3GPP TSG RAN WG1 Meeting #101-e R1-200xxxx

e-Meeting, May 25th – June 5th, 2020

Agenda Item: 7.2.4.2.1

Source: Moderator (Ericsson)

Title: Thread 3 on Resource allocation for NR sidelink Mode 1

Document for: Discussion, Decision

# Thread 3

[101-e- NR-5G\_V2X\_NRSL-Mode-1-03] Email discussion/approval on HARQ reporting to gNB

* Type-1 codebook for reporting in UL-SCH
  + Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.2.2
* Type-2 codebook for reporting in UL-SCH
  + Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.3.2

By 5/29, with potential TPs by 6/4 – Ricardo (Ericsson)

To facilitate the discussion, please provide your answers to the following questions. At the end, I have left room for other comments.

Please use the tables when providing your answers. My intention is to:

* Identify the changes to the spec. In my view, two aspects about this step are crucial: 1) identifying all impact to RAN2; 2) getting an idea of which parts of the Rel-15 spec are relevant for SL HARQ-ACK reporting in UL-SCH and which parts are not.
* Once there is common understanding about the parameters, start working on the changes to the spec. My intention is to address this by preparing a TP (based on the Rel-15 spec) and requesting companies’ views on it. I plan to prepare the TP as early as possible (but not earlier than 5/27). Given that this will be time consuming, the sooner we converge on the previous bullet, the better.

## Q1-1. Type-1 codebook for reporting in UL-SCH. Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.2.2.

**Identify the parameters of the Rel-15 specification that are necessary for SL HARQ-ACK reporting to the gNB in UL-SCH using type-1 codebook. If appropriate, described the necessary changes.**

**NOTE: To ensure that all comments refer to the same version of the specification, make sure to use the latest Rel-15 version (v15.9.0).**

FL comments:

* Two companies propose to introduce a SAI field in DCI 0\_1 scheduling the UL transmission. One company proposes not to have this field and consequently, not distinguish between scheduling by DCI 0\_0 and scheduling by DCI 0\_1. Another company has replied in Q1-2 that this should not be used. Before preparing the TP, I would like to understand the following:
  + Whether we need to have a tSAI index or not and why, given that we agreed not to have it for reports in PUCCH.

My preference would be to have the simplest possible solution.

Proposal (for a conclusion):

* In preparing the TP for SL HARQ-ACK reporting in PUSCH using type-1 codebook, at least the following changes are made with respect to the Rel-15 specification:
  + “PSFCH-to-HARQ\_feedback timing indicator” replaces “PDSCH-to-HARQ\_feedback timing indicator”
    - sl-PSFCH-ToPUCCH is used to determine PSFCH-to-PUCCH gap for SL CG type-1
  + *sl-DataToUL-ACK* replaces *dl-DataToUL-ACK*.
  + DCI format 3\_0 is used instead of formats 1\_0 and 1\_1.
  + SL configured grant replaces SPS PDSCH
  + Counter SAI replaces counter DAI
  + “Subclause 9.1.2” is changed to “Subclause 16.5.1”
  + “Subclause 9.1.2.1” is changed to “Subclause 16.5.1.1”
  + replaces
* NOTE: This is not intended to change the reporting of DL HARQ-ACK in any way.

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| **Company** | **Views** |
| LG | “PDSCH-to-HARQ\_feedback timing indicator field” is replaced by “PSFCH-to-HARQ\_feedback timing indicator field”.  *“dl-DataToUL-ACK”* is replace by “sl-DataToUL-ACK”.  sl-PSFCH-ToPUCCH (it is for SL CG Type-1).  “DCI format 1\_0 or DCI format 1\_1” is replaced by “DCI format 3\_0”.  “SPS PDSCH” is replaced by “SL CG type-1 or SL CG type-2”.  DAI field in UL grant. |
| vivo | ‘DCI format 1\_0 or DCI format 1\_1’ -> ‘DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH reception occasions’.  ‘receiver only for’->’generate HARQ-ACK information only for’  ‘only for SPS PDSCH reception’ -> ‘only for PSFCH reception occasions associated with PSSCH transmissions corresponding to a sidelink configured grant’  ‘M\_C’->’M\_A’  ‘PDSCH-to-HARQ\_feedback timing indicator field’-> ‘PSFCH-to-HARQ\_feedback timing indicator field’  ‘DAI’ in UL DCI->’SAI’ in UL DCI |
| Huawei, HiSilicon | In our views, following parameters are necessary for SL HARQ-ACK reporting using Type-1 codebook   * “PDSCH-to-HARQ\_feedback timing indicator” is replaced by “PSFCH-to-HARQ feedback timing indicator” * “*dl-DataToUL-ACK”* is replaced by “*sl-FeedbackToUL-ACK or sl-ACKToUL-ACK*” * “Subclause 9.1.2” is changed as “ Subclause 16.5.1” * “Subclause 9.1.2.1” is changed as “ Subclause 16.5.1.1” * “DCI format 1\_0” and “DCI format 1\_1” is substituted by “DCI format 3\_0” |
| ZTE, Sanechips | 1. ”received any PDSCH or SPS PDSCH release ” change to “transmittedany PSSCH with corresponding PSFCH reception occasions”  2. “PDSCH-to-HARQ\_feedback timing” change to “PSFCH-to-HARQ\_feedback timing”  3. “*dl-DataToUL-ACK*”  change to “*sl-ACKToUL-ACK*”  4. “DCI format 1\_0 or DCI format 1\_1” change to DCI 3\_0  5. “DAI” change to “SAI”  6.“SPS PDSCH reception” change to “SL configured grant PSSCH transmission” |
| Ericsson | * The procedures for SL HARQ-ACK reporting in PUCCH using type-1 codebook are the baseline. * There is no difference in the procedure if PUSCH is scheduled by DCI format 0\_0 or by format 0\_1. * ”Candidate PSSCH transmissions with corresponding PSFCH reception occasions” replaces ”candidate PDSCH receptions” * “PSFCH-to-HARQ\_feedback timing indicator” replaces “PDSCH-to-HARQ\_feedback timing indicator”   + sl-PSFCH-ToPUCCH is used to determine PSFCH-to-PUCCH gap for SL CG type-1 * SL BWP replaces DL BWP |

## Q1-2. Type-1 codebook for reporting in UL-SCH. Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.2.2.

**Identify the parameters of the Rel-15 specification that are not necessary for SL HARQ-ACK reporting to the gNB in UL-SCH using type-1 codebook.**

**NOTE: To ensure that all comments refer to the same version of the specification, make sure to use the latest Rel-15 version (v15.9.0).**

FL comments:

* It is necessary to clarify whether SAI is included in DCI providing the UL grant or not. I would appreciate input from the companies on this topic. See Q1-1.

Proposal (for a conclusion):

* In preparing the TP for SL HARQ-ACK reporting in PUSCH using type-1 codebook:
  + The following parameters and the corresponding parts of the Rel-15 specification are not used:
    - Parameters related to transmission of more than 1 TB:
      * *harq-ACK-SpatialBundlingPUSCH*
  + The following functionality from the Rel-15 specification is not supported:
    - HARQ-ACK for SPS PDSCH release

NOTE: This is not intended to change the reporting of DL HARQ-ACK in any way.

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| **Company** | **Views** |
| NTT DOCOMO | UL DAI in DCI format 0\_1 should not be used for SL HARQ-ACK report on UL.  In our understanding, the UL DAI for type-1 CB is beneficial when any PDCCH other than the UL grant is not received. However, if UL DAI is used for SL HARQ-ACK report as well, UE cannot know which HARQ-ACK report should be multiplexed on the PUSCH, Uu or SL. Payload size of HARQ-ACK is different between Uu and SL. gNB needs to do blind decode always.  [DCM2] Let us discuss Uu procedure first. If UL DAI is 1, HARQ-ACK CB is generated and multiplexed on the corresponding PUSCH, regardless of whether DL assignment is received or not. The payload size is independent to UL DAI value. Otherwise; PUSCH without HARQ-ACK is transmitted. That is, the benefit of UL DAI is only to know whether the HARQ-ACK multiplexing should be performed or not. In other words, the gain is only for the case that all DL assignments are missed. There is no gain if some DL assignment is received at the UE since the UE already knows that HARQ-ACK CB should be generated and multiplexed on the PUSCH.  Then, let us consider to use UL DAI for SAI. But UL DAI is used for DL HARQ-ACK as well. In this case, if UL DAI is 1, HARQ-ACK CB is generated. But which HARQ-ACK CB should be generated, SL HARQ-ACK or DL HARQ-ACK? As abovementioned, the gain of UL DAI is for the case that all PDCCHs are misdetected. Discussion should be made under the case that the UE did not receive neither DL assignments nor SL grants. Payload size of DL HARQ-ACK will be different from SL HARQ-ACK. Therefore, gNB cannot detect the PUSCH or needs to do blind decoding. The situation is not good.  As possible options, the following are presented:  - UL DAI is not used for SAI when type-1 CB is used  - Additional field is introduced in format 0\_1 to indicate SAI  We are fine with either (while preference is the first one), but not fine with the current proposal of Q1-1, from the above reason. |
| LG | harq-ACK-SpatialBundlingPUSCH (We do not use HARQ bundling scheme for SL)  SPS PDSCH release (For the CG release, MAC confirmation message will be used instead of AN on PUCCH or PUSCH)  ‘PCell’ in ‘DCI format 1\_0 with a counter DAI field value of 1 on the PCell’ (A single carrier will be used for NR sidelink mode 1)  UE behavior for dynamic DL BWP switching (We removed DL BWP switching part in the HARQ codebook for PUCCH)  For forward compatibility, it would be fine to introduce separate SAI field in UL grant instead of reusing UL DAI field.  FL reply:  I do not understand the point of forward compatibility. If at some point we introduce simultanoues reports of SL HARQ-ACK and DL HARQ-ACK, we can change the DCI format. It will only affect the corresponding UEs. Let us avoid optimizing for something that is not even part of the Rel-18 approved WI. |
| Vivo | harq-ACK-SpatialBundlingPUSCH and SPS PDSCH release should be deleted.  To indicate whether the type1 SL HARQ can be transmitted on PUSCH and avoid impact on legacy DAI, a separate 1-bit SAI should be included in UL grant if the scheduled PUSCH is overlapped with PUCCH with SL HARQ type1 codebook.  FL reply:  Let us first clarify whether we have UL SAI at all or not. See my comments to Q1-1  [vivo-2]  tDAI exists in a DL DCI only when more than one serving cell are configured in DL and codebook type = dynamic. However, there is no such restriction for UL DCI, i.e., DAI field also exists in UL DCI for single-cell cases as long as CB is needed. So if we want to reuse the R15 procedure as much as possible, the tSAI part should be present even though R16 supports only a single SL carrier.  For tyep1, the 1-bit DAI in UL DAI is more like an indication to enable/disable the CB reporting multiplexed on the PUSCH. It gives some flexibility to gNB to prioritize the performance of PUSCH by setting the DAI bit to 0. So we think this feature should also be supported in SL CB reporting. And to avoid impact to Uu HARQ (as mentioned by Docomo), 1 addtionan bit for SAI for type1 CB is needed. |
| Huawei, HiSilicon | In our views, following parameters are not necessary for SL HARQ-ACK reporting using Type-1 codebook   * *harq-ACK-SpatialBundlingPUSCH* |
| ZTE, Sanechips | The following parameters are not necessary:   * *harq-ACK-SpatialBundlingPUCCH* * *harq-ACK-SpatialBundlingPUSCH*   FL reply:  My understanding is that *harq-ACK-SpatialBundlingPUCCH* is not used in the original codebook, only mentioned so that *harq-ACK-SpatialBundlingPUSCH* replaces it in the corresponding subclause. |
| Qualcomm | We agree with the comments that at least harq-ACK-SpatialBundlingPUSCH and SPS release are not used. |
| Ericsson | * The following parameters and the corresponding parts of the Rel-15 specification are not used:   + Parameters related to transmission of more than 1 TB     - *harq-ACK-SpatialBundlingPUSCH* * The following functionality from the Rel-15 specification is not supported   + HARQ-ACK for SPS PDSCH release |

## Q2-1. Type-2 codebook for reporting in UL-SCH. Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.3.2**.**

**Identify the parameters of the Rel-15 specification that are necessary for SL HARQ-ACK reporting to the gNB in UL-SCH using type-2 codebook. If appropriate, described the necessary changes.**

**NOTE: To ensure that all comments refer to the same version of the specification, make sure to use the latest Rel-15 version (v15.9.0).**

FL comments:

* Like for Q1-1, we need to understand whether we need to have SAI in DCI scheduling the UL transmission or not. I would appreciate input from the companies on the following aspects:
  + Whether we need to have a tSAI index or not and why, given that we agreed not to have it for reports in PUCCH.

My preference would be to have the simplest possible solution.

Proposal (for a conclusion):

* In preparing the TP for SL HARQ-ACK reporting in PUSCH using type-2 codebook, at least the following changes are made with respect to the Rel-15 specification:
  + DCI format 3\_0 is used instead of formats 1\_0 and 1\_1.
  + SL configured grant replaces SPS PDSCH
  + “Subclause 9.1.3.1” is changed to “Subclause 16.5.2.1”

NOTE: This is not intended to change the reporting of DL HARQ-ACK in any way.

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| **Company** | **Views** |
| NTT DOCOMO | UL DAI field in DCI format 0\_1 is used to indicate SAI.  [DCM2] In type-2 CB, situation is different. The payload size is determined based on the indication. Main motivation of UL DAI is not the case that all PDCCHs are misdetected but some last PDCCHs are missed. Even if the last DL assignment is missed, the UE can know the presence and generate HARQ-ACK CB with correct payload size, from the UL DAI value. Therefore, when UL DAI is used for SAI, there is no issue of payload size in type-2 CB. UE can know payload size that should be multiplexed on the PUSCH. In that sense, additional field for SAI is not needed in format 0\_1. Just to reuse UL DAI field for SAI should be OK.  BTW, NR SL Rel-16 supports one carrier only, so no total SAI. UL DAI indicates the last counter SAI, right? |
| LG | In my reading, V\_temp2 needs to be introduced even for Type-2 codebook for reporting in PUCCH.  “PDSCH-to-HARQ\_feedback timing indicator field” is replaced by “PSFCH-to-HARQ\_feedback timing indicator field”.  *“**dl-DataToUL-ACK”* is replace by “sl-DataToUL-ACK”.  sl-PSFCH-ToPUCCH (it is for SL CG Type-1).  “DCI format 1\_0 or DCI format 1\_1” is replaced by “DCI format 3\_0”.  “SPS PDSCH” is replaced by “SL CG type-1 or SL CG type-2”.  DAI field in UL grant. |
| vivo | ‘DCI format 1\_0 or DCI format 1\_1’-> ‘DCI format 3\_0’  ‘SPS PDSCH’->’HARQ information in response to PSFCH reception occasions associated with a sidelink configured grant’  ‘tDAI’->’tSAI’  tSAI should be defined.  [Vivo-2]  I think we agreed ‘not to having tSAI for reports in PUCCH’ is because, at that point, we were discussing: whether tDAI is an essential field in SL DCI. As there is only SL carrier, there is no need to carry tDAI in SL DCI. But now we are discussing UL DCI which carries 2-bit tDAI even for single carrier case.  Regarding the function of DAI when type2 CB is transmitted on PUSCH, we share the same view with Docomo that tDAI in UL DAI is to handle the case where the latest DCIs are missed by the UE. Without such an indication, UE may misunderstand the number of DCI involved in the CB determination if several last DCI are missing, and hence the generated CB size can be significantly different from what gNB expected. Worse still, in this case, gNB has to blind decode the PUSCH.  So if we want to reuse the R15 procedure as much as possible, the 2-bit tSAI should be present even though R16 supports only a single SL carrier. |
| Huawei, HiSilicon | In our views, following parameters are necessary for SL HARQ-ACK reporting using Type-1 codebook   * “Subclause 9.1.3” is changed as “ Subclause 16.5.2” * “Subclause 9.1.3.1” is changed as “ Subclause 16.5.2.1” * “DCI format 1\_0” and “DCI format 1\_1” is substituted by “DCI format 3\_0” |
| ZTE, Sanechips | 1. ” DCI format 1\_0 or DCI format 1\_1” change to DCI 3\_0  2. “PDSCH receptions or SPS PDSCH release” change to “PSSCH transmissions with corresponding PSFCH reception occasions”  3. “SPS PDSCH reception” change to “SL configured grant PSSCH transmission”  4.“PDSCH” change to "PSSCH" |
| Ericsson | * The procedures for SL HARQ-ACK reporting in PUCCH using type-2 codebook are the baseline. * There is no difference in the procedure if PUSCH is scheduled by DCI format 0\_0 or by format 0\_1. |

## Q2-2. Type-2 codebook for reporting in UL-SCH. Required changes to the Rel-15 procedures (as agreed) – TS 38.213 Section 9.1.3.2**.**

**Identify the parameters of the Rel-15 specification that are not necessary for SL HARQ-ACK reporting to the gNB in UL-SCH using type-2 codebook.**

**NOTE: To ensure that all comments refer to the same version of the specification, make sure to use the latest Rel-15 version (v15.9.0).**

FL comments:

* It is necessary to clarify whether SAI is included in DCI providing the UL grant or not. I would appreciate input from the companies on this topic. See Q2-1.

Proposal (for a conclusion):

* In preparing the TP for SL HARQ-ACK reporting in PUSCH using type-2 codebook:
  + The following parameters and the corresponding parts of the Rel-15 specification are not used:
    - Parameters related to transmission of more than 1 TB:
      * *harq-ACK-SpatialBundlingPUSCH*
    - Parameters related to CBG transmission:
      * *PDSCH-CodeBlockGroupTransmission*
  + The following functionality from the Rel-15 specification is not supported:
    - HARQ-ACK for SPS PDSCH release
    - Sub codebooks

NOTE: This is not intended to change the reporting of DL HARQ-ACK in any way.

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| **Company** | **Views** |
| LG | harq-ACK-SpatialBundlingPUSCH (We do not use HARQ bundling scheme for SL)  SPS PDSCH release (For the CG release, MAC confirmation message will be used instead of AN on PUCCH or PUSCH)  ‘PCell’ in ‘DCI format 1\_0 with a counter DAI field value of 1 on the PCell’ (A single carrier will be used for NR sidelink mode 1)  UE behavior for dynamic DL BWP switching (We removed DL BWP switching part in the HARQ codebook for PUCCH)  *PDSCH-CodeBlockGroupTransmission* (CBG is not supported for NR SL.)  Second-HARQ-ACK sub-codebook (This is for CBG-based HARQ-ACK)  For forward compatibility, it would be fine to introduce separate SAI field in UL grant instead of reusing UL DAI field.  FL reply:  I do not understand the point of forward compatibility. If at some point we introduce simultanoues reports of SL HARQ-ACK and DL HARQ-ACK, we can change the DCI format. It will only affect the corresponding UEs. Let us avoid optimizing for something that is not even part of the Rel-18 approved WI. |
| vivo | harq-ACK-SpatialBundlingPUSCH and SPS PDSCH release should be deleted.  Texts related to CBG and second HARQ subcodebook should be deleted.  To indicate whether the total number of SL DCI and avoid impact on legacy DAI, a separate 2-bit tSAI should be included in UL grant.  FL reply:  What is the impact on legacy DAI given that SL HARQ-ACK reports and DL HARQ-ACK reports are not multiplexed?  [vivo-2]  If SAI is not included, as we replied in Q2-1, if some latest SL DCIs are missed, UE and gnb will have different understandings on the CB size and the number of bits to be rate matched on PUSCH, gnb needs to perform blind decoding.  If SAI is included, there are two options:   * Reuse DAI to indicate SAI * Additional field for SAI   We think there may be some confusion on the legacy DAI interpretation if DAI in UL DCI is reused for SAI indication. For example, if DCI format 0-1 can just reuse the legacy DAI field (e.g., 1st DAI) to indicate SAI, then it means the said 2-bit field in DCI format 0-1 indicates tDAI in some instances while represents SAI in some other instances, the interpretation will be dependent on the PUCCH (I.e., PUCCH for SL or DL) overlapped with the PUSCH. Moreover, if DL BWP is configured with CBG, then there will always be 2nd DAI in the DCI format 0-1. However, the function and meaning of the 2nd DAI field may be ambiguous when SL HARQ is multiplexed on the PUSCH.  So we prefer to include a separate 2-bit SAI in UL DCI for type2. |
| Huawei, HiSilicon | In our views, following parameters are not necessary for SL HARQ-ACK reporting using Type-1 codebook   * *harq-ACK-SpatialBundlingPUSCH* * *PDSCH-CodeBlockGroupTransmission* |
| ZTE, Sanechips | The following parameters are not necessary:   * harq-ACK-SpatialBundlingPUSCH * sub-codebooks * PDSCH-CodeBlockGroupTransmission |
| Qualcomm | We agree with the comments that at least harq-ACK-SpatialBundlingPUSCH, CBG-related aspects, and SPS release are not used. |
| Ericsson | * The following parameters and the corresponding parts of the Rel-15 specification are not used: * Parameters related to transmission of more than 1 TB   + *harq-ACK-SpatialBundlingPUSCH* * Parameters related to CBG transmission   + PDSCH-CodeBlockGroupTransmission * The following functionality from the Rel-15 specification is not supported * HARQ-ACK for SPS PDSCH release |

## Q3. Configuration.

**Which of the following options is preferable:**

* **Option 1: For SL HARQ-ACK reporting to the gNB, the values of beta\_offset configured for DL HARQ-ACK reporting in PUSCH are used.**
* **Option 2: For SL HARQ-ACK reporting to the gNB, the values of beta\_offset are configured separately from the values for DL HARQ-ACK reporting.**

FL comments:

* Option 1 is supported by all but one company.
* One company has raised the issue about the scaling α which is also used for rate matching and configured by higher layers.

Proposal:

* For SL HARQ-ACK reporting to the gNB, the value of and the scaling used for rate matching configured for DL HARQ-ACK reporting in PUSCH are used.

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| **Company** | **Views** |
| NTT DOCOMO | Support option 2.  We agreed that PUCCH configuration is separate from Uu. The motivation is to consider different performance requirements between Uu and SL. From the same reason, separate configuration is reasonable.  BTW, how about *scaling*, which is used in rate-matching formula as beta\_offset? Please see clause 6.3.2.4.1.1 of 38.213. The same option as beta\_offset should be taken.  FL reply:  My understanding of having different PUCCH configurations is because at that point, it was still not clear whether we would use PSFCH-to-PUCCH or something like PDCCH-to-PUCCH.  Thanks for the pointer to scaling (I guess you referred to TS 38.212)  [DCM2] We are not sure why PSFCH-to-PUCCH/PDCCH-to-PUCCH is mentioned.. We mean that PUCCH configuration is e.g. PUCCH resource set. But anyway, we understand companies support option 1, so we can accept to take option 1. Regarding scaling, Yes, it is used in 212 as you assumed. |
| LG | We are supportive of Option 1. This is similar approach of determining HARQ codebook type for NR SL.  It is a communication between UE and the serving cell, and we do not see the necessity of having separate configuration for NR SL. |
| Huawei, HiSilicon | Option 1. The SL HARQ and UL HARQ cannot be multiplexed on a PUSCH simultaneously, same beta\_offset value for DL HARQ reporting can be reused for SL HARQ. |
| ZTE, Sanechips | Slightly prefer to Option 1, due to no strong need to have separate parameters to SL HARQ report and UL HARQ that do not occur at the same time. |
| Qualcomm | We support Option 1. In our view, since reporting is on PUSCH, there is no need for separate beta\_offset configuration. |
| Ericsson | We support Option 1. Given that the same codebook is used, that there is flexibility in the configuration and choice, etc., we do not see the need for separate configurations. |

## Q4. Other issues.

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| **Company** | **Views** |
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