issues:5.8.9.7.1 PC5 Relay RLC channel release…1> if the PC5 Relay RLC channel release was triggered by end-to-end DRB release as specified in 5.8.9.1a.1.2:2> if the UE is acting as a source L2 U2U Remote UE and end-to-end DRB release was triggered upon detection of end-to-end PC5 connection failure due to per-hop PC5 link failure or per-hop PC5 link release; or2> after receiving the *RRCReconfigurationCompleteSidelink* message, if the UE is acting as a L2 U2U Remote UE and end-to-end DRB release was triggered due to no associated sidelink QoS flow, T400 expiry, integrity check failure, or reception of *NotificationMessageSidelink* indicating PC5 RLF from the L2 U2U Relay UE; or2> after receiving the *RRCReconfigurationCompleteSidelink* message, if the UE is acting as a L2 U2U Relay UE and end-to-end DRB release was triggered due to no associated sidelink QoS flow, end-to-end PC5 connection failure, or reception of *RemoteUEInformationSidelink* indicating end-to-end connection release or failure;~~2~~3> release the RLC entity and the corresponding logical channel; |
| **ASUSTeK** | **Issue 5**: In our understanding, clause 5.8.9.7.2 reuses the same mechanism of PC5 Relay RLC entity establishment and reconfiguration, as in L2 U2N Relay, for L2 U2U Relay. That is, the L2 U2U remote UE may establish a sidelink RLC entity with the L2 U2U relay UE in accordance with *sl-RLC-ChannelConfig* received from the L2 U2U remote UE’s gNB and sends *sl-RLC-ChannelConfigPC5* to the L2 U2U relay UE for establishing a corresponding sidelink RLC entity in the L2 U2U relay UE. For a RLC AM entity or bi-directional UM entity, the L2 U2U relay UE may send a *SidelinkUEInformationNR* message to request the opposite directional configuration of a PC5 Relay RLC channel (i.e. *sl-RLC-ChannelConfig*) associated with the sidelink RLC entity. After receiving the *sl-RLC-ChannelConfig* from the L2 U2U relay UE’s gNB, the L2 U2U relay UE then sends the *sl-RLC-ChannelConfigPC5* to the L2 U2U remote UE for reconfiguring the sidelink RLC entity.According to clause 5.8.9.7.2, the L2 U2U remote UE reconfigures the sidelink RLC entity if *sl-RLC-ChannelID-PC5* received from the L2 U2U relay UE is equal to *sl-RLC-ChannelID* received from the L2 U2U remote UE’s gNB. In L2 U2N Relay, both the L2 U2N remote UE and the L2 U2N relay UE are served by the same gNB and thus the gNB can configure the same *sl-RLC-ChannelID* to both the L2 U2N remote UE and the L2 U2N relay UE. However, in L2 U2U Relay the serving gNBs of the L2 U2U remote UE and the L2 U2U relay UE may be different and thus the *sl-RLC-ChannelID* included in the *sl-RLC-ChannelConfig* received from the L2 U2U remote UE’s gNB and the *sl-RLC-ChannelID-PC5* included in the *sl-RLC-ChannelConfigPC5* received from the L2 U2U relay UE may be different. As a result, instead of reconfiguring an existing the sidelink RLC entity, a new sidelink RLC entity will be established by the L2 U2U remote UE in accordance with the *sl-RLC-ChannelConfigPC5* received from the L2 U2U relay UE. How to ensure the L2 U2U remote UE receives the same *sl-RLC-ChannelID-PC5* fromthe L2 U2U relay UEasthe *sl-RLC-ChannelID* received from its serving gNB should be considered. |
| **ASUSTeK** | **Issue 6**: PDCP entity/SDAP entity release, by the L2 U2U remote UE, for sidelink DRB release due to end-to-end PC5 connection failure was missing in clause 5.8.9.1a.1.2. |
| **ASUSTeK** | **Issue 7**: Clause 5.8.9.1a.2.1 includes the case “if any sidelink QoS flow is (re)configured by source L2 U2U Remote UE and is mapped to a end-to-end sidelink DRB for transmission when the UE is acting as L2 U2U Relay UE” in sidelink DRB addition/modification conditions. However, the behaviour of L2 U2U Relay UE was missing in clause 5.8.9.1a.2.2.5.8.9.1a.2.1 Sidelink DRB addition/modification conditionsFor NR sidelink communication, a sidelink DRB addition is initiated only in the following cases:<omitted>1> if any sidelink QoS flow is (re)configured by source L2 U2U Remote UE and is mapped to a end-to-end sidelink DRB for transmission when the UE is acting as L2 U2U Relay UE;**Text proposal:**5.8.9.1a.2.2 Sidelink DRB addition/modification operationsFor the sidelink DRB, whose sidelink DRB addition conditions are met as in 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:<omitted>2> for an end-to-end sidelink DRB (i.e. the UE is acting as L2 U2U Remote UE or L2 U2U Relay UE):3> if the UE is in RRC\_CONNECTED:4> associate this end-to-end sidelink DRB with the PC5 RLC channel indicated by *sl-EgressRLC-ChannelPC5* included in *sl-ConfigDedicatedNR,* received from *RRCReconfiguration*;3> else if the UE is in RRC\_IDLE or RRC\_INACTIVE:4> consider the PC5 RLC channel derived by per-SLRB QoS profile of this end-to-end sidelink DRB based on the configuration in *SIB12* as the egress PC5 relay RLC channel; 4> associate this end-to-end sidelink DRB with the PC5 RLC channel and configure the mapping to SRAP;3> else if the UE is out of coverage:4> consider the PC5 RLC channel derived by per-SLRB QoS profile of this end-to-end sidelink DRB based on the configuration in *SidelinkPreconfigNR* as the egress PC5 relay RLC channel;4> associate this end-to-end sidelink DRB with the PC5 RLC channel and configure the mapping to SRAP;<omitted>For the sidelink DRB, whose sidelink DRB modification conditions are met as in 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 modification was triggered due to the reception of the *RRCReconfigurationSidelink* message; or1> for unicast, after receiving the *RRCReconfigurationCompleteSidelink* message, if the sidelink DRB modification was triggered due to the configuration received within the *sl-ConfigDedicatedNR,* *SIB12* or *SidelinkPreconfigNR*:<omitted>2> for an end-to-end sidelink DRB (i.e. the UE is acting as L2 U2U Remote UE or L2 U2U Relay UE):3> if the UE is in RRC\_CONNECTED:4> reconfigure the SRAP entity for the sidelink DRB, in accordance with the *sl-SRAP-ConfigU2U* received in *sl-ConfigDedicatedNR*, if included;3> else if the UE is in RRC\_IDLE or RRC\_INACTIVE:4> reconfigure the SRAP entity for the sidelink DRB derived based on configuration received in *SIB12*;3> else if the UE is out of coverage:4> reconfigure the SRAP entity for the sidelink DRB derived based on configuration received in *SidelinkPreconfigNR*. |
| **ASUSTeK** | **Issue 8**: According to clause 5.8.9.1a.2.2, the source remote UE may reconfigure the SRAP entity for the end-to-end SL DRB based on *SIB12* or *SidelinkPreconfigNR*. It is possible that a first-hop PC5 Relay RLC channel may become useless since the original end-to-end SL DRB may be mapped to another first-hop PC5 Relay RLC channel based on the newly applied *SIB12* or *SidelinkPreconfigNR*. Besides, it is also possible that a second-hop PC5 Relay RLC channel may become useless since the original end-to-end SL DRB may be mapped to another second-hop PC5 Relay RLC channel based on the *SIB12* or *SidelinkPreconfigNR* newly applied by the relay UE. In above situation, PC5 Relay RLC channel release is missing.**Text proposal:**5.8.9.1a.2.2 Sidelink DRB addition/modification operations<omitted>For the sidelink DRB, whose sidelink DRB modification conditions are met as in 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 modification was triggered due to the reception of the *RRCReconfigurationSidelink* message; or1> for unicast, after receiving the *RRCReconfigurationCompleteSidelink* message, if the sidelink DRB modification was triggered due to the configuration received within the *sl-ConfigDedicatedNR,* *SIB12* or *SidelinkPreconfigNR*:<omitted>2> for an end-to-end sidelink DRB (i.e. the UE is acting as L2 U2U Remote UE or L2 U2U Relay UE):3> if the UE is in RRC\_CONNECTED:4> reconfigure the SRAP entity for the sidelink DRB, in accordance with the *sl-SRAP-ConfigU2U* received in *sl-ConfigDedicatedNR*, if included;3> else if the UE is in RRC\_IDLE or RRC\_INACTIVE:4> reconfigure the SRAP entity for the sidelink DRB derived based on configuration received in *SIB12*;4> perform the PC5 Relay RLC channel release according to 5.8.9.7.1, if there is no other end-to-end sidelink DRB(s) associated with a PC5 Relay RLC channel;3> else if the UE is out of coverage:4> reconfigure the SRAP entity for the sidelink DRB derived based on configuration received in *SidelinkPreconfigNR*;4> perform the PC5 Relay RLC channel release according to 5.8.9.7.1, if there is no other end-to-end sidelink DRB(s) associated with a PC5 Relay RLC channel.…5.8.9.7.1 PC5 Relay RLC channel releaseThe UE shall:1> if the PC5 Relay RLC channel release was triggered after the reception of the *RRCReconfigurationSidelink* message; or1> after receiving the *RRCReconfigurationCompleteSidelink* message, if the PC5 Relay RLC channel release was triggered due to the configuration received within the *sl-ConfigDedicatedNR* ordue to sidelink DRB modification as specified in clause 5.8.9.1a.2.2:2> for each *SL-RLC-ChannelID* in *sl-RLC-ChannelToReleaseList* received in *sl-ConfigDedicatedNR* within *RRCReconfiguration,* or for each *SL-RLC-ChannelID* included in the received *sl-RLC-ChannelToReleaseListPC5* that is part of the current UE sidelink configuration:3> release the RLC entity and the corresponding logical channel associated with the *SL-RLC-ChannelID*;1> if the PC5 Relay RLC channel release was triggered by end-to-end DRB release as specified in 5.8.9.1a.1.2:2> release the RLC entity and the corresponding logical channel;1> if the PC5 Relay RLC channel release was triggered for a specific destination by upper layers as specified in 5.8.9.5, or due to sidelink RLF as specified in 5.8.9.3:2> release the RLC entity and the corresponding logical channel associated with the *SL-RLC-ChannelID* of the specific destination; |
| **LG** | **Issue 1-1: Does it need to be handled when the source remote UE doesn’t receive UEInformationResponseSidelink from relay UE after sending UEInformationRequestSidelink?**We think this issue needs to be handled. If not, it’s not clear how the source remote UE has to operate when split-QoS information doesn’t know.**Issue 1-2: If the issue 1-1 is valid, how to handle this issue?**- (Option 1) timer-based handling. For example, if the timer expires, the source remote UE or the serving gNB of the source remote UE configures the 1st-hop RLC channel (i.e., packet delay budget) within half of the e2e PDB. (under the assumption of the PDB is split evenly between two hops)- (Option 2) trigger relay reselection. |
| **LG** | **Issue 2: Is the same value of the T400 timer applied in the cases of single-hop (i.e., the 1st-hop or the 2nd-hop) SL configuration and U2U e2e SL configuration?**- In the current spec, it looks like the two cases apply the same T400 timer. To reduce the latency for the connection establishment between the source and target remote UE, assigning another T400 value for the U2U relay may be needed. Also, for considering multi-hop extensibility, we can discuss whether to define the T400 timer for the U2U relay operation. |
| **Lenovo** | **B109 is missing in this email which will impact ASN.1.**There are two types of failure including sidelink radio link failure or a sidelink RRC reconfiguration failure according to clauses 5.8.9.3 and 5.8.9.1.8, respectively. In the current specification for U2U relay, only detection of PC5 RLF is used to trigger NotificationMessageSidelink message. Therefore, the case of sidelink RRC reconfiguration failure is missing. We propose that a U2U Relay UE initiates transmission of the NotificationMessageSidelink message due to sidelink RRC reconfiguration failure. |
|  |  |
|  |  |
|  |  |
|  |  |

# Conclusion

TBD