**[100b-e-NR-5G\_V2X\_NRSL-SYNC-03]**

**Email discussion/approval related to sync procedure**

[100b-e-NR-5G\_V2X\_NRSL-SYNC-03] Email discussion/approval related to sync procedure –

SL SSIDs/sync resources for each priority and

Lower SLSS ID with higher priority for P6/P6’ UE

(a,k.a. issues 4-1 & 4-2) by 4/24, with potential TPs by 4/29 (CATT, Teng)

**Issue 4-1 SL SSIDs/sync resources for each priority**

According to the responses 4/20-4/23, it seems like most of the companies admit the priority ambiguity issue in the current sync procedure, but majority views is that this issue can be solved by proper configuration, and it is an optimation than a solution.

From my perspective, this issue is inevitable among different priority if no proper solution is given, unless we leave it as UE implementation. So I would like to leave a little bit more time for further clarification and discussion.

***Proposal 5: the following corrections shall be applied in current synchronization mechanism to solve the issues of ambiguity:***

* ***Reserve a SL-SSID for InC UE directly synch with GNSS, e.g. SL-SSID=1.***
* ***Then the SL-SSID set for In\_C UE directly synch with gNB/eNB is SL-SSID= [2,335].***
* ***For UE OoC sync to UE OoC, distinguish 2 cases:***
* ***If sync Ref UE is directly sync to GNSS (i.e., SL-SSID=0, and transmitting on resource 3).***
* ***Resource 2: InC = 0. SL-SSID=0.***
* ***Other cases:***
* ***Resource 1 or 2 (different from Sync Ref):***
* ***If the SL-SSID of Sync Ref UE is 0, SL-SSID = 336 and InC = 0;***
* ***Else, SL-SSID is from Sync Ref and InC = 0.***

**Comments 4/23-4/24**

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| **Company** | **Views** |
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**Email responses in 4/20-4/23**

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| **Company** | **Views** |
| vivo | **Regarding the 1st and 2nd bullet:** Whether there would be ambiguity in identifying the sync priority of UEs using SSLID=337 depends on the number of sync resource sets (pre-)configured. If only two resource sets are provided, there is no ambiguity and SLSSID=1 still can be used by UE synced to NW. If three sets are used, there could be some ambiguities, but note that a similar issue also exists in LTE V2X, and it can be avoided by proper configuration, there is no need to always reserve SLSSID=1 for InC UE directly synch with GNSS.**Reading the 3rd bullet:**This bullet is the same as the LTE sync procedure except that 168 is replaced by 336. The relevant description has been already captured in 38.331, I am not sure why this bullet is needed?[CATT]Thank you for admit about this ambiguious issue. Yes, it is existed in LTE V2X but not be solved. We also did not see any configuration solution to avoid the ambiguity. We do not want to see the same problem happen in NR V2X sync procedure since we are reusing the same procedure (38.331 almost copy everything from 36.331). The above table is quite clear to express the issue, and a solution can be discussed by us. |
| Nokia, NSB | We don’t support the proposal. We think that further agreements are not needed. Potential ambiguities can be avoided by proper configuration.[CATT] Please see the explanation to vivo. |
| Ericsson | Do not agree with the proposal. The table of priorities agreed in [98-NR-09] only distinguishes between direct and indirect synchronization to GNSS. We did not consider any optimization for the case of more than 2 hops. We do not see the need to have it now, specially at this point in time of the release (maintenance phase). Additionally, the proposed procedure adds the potential issue of having a two different UE sending SLSS with different SL-SSID in the same resource (creating interference at the receiver) which does not occur in the current procedure without the modification.[CATT]The agreements in sync procedure has the table with P6 as the remaining UEs, how to express the remaining UEs have to be clear in the spec. obviousely, UEs with >=2 hops will suffer the ambiguous issue according to the current spec. P6 is always contains all of the rest kind of UEs expect P0~P5 UEs. If we ignore this issue, it is always there from LTE to NR. |
| LGE | FL proposal is not supported.The current agreement on SL-SSID that follows the LTE rule does not need further optimization.[CATT] Please see the explanation to Ericsson. |
| CATT | The above proposal is supported.The ambiguity does happen in both LTE and NR sync procedure. UE in P6’ and P6 with more than 1 hops are allocated with SL SSID 169/337 have the same priority level with P5’ and P6, respectively. Especially in GNSS-based sync procedure, P2 and P6 have the same sync resource, InC indicator and SSID 337. P2 and P6 have large gap in the priority but suffer the ambiguity issue, which can lead to ignorable problem. The issue is obvious, and also a solution is needed. P6’ and P6 include not only standalone UEs but also >=2 hops UEs. The proposal above is not a simple optimization, it is a solution to eliminate the ambiguity.**Table 7: GNSS-based synchronization priority levels for NR V2X**

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| **Priority****level** | **GNSS-based synchronization** | **Sync resource** | **In-coverage indicator** | **NR V2X SL-SSID range** |
| P0 | GNSS | 　 | 　 | 　 |
| P1 | InC UE1 directly sync with GNSS | R1 | TRUE | 0 |
| OoC UE2 directly sync with GNSS | R3 | FALSE | 0 |
| P2 | UE3 indirectly sync with GNSS by InC UE(UE1) | R2 | FALSE | 0 |
| UE4 indirectly sync with GNSS by OoC UE(UE2) | R2 | FALSE | 337 |
| P3 | gNB/eNB | 　 | 　 | 　 |
| P4 | InC UE5 directly sync with gNB/eNB | R1 | TRUE | [1,335] |
| P5 | UE6 indirectly sync with gNB/eNB by InC UE(UE5) | R2 | FALSE | [1,335] |
| P6 | UE7(>=2 hops  sync with GNSS by InC UE) | R1/R2 | FALSE | 336 |
| UE8(>=2 hops  sync with gNB/eNB by InC UE) | R1/R2 | FALSE | [337,671] |
| UE9(>=2 hops sync with GNSS by OoC UE) | R1/R2 | FALSE | 337 |
| UE10(standalone) | R1/R2 | FALSE | [338,671] |

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| ZTE, Sanechips | We share the view that there is an issue of ambiguity between the UE sync to gNB/eNB indirectly with no less than 2 hops and the UE sync to GNSS indirectly or with more than 2 hops if the SL-SSID = 1is used by InC UE. However, we think the potential collision can be avoided by add a note in specification that ***InC UE is not expected to be assigned SL-SSID =1***[CATT]Thank you for admit about this ambiguious issue. Any proper solution should be added no matter it is a note or some modification on the current SSID range for some priorities. |
| Samsung | We share the view with vivo, Nokia, Ericsson and LGE. There may exist an ambiguity but it can be resolved by proper configuration as in LTE V2X. Also, we don’t think that synchronization procedure over more than 2-hop is often necessary. Having said that, this proposal is further optimization and we don’t support this proposal.[CATT] Please see the explanation to vivo. |
| Huawei, HiSilicon | *Not necessary*. For the first sub-bulletin (i.e.: ‘Reserve a SL-SSID for InC UE directly synch with GNSS, e.g. SL-SSID=1’), even for LTE-V2X, we haven’t the agreement said SLSSID dedicated to 1 for UE which is sync to GNSS when under the coverage of network. Hence, this newly added proposal need more justification.Then the second sub-bulletin is related to the first one.For the third sub-bulletin, this also is different from LTE-V2X. In LTE-V2X, SLSSD 169 is used if the third sync source is introduced. So we need to first discuss whether to support the third sync source. If the answer is yes, then we need to check whether the LTE-V like mechanism can be reused or not. If not, some new rules like above can be discussed further. In general, this maintenance stage is not suitable to discuss nonessential issues. Please notice, we have made the agreement as following: *Agreements****:****672 SL-SSIDs are divided into 2 sets to indicate different synchronization priorities following a similar approach as in LTE-V2X:* * *Set id\_net {0, 1, …, 335}*
* *Set id\_oon{336, 337, 338, …, 671}*
* *The usage of 0 is the same as 0 as in LTE*
* *The usage of 336 is the same as 168 as in LTE*

*The usage of 337 is the same as 169 as in LTE*[CATT]Thanks for providing the agreements. In the agreement, the last bullet said that the usage of 337 is the same as 169 in LTE. This is why we have the ambiguious issue. The above solution can be discussed and modified, but this issue cannot be ignored. |
| MediaTek | *Maybe not necessary in the maintenance stage. Besides, It may be more like a corner case that both P6 and P2 (close to each other) can be detected by the other UEs.*  |

**Issue 4-2 Lower SLSS ID with higher priority for P6/P6’ UE**

We had long time discussion on this issue for several meetings, and there are two companies still have concerns on this issue. So I would like to give it a little bit more time further discussion.

***Proposal 6: RAN1 should discuss whether UE can be (pre-)configured with P6 sync source with SSID-based selection as the alternative of RSRP-based mechanism in Rel-16.***

**Comments 4/23-4/24**

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| **Company** | **Views** |
| Qualcomm | As mentioned by Volkswagen, scenarios where the UE is without GNSS or network coverage occur and need to be addressed and FirstNet already commented on the benefit to public safety. A large number of companies also view those scenarios as important to address (R1-2002756).The complexity of supporting multiple sync sources is substantially larger than a simple SLSSID comparison. A solution to reduce the number of independent sync cluster in the first place is more efficient than attempting to deal with them after the fact. Even, if the UE supported multiple sync sources, it would still benefit from having fewer sync sources to follow and track.There will always be cases when UEs cannot communicate with each other, the proposal here is removing/reducing the impact of synchronization as a compounding factor.20 second was chosen to show that even after such a long time, the RSRP-only approach failed to merge into a single cluster, leading to significant performance loss.In terms of stability, SLSS-ID selection is only performed above an RSRP threshold as has been discussed previously, i.e. the SLSS-ID is only used the signal from both potential sync sources is good enough.It’s our preference to have only the SLSS-ID-based solution based on the performance gains. However, (pre)configuration was introduced as a potential compromise a few meetings ago.For reference, this is the proposal in R1-2002756:**Proposal 1:** If (pre)-configured in a carrier, the mechanism given below replaces the RSRP-based SynchRefUE selection only for P6 and P6’ priority case.* For the prioritization among references of the same priority for P6/P6’ UE, UEs select the lowest SLSS ID SynchRefUE among the SyncRefUEs with RSRP>threshold.
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**Email responses in 4/20-4/23**

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| **Company** | **Views** |
| Qualcomm | Yes, RAN1 should discuss and agree on the proposed mechanism. Merging independent synchronization clusters is a critical issue that needs to be addressed in NR V2X; otherwise, NR V2X performance can be significantly degraded. This view is shared by the primary users of NR V2X/Sidelink technology (the public-safety community, car manufacturers, and industrial OEMs) and the many companies who co-sourced R1-2002540.We tested alternative proposals that came up in prior RAN1 discussions and provided results in our companion contribution R1-2002543, where we observed that they do not address the issue. |
| LGE | FL proposal is supported.Support the following for details:UE is (pre-)configured to use either RSRP-based or SLSSID-based SyncRefUE selection for P6 and P6’ priority. If SLSSID-based SyncRefUE selection is (pre-)configured, UE selects SyncRefUE with a lower SLSSID. |
| FirstNet | Yes. FirstNet recommends RAN1 to discuss and agree to the proposed technique. As we have said many times thus far in several meetings, as long as there is a finite amount of benefit to public safety personnel, however small it might be, FirstNet requests the 3GPP community to endorse the solution. Merging independent synchronization clusters is a critical issue that needs to be addressed now in NR V2X and not postpone the problem to the future. |
| Huawei, HiSilicon | Not necessary to discuss anymore, as has already consumed substantial amounts of time without reaching consensus. We have nevertheless looked into the proposal again, and found that our concerns only seem to grow. We reiterate with repeating them all here, our points made during email [99-NR-10], since the proposal is only a repeat of that, and we also expand our analysis below. 1. The proposal mainly is used in the P6/P6’ where UE is without GNSS or network coverage. From our understanding, most ITS related traffic is location-dependent traffic. If a UE loses its GNSS signal, it may obtain its location based on its implementation within a short time (e.g. estimate its moving direction and speed, then can get its further location), and emergency message(s) can be sent then. While the proposal will require 20s (at least: it is doubtfulwhether 20s is enough to finish the merging in realities) time to merge the sync cluster. But after 20s long time, all the location information estimated by UE cannot be relied on. Thus P6/P6’ is more useful for public safety.
2. There is not a clear benefit to public safety if all network is broken from the above proposal.Quickly sending the message out to network is more important than to let everyone communicate with each other in some certain area. Then RSRP based sync source selection based on P6/P6’ can make the UE choose the best sync source and connect to the available network more quickly.
3. The main point raised in the proposal is: for RSRP based solution will form different e.g. 2 timing cluster, while the proposed solution attempts to merge into one single timing cluster. The proponent think the RSRP based solution cannot communicate with each other if UEs are located in different timing cluster. While the assumption is that: the UE cannot support more than one sidelink timing. Both in LTE-V and NR-V, there are more than one Rx resource pool, e.g. 16 for NR-V. And the sync source is separately configured in the Rx resource pool. This mean, if the different Rx resource pool is configured by different sync source, e.g. some by GNSS, the other by gNB. And even all are configured as gNB (or eNB), different gNB will have different timing according to RAN4 discussion on this issue. Then the result will be, the UE have to support more than one sidelink timing. Since the UE support multiple timing, under P6/P6’ cases, the sidelink UE can communicate simultaneously with different UEs within different timing cluster. No issue come out for the RSRP based P6/P6’s solution.
4. There are more critical issues identified during the email discussion, including:
	1. Even merged into one single timing by the proposal, different UEs may or may not communicate with each other for the multiple hops timing will beyond the CP length, since the adjacent UEs would be from 4 hops or 1 hop to the sync source.
	2. After multiple hops (e.g. 4 hops), the timing error (0.4us per hop) and frequency error (e.g. 0.1PPM per hop) will be very large, this will beyond the UE capability which is defined by RAN4 for Uu link. 0.3 to 0.4 ppm frequency error will give big challenging to the UE communication with each other. When the UE with 4hops and the UE with single hop communication with each other, the will be big frequency error, timing error and timing delay. This will result big interference and even make it cannot be communicate since the receiver think they are timing and frequency aligned while actually not. The proposal is likely to degrade the sidelink synchronization quality to the extent that public safety can no longer be assured.
	3. How long to achieve the single cluster merging? Considering from the performance requirement from 36.133, one syncRef UE selection/resection will cause around 8.8s, the current 20s claim is doubtful. For the proposed solution, since every UE will select one SLSSID random, at the beginning, every UE will choose different SLSSID, and which one is the lowest one need a long time to stable (some UE gives up its own SLSSID or change its sync source to another one etc.). Were the proposal used, the real-world stability of the system is low.
	4. The stability is much worse than the RSRP based solution. Even after some UEs have spent the time to merge into a cluster, the SyncRef UE may leave or power off for some reason. The merged timing will be broken again, since the second lowest SLSSID UE does not know how many UE sync to it, and it may not know whether it's the lowest SLSSID UE now. While the RSRP based solution does not have this problem. UE will always choose the largest RSRP sync source as its reference UE.
	5. Under the single timing, the chosen lowest SLSSID syncRef UE’s RSRP will be much lower than the RSRP based solution. This will degrade the system performance.
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| MediaTek | The proposal seems not necessary and unclear. Actually this issue has been discussed for a long time in the last meeting. So it is unclear on the implication of “should be discussed”. Anyway, any discussion can be allowed. Besides, (pre-)configurion between RSRP-based or SLSSID-based SyncRefUE selection for P6 and P6’ priority is not preferred. If one of them works, why do we need to support the other one and make them configurable? |
| Volkswagen AG | The formation of synchronization clusters can lead to vehicles within the communication range not being able to communicate between each other. From a car OEM’s perspective this a situation which needs to be avoid or at least the propability of occurrence needs to be minimized: The negative impact (loss of packets) on the communication between UEs while some of these UEs are in the transition between different synchronization sources needs to be minimized.Examples of these scenarios are a needed communication * Between cars driving in a tunnel and eg. not synchronized to a GNSS synchronization source and vehicles outside of this tunnels being connected to a GNSS synchronization source.
* Of vehicles in an underground parking lot eg. not connected to a GNSS synchronization source and vehicles outside on the street being connected to a GNSS synchronization source.

A discussion on this matter should lead to an enhancement and not be potentially postpone to the next release. |