**#3GPP TSG RAN WG1 #100bis R1-2001892**

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

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**Source:** Moderator (LG Electronics)

**Title:** Feature lead summary#1 for AI 7.2.4.5 Physical layer procedures for sidelink

**Document for:** Discussion and decision

# **Potential issues for email discussions**

* Power control
  + Issue 1-1: The lower bound of the transmitted PSFCH number in Case 1-2 and Case 2-2
  + Issue 1-2: How to determine the number of transmitted PSFCHs when P\_(O,PSFCH) is not provided
  + Issue 1-3: RS used to derive DL pathloss for open-loop power control based on DL pathloss.
  + Issue 1-4: the assumption on P\_("MAX" ,CBR) when maximumtransmitPower-SL is not provided
* Prioritization
  + Issue 2-1: Remaining issues on prioritization for SL HARQ reporting on PUCCH or PUSCH
  + Issue 2-2: Tie-break of the same priority
  + Issue 2-3: UL/SL prioritization for the case when multiple UL TX and multiple SL TX overlap in time
  + Issue 2-4: How to handle remaining UL/SL prioritization cases other than Issue 2-1/2-2/2-3
* HARQ operation
  + Issue 3-1: Details of indicating SL HARQ feedback related information
  + Issue 3-2: Capturing PSFCH reception behavior in the specifications
  + Issue 3-3: Exact location of PSFCH slots in the time domain in a given resource pool
  + Issue 3-4: Number of HARQ processes in SCI
* Sidelink CSI
  + Issue 4-1: Assumptions for the CSI reference resource
  + Issue 4-2: How to determine the CQI table used for CSI reporting

Company input on the identification of email discussion topics:

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| --- | --- | --- |
| Company | Prioritized issues | Comments |
| LGE | Thread #1 {1-1, 1-2, 1-3}  Thread #2 {2-1, 2-3, 2-4}  Thread #3 {3-1, 3-2, 3-4} | We propose to treat the issues of completing RRC parameters when RAN1 discusses RRC parameter update. |
| NTT DOCOMO | Thread #1 {1-1, 1-2, 1-3, 1-4}  Thread #2 {2-1, 2-3, 2-4}  Thread #3 {3-1, 3-2, 3-3} | Regarding issue 3-4, the discussion will be dependent on UE feature discussion, where how many HARQ processes are mandated is discussed. |
| ZTE, Sanechips | Thread #1 {1-1, 1-2, 1-3}  Thread #2 {2-1, 2-3, 2-2/4}  Thread #3 {3-1, 3-2, 3-3} | We think issue 2-2 is part of remaining issues/cases, and therefore can be merged into issue 2-4.  We think 3-4 could be up to RAN2. |
| Apple | Thread #1 {1-1, 1-2, 1-3, 1-4}  Thread #2 {2-1, 2-3, 2-4}  Thread #3 {3-1, 3-2, 3-3} | For issue 1-4, it may be discussed in QoS AI. If so, we do not need to discuss it here. |
| Huawei, HiSilicon | [1-1, 1-2, 1-3]  2-1, 2-3, 2-4  3-1, 3-4 (in UE features?)  4-2, 4-1 | Issue 4-2 is very likely to have higher-layer signaling impact so needs to be addressed this meeting. Issue 4-1 may also according to the papers. Thus if the CSI issues are not prioritized here, they must be prioritized in the RRC discussion, which may be difficult.  It seems issues 1-x, although clearly relevant, have little or no impact on other WGs, so could be deferred to August.  Possibly, we should take one email thread for all things impacting other WGs, and of the remaining PHY-only issues decide which in May and which in August:   * “Other WGs” email thread: 3-2, 4-1, 4-2. * “PHY only” threads in May: Issues 2-x, 3-1(or 1-x) * August: Issues 1-x (or 3-1). * NOTE: 3-4 in UE features. |
| vivo | Thread #1 {2-1, 2-3}  Thread #2 {3-1, 3-2, 3-3, 3-4}  Thread #3 {4-2, 4-1} | Issue 2-2 can be up to UE implementation.  Issue 2-4 is concerning the overlapping between different UL transmissions which does not seem to be a SL issue.  Agree with Huawei that issue 4-2 may have RAN2 impact, so that should be prioritized. On the other hand, issue 1-x have no RAN2 impact, so that can be discussed in next meeting. |

Proposed email discussion topics:

# **Power control**

*Agreements made in RAN1#100b-e:*

*When the UE supports up to Nmax,psfch simultaneous PSFCH transmissions in a PSFCH TX occasion and UE have Nreq PSFCHs to be transmitted in a given PSFCH TX occasion, the UE selects N PSFCHs for actual transmission with ascending order of the priority in a PSFCH TX occasion as follows:*

* *Case 1: When Nreq<=Nmax,psfch and is (pre-)configured,*
  + *Case 1-1: N=Nreq if the sum of for the Nreq PSFCHs is smaller than or equal to determined for the Nreq PSFCH transmissions.*
  + *Case 1-2: Otherwise, N is up to UE implementation under N >= X >= 1.*
* *Case 2: When Nreq>Nmax,psfch and is (pre-)configured, the UE firstly selects Nmax,psfch PSFCHs with ascending order of the priority.*
  + *Case 2-1: N=Nmax,psfch if the sum of for the Nmax,psfch PSFCHs is smaller than or equal to determined for the Nmax,psfch PSFCH transmissions.*
  + *Case 2-2: Otherwise, N is up to UE implementation under N >= X >= 1.*
* *Down select X in RAN1#101-e*
  + *Alt 1: X = max {1, the largest value which doesn’t lead to the power limited case}*
  + *Alt 2: X= 1*
  + *Other alternatives are not precluded.*
* Issue 1-1: The lower bound of the transmitted PSFCH number in Case 1-2 and Case 2-2
  + X = max {1, the largest value which doesn’t lead to the power limited case}
    - Support: [Nokia,1] [Huawei,3] [LG,5] [Lenovo,9] [CMCC,12] [Spreadtrum,13] [Apple,16] [InterDigital,18] [Ericsson,23] (9 companies)
      * Rationale: Unclear benefit of further reducing the number of PSFCH TXs when the UE transit power is sufficient.
  + X=1
    - Support: [vivo,2] [ZTE,4] [CATT,6] [Samsung,10] [Panasonic,11] [OPPO,15] [Qualcomm,22] (7 companies)
      * Rationale: To find the largest value which doesn’t lead to the power limited case needs large specification work
* Issue 1-2: How to determine the number of transmitted PSFCHs when is not provided
  + N is up to UE implementation with X=1 and the transmit power of each PSFCH is where determined for the N PSFCH transmission
    - Support: [vivo,2] [ZTE,4] [Qualcomm,22] (3 companies)
  + N=1 and the transmit power of PSFCH is determined for a single PSFCH transmission
    - Support: [LG,5]
  + N= min(Nreq, Nmax,psfch) and the transmit power of each PSFCH is where determined for the N PSFCH transmission
    - Support: [LG,5]
* Issue 1-3: RS used to derive DL pathloss for open-loop power control based on DL pathloss.
  + Reuse DL pathloss estimation for PUSCH scheduled by DCI format 0\_0
    - Support: [LG,5]
  + Take minimum value of DL pathloss across multiple configured RS
    - Support: [ASUSTek,20]
  + DL RS of PDCCH for SL grant
    - Support: [ASUSTek,20]
* Issue 1-4: the assumption on when maximumtransmitPower-SL is not provided
  + is not used for power control
    - Support: [vivo,2] [OPPO,15] [Apple,16]
* Others
  + [vivo,2] [ZTE,4]
    - Correcting power control for PSSCH considering that a UE could be configured to use DL pathloss only, SL pathloss only, or both DL pathloss and SL pathloss for the SL open-loop power control

# **Prioritization**

* Issue 2-1: Remaining issues on prioritization for SL HARQ reporting on PUCCH or PUSCH
  + Priority of SL HARQ reporting on PUCCH or PUSCH for the case when there is no associated PSFCH.
    - When a UE does not transmit a PSCCH with a SCI format 1-A scheduling a PSSCH in any of the resources provided by a configured grant in a single period, the UE reports ACK to the serving gNB. The priority of this ACK is
      * Smallest priority value: [LG,5]
      * Largest priority value: [vivo,2] [Fujitsu,14]
      * (Pre)configured priority value: [LG,5]
    - When a UE does not transmit a PSCCH due to intra-UE prioritization, the UE reports NACK to the serving gNB. The priority of this NACK is
      * The priority value of the dropped PSSCH: [vivo,2] [LG,5] [Fujitsu,14]
    - If the SL transmission does not use SL HARQ feedback, the UE reports NACK to request further resources for blind retransmission and ACK otherwise. The priority of this SL HARQ-ACK is
      * Smallest priority value:
      * Largest priority value: [vivo,2]
      * The priority value of the associated PSSCH: [LG,5]
    - In case of reaching the maximum number of HARQ re-transmissions for a TB, the UE sends one bit on the UL resources for SL HARQ-ACK reporting. The priority of this SL HARQ-ACK is
      * The priority value of the associated PSSCH: [LG,5]
  + When SL HARQ reporting on PUCCH or PUSCH overlaps with UL TX
    - When PUCCH carrying SL HARQ reporting overlaps with other UL TX except for PUSCH without UCI in the same carrier,
      * Reuse UL/SL prioritization rule for PSFCH and UL transmission except for PUCCH carrying SL HARQ reporting
        + Support: [Huawei,3] [ZTE,4] [LG,5] [Samsung,10] [CMCC,12] [NTT,21]
    - When PUSCH carrying SL HARQ reporting overlaps with UL TX,
      * Rule for PUSCH without SL HARQ reporting is reused
        + Support: [LG,5]
  + When SL HARQ reporting on PUSCH overlaps with SL TX
    - When PUSCH carrying SL HARQ reporting overlaps with SL TX,
      * Reuse UL/SL prioritization rule for PUSCH without SL HARQ reporting
        + Support: [LG,5]
      * UE implementation
        + Support: [CMCC,12]
      * UL TX is prioritized if SL HARQ reporting is prioritized over the SL TX or if PUSCH without SL-HARQ reporting is prioritized over the SL TX. Otherwise, SL TX is prioritized.
        + Support: [CMCC,12] [Spreadtrum,13] [Apple,16]
* Issue 2-2: Tie-break of the same priority
  + PSFCH TX and PSFCH RX
    - Up to UE implementation: [Samsung,10]
    - Groupcast with HARQ feedback Option 1 is prioritized: [Fraunhofer,7] [Qaulcomm,22]
    - NACK feedback of unicast/groupcast with HARQ feedback Option 2 is deprioritized: [Fraunhofer,7]
    - Based on additional rule by using HARQ status, cast type, and HARQ feedback option): [InterDigital,18]
  + For prioritization between PUCCH carrying SL HARQ reporting and SL-TX with the same priority,
    - Up to UE implementation
      * Support: [ZTE,4] [Samsung,10]
* Issue 2-3: UL/SL prioritization for the case when multiple UL TX and multiple SL TX overlap in time
  + Whether look-ahead operation is assumed to be used or not
    - Look-ahead operation is used (i.e. To decide whether SL TX in slot i is prioritized, the priority of SL TX in slot i+1 is not used, and to decide whether UL TX in slot n is prioritized, the priority of UL TX in slot n+1 is not used).
      * Support: [LG,5]
    - Look-ahead operation is not used (i.e. To decide whether SL TX in slot i is prioritized, the priority of SL TX in slot i+1 can be used. To decide whether UL TX in slot n is prioritized, the priority of UL TX in slot n+1 can be used.)
      * Support: [ZTE,4] [LG,5] [NTT,21]
  + When to perform SL/UL prioritization
    - For PUCCH carrying SL HARQ reporting, the prioritization with PUCCH is performed before multiplexing/prioritization with PUSCH [Huawei,3]
    - The prioritization is performed after UL multiplexing/cancellation [NTT,21]
    - The prioritization is performed before UL multiplexing/cancellation [Qualcomm,22]
  + [Panasonic,11] [Ericsson,23]
    - How to apply prioritization in details is up to UE implementation.
  + [OPPO,15]
    - For power sharing between UL and SL, UL/SL prioritization rule is performed for each UL carrier.
* Issue 2-4: How to handle remaining UL/SL prioritization cases other than Issue 2-1/2-2/2-3
  + When PUCCH carrying SL HARQ reporting overlaps with PUSCH without UCI in the same carrier,
    - Piggybacking SL HARQ reporting on the overlapped PUSCH before performing prioritization rule
      * Support: [Huawei,3] [Samsung,10] [CMCC,12] [Qaulcomm,22]
    - Piggybacking SL HARQ reporting on the overlapped PUSCH if the overlapped PUSCH is prioritized
      * Support: [CMCC,12]
  + When PUCCH carrying SL HARQ reporting overlaps with other UL TX across different carriers,
    - Reuse UL transmit power control rule
      * Support: [LG,5]
    - Reuse UL/SL prioritization rule for PSFCH and UL transmission except for PUCCH carrying SL HARQ reporting (i.e. if PUCCH carrying SL HARQ reporting is prioritized, the UE shall adjust the other UL TX power such that the total power does not exceed P\_CMAX)
      * Support: [Fujitsu,14]
  + For prioritization between PSCCH/PSSCH and PUCCH/PUSCH without UL-SCH/SRS
    - Reuse UL/SL prioritization rule for PSFCH and UL transmission except for PUCCH carrying SL HARQ reporting
      * Support: [ZTE,4] [LG,5]
  + For prioritization between PSFCH RX and UL-TX
    - Reuse UL/SL prioritization rule for PSFCH and UL transmission except for PUCCH carrying SL HARQ reporting
      * Support: [ZTE,4]
  + MsgA PUSCH is always prioritized over sidelink transmission
    - Support: [Apple,16]
* Others
  + Consideration on how to support power sharing between UL transmission and SL transmission for dual connectivity [LG,5]
    - Reuse power control for NE-DC and EN-DC for simultaneous transmission of SL transmission and UL transmission on different carriers
    - NR-DC with Semi-static-mode1 or Semi-static-mode2 is supported for NR sidelink

# **HARQ operation**

*Agreements made in RAN1#100b-e: One SCI format (referred to as 2nd SCI format A) is defined as follows:*

* *This format includes Zone ID and Communication range requirement.*
* *This format is used when the following HARQ operations are in use*
  + *HARQ-ACK information includes only NACK*
  + *FFS: No HARQ feedback*

*Agreements made in RAN1#100b-e: One SCI format (referred to as 2nd SCI format B) is defined as follows:*

* *This format does not include Zone ID or Communication range requirement.*
* *This format is used when the following HARQ operations are in use* 
  + *No HARQ feedback*
  + *HARQ-ACK information includes ACK or NACK*
    - *FFS: how to determine M\_ID in the equation for the PSFCH resource index* 
      * *Option 1: Based on L1 ID(s)*
      * *Option 2: An explicit indication in SCI*
  + *FFS: HARQ-ACK information includes only NACK*

*Agreements made in RAN1#100b-e: Down-select one out of the following for the indication of HARQ feedback enable/disable:*

* *Option 1: This indication is conveyed in the 1st SCI.*
* *Option 2: This indication is conveyed in the 2nd SCI.*
  + *Option 2-1: This indication is present both in 2nd SCI format A and B.*
  + *Option 2-2: This indication is present in 2nd SCI format B but not in 2nd SCI format A.*

In the latest version of TS38.212, the naming of “2nd SCI format A” is “SCI format 2-B”, and the naming of “2nd SCI format B” is “SCI format 2-A, and the naming of “1st SCI” is “SCI format 1-A”.

* Issue 3-1: Details of indicating SL HARQ feedback related information
  + Whether SCI format 2-B can be used for the case of “No HARQ feedback”.
    - Yes: [Nokia,1] [vivo,2] [Intel,8] [Lenovo,9] [Apple,16] [Qaulcomm,22] [Ericsson,23] (7 companies)
      * Rationale: If mix of feedback-based retransmission and blind retransmission is supported, it would be beneficial to maintain the level of the 2nd SCI overhead for TBS determination.
    - No: [Huawei,3] [ZTE,4] [LG,5] [Fraunhofer,7] [Samsung,10] [CMCC,12] [OPPO,15] [Futurewei,17] [InterDigital,18] [NTT,21] (10 companies)
      * Rationale: Distance-based HARQ feedback does not need to have explicit indication of HARQ-ACK disabling.
  + How to determine M\_ID in the equation for the PSFCH resource index
    - Option 1: Based on L1 ID(s)
      * Support: [Nokia,1] [vivo,2] [ZTE,4] [CATT,6] [Intel,8] [Samsung,10] [Spreadtrum,13] [Sharp,19] [Ericsson,23] (9 companies)
    - Option 2: An explicit indication in SCI format 2-A
      * Support: [Huawei,3] [LG,5] [Fraunhofer,7] [Lenovo,9] [OPPO,15] [Apple,16] [InterDigital,18] [Qaulcomm,22] (8 companies)
  + Whether SCI format 2-A can be used for the case when “HARQ-ACK information includes only NACK”
    - Yes: [ZTE,4] [LG,5] [CATT,6] [Fraunhofer,7] [Intel,8] [OPPO,15] [Ericsson,23] (7 companies)
    - No: [Huawei,3] [Samsung,10] [CMCC,12] [Apple,16] [Futurewei,17] [NTT,21] [Qaulcomm,22] (7 companies)
  + Which SCI format includes the indication of HARQ feedback enable/disable
    - Option 1: This indication is conveyed in the SCI format 1-A
      * Support: [Nokia,1] [Huawei,3] [Lenovo,9] [OPPO,15] [Qaulcomm,22] (5 companies)
    - Option 2-1: This indication is present both in SCI format 2-A and SCI format 2-B
      * Support: [CATT,6] [Intel,8] [Ericsson,23] (3 companies)
    - Option 2-2: This indication is present in SCI format 2-A but not in SCI format 2-B
      * Support: [ZTE,4] [LG,5] [Fraunhofer,7] [Samsung,10] [Panasonic,11] [CMCC,12] [Futurewei,17] [InterDigital,18] (8 companies)
  + Others
    - [vivo,2]
      * Introduce additional 2nd SCI format for broadcast.
* Issue 3-2: Capturing PSFCH reception behavior in the specifications
  + Whether or how to capture UE procedure for receiving HARQ-ACK feedback on sidelink in TS38.213
    - Depending on cast type, GC HARQ feedback Options, PHY layer determines HARQ-ACK status to report to MAC layer [LG,5] [InterDigital,18]
      * Rationale:
        + MAC will define the UE behavior such as commencing retransmission based on the SL HARQ status reported from PHY
        + MAC will use the absence of HARQ feedback (DTX) for RLF declaration.
      * For unicast and groupcast with HARQ feedback Option 2, what is reported to MAC layer when UE determines the absence of the expected PSFCH
        + Reporting nothing: [LG,5]
        + Reporting DTX state: [InterDigital,18]
* Issue 3-3: Exact location of PSFCH slots in the time domain in a given resource pool
  + What is the slot offset for the PSFCH resource in time domain in a resource pool
    - (periodPSFCHresource - 1)-th slot in a period of a resource pool
      * Support: [NTT,21]
    - 0-th slot in a period of a resource pool
      * Support: [ZTE,4]
    - (Pre)configured slot offset with respect to first slot of a resource pool
      * Support:
  + Whether or how to allocate PSFCH resource across different periods of a resource pool
    - Rx UE doesn’t transmit PSFCH corresponding to PSSCH on orphan slots. PSFCH location is calculated form the start of a resource pool period [Panasonic,11] [NTT,21]
    - the number of slots in a period of a resource pool shall be a multiple of periodPSFCHresource [NTT,21]
* Issue 3-4: Number of HARQ processes in SCI
  + How many bits are needed to indicate HARQ process number in 2nd SCI.
    - The number of HARQ processes on the sidelink is configurable from the following set of values: 1, 2, 4, 8, 16
      * Support: [Futurewei,17]

# **Sidelink CSI**

* Issue 4-1: Assumptions for the CSI reference resource
  + AGC overhead
    - First symbol is occupied by duplicated symbol of 2nd symbol within a SL slot: [Huawei,3]
  + PSCCH overhead
    - Predefined overhead: [vivo,2]
    - (Pre)configured overhead: [Huawei,3] [LG,5] [Intel,8] [Panasonic,20]
    - Actual overhead associated with CSI reporting triggering: [Samsung,10]
  + PSSCH symbol duration
    - Predefined value: [vivo,2]
    - (Pre)configured overhead: [Huawei,3] [LG,5] [Intel,8] [Apple,16]
    - Actual overhead associated with CSI reporting triggering: [Samsung,10]
  + CSI-RS overhead
    - No CSI-RS overhead: [vivo,2] [Huawei,3] [LG,5] [Intel,8]
    - Actual overhead associated with CSI reporting triggering: [Samsung,10]
  + 2nd-stage SCI overhead
    - No 2nd-stage SCI overhead is used: [Huawei,3] [LG,5] [Intel,8]
    - Lowest overhead per (pre)configuration is used: [Intel,8]
    - Actual overhead associated with CSI reporting triggering: [Samsung,10]
  + Assumption on the number of DMRS symbol
    - Actual overhead associated with CSI reporting triggering: [vivo,2] [Huawei,3] [Samsung,10]
    - Lowest density per (pre)configuration: [LG,5] [Intel,8]
    - (Pre)configured overhead: [LG,5]
* Issue 4-2: How to determine the CQI table used for CSI reporting
  + Option 1: PC5-RRC configuration
    - Support: [Huawei,3] [Lenovo,9] [Futurewei,12]
  + Option 2: CSI reporting MAC CE indication
    - Support: [vivo,2]
  + Option 3: CQI table associated with MCS table indicated by SCI triggering CSI reporting.
    - Support: [LG,5]

# **Other issues**

* Further consideration on how to complete the higher layer parameters for Rel-16 sidelink
  + [LG,5]
    - Followings are (pre)configured per resource pool:
      * maximumtransmitPower-SL
      * p0-DL-PSCCHPSSCH
      * p0-DL-PSFCH
      * p0-SL-PSCCHPSSCH
      * alpha-DL-PSCCHPSSCH
      * alpha-DL-PSFCH
      * alpha-SL-PSCCHPSSCH
      * filterCoefficient-SL
      * CSIsiReporting
    - Followings are (pre)configured per SL BWP:
      * p0-DL-PSBCH
      * alpha-DL-PSBCH
  + [NTT,21]
    - Clarify that sl-PSFCH-HopID-r16 is used instead of hoppingId for PUCCH.
    - PSFCH sequence is generated as pucch-GroupHopping = neither

# **Email discussions**

# **References**

1. R1-2003313 Remaining details of Physical layer procedures for sidelink Nokia, Nokia Shanghai Bell
2. R1-2003383 Remaining issues on physical layer procedure for NR sidelink vivo
3. R1-2003498 Remaining details of physical layer procedures for sidelink Huawei, HiSilicon
4. R1-2003552 Remaining issues on PHY procedures for Rel-16 sidelink ZTE, Sanechips
5. R1-2003566 Discussion on physical layer procedure for NR sidelink LG Electronics
6. R1-2003618 Remaining issues on physical layer procedures for NR V2X CATT
7. R1-2003715 Remaining Issues in Physical Layer Procedures for NR V2X Fraunhofer HHI, Fraunhofer IIS
8. R1-2003736 Remaining opens of physical layer procedures for NR V2X sidelink design Intel Corporation
9. R1-2003827 Remaining issues on physical layer procedures for NR sidelink Lenovo, Motorola Mobility
10. R1-2003877 On Physical Layer Procedures for NR Sidelink Samsung
11. R1-2003943 Remaining issue on physical layer procedures for sidelink in NR V2X Panasonic Corporation
12. R1-2003952 Remaining issues on physical layer procedures for sidelink CMCC
13. R1-2003993 Remaining issues in physical layer procedures for sidelink Spreadtrum Communications
14. R1-2004044 Remaining issues on prioritization rule for NR V2X Fujitsu
15. R1-2004073 Remaining issues of physical layer procedure for NR-V2X OPPO
16. R1-2004219 Remaining Issues of Physical Layer Procedures for NR V2X Apple
17. R1-2004276 Remaining details on physical procedures for sidelink Futurewei
18. R1-2004296 Remaining Issues on Physical Layer Procedures for NR V2X InterDigital, Inc.
19. R1-2004330 Remaining issues on physical layer procedures for NR sidelink Sharp
20. R1-2004345 Remaining issues on sidelink physical layer procedure on NR V2X ASUSTeK
21. R1-2004387 Remaining issues on sidelink physical layer procedure NTT DOCOMO, INC.
22. R1-2004456 Physical layer procedures for sidelink Qualcomm Incorporated
23. R1-2004548 Physical layer procedures for NR sidelink Ericsson