3GPP TSG-RAN WG2 #111 electronic DRAFT R2-2008427

17th – 28th August 2020

Online

**Source: NTT DOCOMO, INC. (Email discussion rapporteur)**

**Title: Report of email discussion [AT111-e][009][NR15] LTE SIB extension issue**

**Document for: Discussion and decision**

**Agenda Item: 5.4.2**

## Introduction

This paper is aimed at discussing the following topic.

 ***[AT111-e][009][NR15] LTE SIB extension issue (NTT DOCOMO)***

 *Scope: Treat R2-2008083, R2-2008367, R2-2008107 (proponents to drive)*

 *Part 1: Start after on-line initial discussion, Confirm severity/consequences of the issue, Try to find acceptable solutions, put solutions on the table, gather initial round of comments to understand which could be acceptable.*

 *Deadline: Aug 20, 0900 UTC.*

 *Part 2: TBD. Urgency might depend on Whether acceptable Workarounds are found or not*

 *Deadline: EOM*

All of the relevant contributions were treated on-line at first. As a conclusion of the initial discussion, the following scopes were agreed to discuss by email:

**=> Continue by email, solutions with and without TS impact may be discussed. It is also interesting to understand better the magnitude of the problem.**

**=> We can attempt to have a solution at this meeting, need to put solutions on the table and understand the impacts to, we can assess the maturity towards the end of the meeting.**

The following discussions are conducted in accordance with the agreed scopes.

## Discussion

## Identifying the problematic scenarios

According to the contributions submitted to this meeting and the on-line comments in the initial discussion, the following two cases are the scenarios where some legacy UEs are unable to ignore the uncomprehending field.

**Case 1:** Only SIB24 is scheduled in a SI message;

Example: SI message #1 (SIB2), SI message #2 (SIB3, SIB5), SI message #3 (SIB24).

**Case 2:** An SI message schedules the other legacy SIBs as well as SIB24.

Example: SI message #1 (SIB2), SI message #2 (SIB3, SIB5, SIB24).

For both cases, some legacy UEs ignore the entire SIB1 and considers to fail in acquiring SIB1. As a consequence, the cell broadcasting SIB24 is considered as barred. The same problem could be envisaged when the eNB broadcasts the other SIBs than SIB24 which were introduced after the extension marker in the *SIB-Type* IE as shown below.

SIB-Type ::= ENUMERATED {

 sibType3, sibType4, sibType5, sibType6,

 sibType7, sibType8, sibType9, sibType10,

 sibType11, sibType12-v920, sibType13-v920,

 sibType14-v1130, sibType15-v1130,

 sibType16-v1130, sibType17-v1250, sibType18-v1250,

 ..., sibType19-v1250, sibType20-v1310, sibType21-v1430,

 sibType24-v1530, sibType25-v1530, sibType26-v1530,

 sibType26a-v1610, sibType27-v1610, sibType28-v1610,

 sibType29-v1610}

Thus, the follow scenario can be identified as problematic:

- When an eNB broadcasts SIB1 which includes scheduling information of SI messages including SIB19 and onwards, some legacy UEs are unable to acquire SIB1 and consider the cell as barred.

- It happens no matter whether SIB19 and onwards are scheduled separately from the other legacy SIBs (SIB2 to SIB18) via the different SI message, or SIB19 and onwards are scheduled together with the legacy SIBs in the same SI message.

- When an eNB broadcasts a SI which includes both legacy SIB(s) and SIB19 and onwards, some legacy UEs will discard the SI even if it understands the corresponding scheduling information in SIB 1

First of all, the rapporteur would like to develop the common understanding of the problematic scenarios.

Companies are invited to provide their views if companies share the same understanding of the problematic scenario. If not, please share how you observe the problematic scenario.

|  |  |  |
| --- | --- | --- |
| Company name | Agree/Not agree | Comments (especially if not agree) |
| NTT DOCOMO | Agree | Although it has not been verified in the field whether any other extended SIBs than SIB19 have the same problem, it most likely exists, given the root cause of the SIB24 case. |
| Nokia | Agree | It is also our understanding that any SIB after the ellipsis marker in the ENUMERATED list will end up resulting in the same issue. |
| Ericsson | Agree, but | We also wonder if there are additional cases where the problem UEs encounter problems when an extension marker is used . |
| Qualcomm | Agree | Based on online discussion comments and submitted contributions, our assumption is the above scenarios are correct. |
| Apple | Not fully  | The problematic scenarios exist only when UEs are compliant with the standard and handle the *SIB-Type* IE incorrectly. It would be more accurate to improve the wording, e.g.,: “When an eNB broadcasts SIB1 which includes scheduling information of SI messages including SIB19 and onwards, some legacy UEs that do not handle the *SIB-Type* IE correctly are unable to acquire SIB1 and consider the cell as barred” |
| Lenovo | Agree, but | Referring to the described problem statement and online discussion we understand that the issue exists due to non-standard-compliant, very badly implemented UEs up to Rel-15. We share Ericsson’s comment that such UEs may cause further issues other than the known SI scheduling issue for SIB24. |
| T-Mobile USA | Agree | UE’s using the defective firmware load will crash and reset in an infinite when camped on eNB upgraded to broadcast SIB24. Effectively this problem delays the deployment of other features requiring the use of SIB’s introduced after SIB24.  |
| Samsung | Agree, but | It is unfortunate that some legacy UE implementation is not implemented in correct way. Nevertheless, if the problem is observed in the field, there is problem. Maybe more important question is how serious the problem is.By the way, we like to include both cases in the problematic scenario. Some implementation might have problem only in case 2 |
| Vivo | Agree | If SIB1 includes scheduling information of SI messages of SIB19, some legacy UEs (standard compliant) would not b able to acquire SIB1 and consider the cell as barred |
| MediaTek | Not fully | We are not able identify the problematic scenarios which is related to wrong UE implementation on some other vendors. The implementation is different form company to company and is of course not specified.Our best guess is just that some UE has problem on decoding the scheduling info in SIB1 if the scheduling info include SIB higher than SIB19. We don’t know whether there is problem beyond the SIB Type in scheduling info. So not sure the following scenario is problematic or not.“*When an eNB broadcasts a SI which includes both legacy SIB(s) and SIB19 and onwards, some legacy UEs will discard the SI even if it understands the corresponding scheduling information in SIB 1*”And least, there is no problem from our side in above scenarios. |
| Huawei, HiSilicon | Agree | According to the contributions and online discussion, we understand the problem is about ellipsis marker handling. |
| SoftBank | Agree | The same issue will happen as some legacy UEs cannot acquire the SIB1 when any of SIB after an extension maker is scheduled. |
| Telecom Italia | Agree | It should be verified whether this issue comes out with SIBs listed after the ‘…’ other than SIB24 as well as, in general, the use of ‘…’ represents the root cause of the problem for legacy UEs |
| LG Uplus | Agree | There are same problems with some Cat.6(or not mentioning here) UEs, and we think the same problem will occur if extension marker is used. |
| KDDI | Agree | Same view with docomo, T-Mobile USA, and others. |
| CMCC | Agree | The issue exits in the field, and the latest number of such problematic UEs provided from our colleagues involved in network operations is more than 5 million, and most of them are used for IOT field, which are just not equipped with NB-IoT or MTC chipset, but rather regular 4G chipsets, and cannot support remote software upgrade. Meanwhile, in our understanding that any SIB after the ellipsis marker in the ENUMERATED list end up is possible to cause the same issue as SIB24. |
| ZTE | Agree | Based on the contributions provided, it is clear that issue exists in the field. Given that this impacts the legacy 4G UEs, we also share the concern that a relatively large population of UEs are impacted!  |
| Turkcell | Agree | Based on discussions, we think that the scenarios are correct. |
| Vodafone | Agree, but.. | This seems to be a very similar/same issue that has already been detected during LTE-M trials. Some mitigation activities have already been undertaken – e.g. the Over The Air updating of some of the erroneous mobiles, and possibly, with RAN vendors working around the issue. |
| CATT | agree | Based on the discussions so far it seems those are real world issues. |
| AT&T | Generally Agree | We share Ericsson’s comment that some legacy UEs may cause further issues other than the known SI scheduling issue for SIB24. Also, any proposed fixes need to thoroughly examine possible/probable future consequences of any resulting, implemented changes. |
| OPPO | Partial agree | For the issue of discarding SIB1 due to wrong implementation, it seems true according to contribution on the table. But we are not sure whether 2nd issue is problematic i.e. UE will drop the SI mixing legacy and SIB19 and onwards if SIB1 scheduling information is correctly understand. Even if it happen to some legacy UE, I guess network can easily avoid it by not mixing legacy SIB and SIB19 and onwards. |
| China Telecom | agree | From our side the scenarios are correct. |
| BT | Agree, but | We agree with Ericsson and it will be worth to indentify other potential cases where an extension marker is used. That will give a more comprehensive view of the issue. |

[Rapporteur’s summary]

Amongst 24 companies who expressed their views, 22 companies agreed on the problematic scenarios, although the degree of conviction was somehow diverged. In contrast, 2 companies were not sure if such a problem exists. In light of the comments received from all the companies, the following scenarios are observed in the field:

**Problematic scenario:**

**Case 1:** When an eNB broadcasts SIB1 which includes scheduling information of SI messages including SIB19 and onwards, some legacy UEs that do not handle the *SIB-Type IE* correctly are unable to acquire SIB1 and consider the cell as barred.

- It happens no matter whether SIB19 and onwards are scheduled separately from the other legacy SIBs (SIB2 to SIB18) via the different SI message, or SIB19 and onwards are scheduled together with the legacy SIBs in the same SI message.

**Case 2:** When an eNB broadcasts a SI which includes both legacy SIB(s) and SIB19 and onwards, some legacy UEs that do not handle the *SIB-Type IE* correctly will discard the SI even if it understands the corresponding scheduling information in SIB1.

**Types of UEs:**

- The problematic UEs are used not only for IoT service, but also for any types of services including smartphones.

## Assumption of legacy UE

As discussed on-line, the standard itself is correct and there is no problem from the standard perspective. It is not compliant with the standard that the UE is unable to acquire SIB1 and consider the cell as barred, when SIB1 includes uncomprehending fields. Given that the test case has been introduced by RAN5 to check the handling of uncomprehending fields, the standard compliant UE works properly from now on.

Nonetheless, the magnitude of this problem hinges on whether all of the concerning UEs already released into the market can be upgraded to fix the bug or not. Ideally, the problem could be ironed out, if it were possible. On the other hand, the real business seems not go well as ideal, according to the opinions expressed by operators, on-line. In that case, potential solutions or workarounds need to be analysed based on the assumption that not all of the concerning Ues can be upgraded and so there remains the Ues in the network which cannot handle the uncomprehending field in SIB1 properly.

**Assumption:** Not all of the concerning Ues can be upgraded, and so there remains the UE in the network which cannot handle the uncomprehending field in SIB1 properly.

Companies are invited to provide their views if the assumption is agreeable to investigate potential workarounds or solutions.

|  |  |  |
| --- | --- | --- |
| Company name | Agree/Not agree | Reason |
| NTT DOCOMO | Agree | For instance, due to expiry of warranty period, lack of software update functionality, it is not likely in reality to rely on the software update.To answer to Nokia’s comment, the rest of normal Ues do not require upgrading their software. Currently, there are three types of Ues in the live network:1) Legacy LTE Ues having this problem2) Legacy LTE Ues w/o having this problem3) NSA (EN-DC) capable Ues (w/o having this problem)2) and 3) does not require updating their software, since they do not support NR SA. In our knowledge, the service of NR standalone has not been commercialised yet in most of the networks world-wide. So, even though the population of 1) is 1%, the rest of 99% of the Ues (i.e. 2) and 3)) does not have to update their software. |
| Nokia | Agree, but | In general, the understanding is that there may be a population of legacy devices that cannot be upgraded (e.g. device out of warranty or any other reason), but that cannot be a good enough reason to mandate specification changes. For example, if 1% devices on the field have an issue then it does not seem logical to force remaining 99% of Ues to be upgraded as a result of a specification change. For this to be even considered as a viable approach, we need to assume that all the non-problematic Ues can be upgraded to incorporate the new behaviour. As soon as more than 1% of the non-faulty Ues cannot be upgraded, this makes no difference in terms of population of problematic Ues to deal with. Which means we have just moved the problem around and not solved anything. Then the impact of the fix to existing network implementations and existing features are also non-trivial.It would be good to understand the magnitude of the problem first in terms of what percentage of the UE population we are referring to. |
| Ericsson | - | It is not clear if problem Ues technically cannot be upgraded, or cannot be upgraded for other reasons. It seems clear that some problem Ues can be upgraded, and the question is what is the number of problem Ues that cannot or will not be upgraded in the end.We think it is not reasonable to assume that the NW or the UE that made a correct implementation will fix the problem, until it is clear that a significant number of problem Ues cannot be upgraded and a solution is needed.  |
| Apple |  | Not in the position to answer this question |
| Lenovo |  | In general, we should avoid introducing workarounds in our specifications to handle bad UE implementations, esp. if we don’t know for how long the problematic Ues may exist. Therefore, it would be good to know how many of these problematic Ues cause this problem, their types (IoT, smartphones etc.) and where they are populated (region, network).  |
| T-Mobile USA | Agree | Under ideal conditions about 98% of the affected UE’s can be upgraded via a maintenance release. In this case the UE’s containing the defective chipset were introduced in 2014-15 significantly decreasing the percentage of UE’s that receive the firmware upgrade. Those that fail to properly receive and apply the firmware upgrade are unable to acquire the network when SIB24 is broadcast on an eNB.  |
| Samsung | Agree, but | As in the previous issue, if there are problematic legacy Ues observed in the field, there is no way to deny it. However, the real question is how severe the problem is. If it is only IOT device, the scenario would only occur in a specific frequencies and does not deserve spec changes. If it is universal problem observed in significant portion of legacy Ues all around the world, we might consider solution impacting Release 15.  |
| MediaTek | - | We are more interested in how much percentage of UE could not perform software upgrade. In our understanding, most smart phone could do software upgrade. For the UE that could not be upgraded, how long is it going to be exist in the marketing?  |
| Huawei, HiSilicon |  | We are also interested to know the percentage of Ues which cannot perform software upgrade. |
| SoftBank | Agree | Even if we can upgrade problematic Ues, we consider open market devices or roaming Ues with this problem in future. As it is likely not correctly countable, it is not a good idea to count the problematic Ues for handling this existing issue.  |
| Telecom Italia | Agree | We think that the type of UE (e.g. smartphone vs old devices used for IoT applications) should also be considered in this evaluation, not only the simply ‘amount of problematic Ues’. In our understanding, very low-end devices used for IoT applications may not be SW upgraded due to the lack of the related functionality and, even assuming they are not so numerous, we may expect they will still be present for a long time in the next years. |
| LG Uplus | Agree | Agree with DCM and TMUS. Some problematic Ues do not support forced(=automatic) FOTA(Firmware Over-The-Air) upgrades. |
| KDDI | Agree | Agree with docomo, T-Mobile USA. There are many cases where the software update cannot be done. Operators may not be able to request update software to UE vendors because of the expiry of warranty period. Sometimes it’s impossible to inform users own the problematic legacy Ues of its software update. |
| CMCC | Agree | As we mentioned above, and the latest number of such problematic Ues provided from our colleagues involved in network operations is more than 5 million, and most of them are used for IOT field, which are just not equipped with NB-IoT or MTC chipset, but rather regular 4G chipsets, and cannot support remote software upgrade.  |
| ZTE | Agree | We think upgrading the Ues in the field is generally problematic and this is particularly so for legacy Ues which already exist in the field. So, any solution based on UE upgrade would have more chance of success if it targets the new population (i.e. NR Ues) rather than relies on the upgrade of the legacy Ues.  |
| Turkcell | Agree | Agree with NTT Docomo and T-Mobile USA |
| Vodafone | Agree, but… | While UE OTA upgrading is difficult, we suspect that activities have been ongoing in this area since LTE-M trials commenced. Networks that have deployed LTE-M have clearly already tackled this issue.We are open to continuing to discuss solutions. |
| CATT | agree | We agree there are Ues out in the field that cannot be updated. From the feedback of some operators it seems the number of such problematic devices it not very small and at least the issue spans a few regions like China and Korean. So we are positive to seek for a solution to solve the issue.  |
| OPPO | Agree but | We basically agree what Samsung said |
| AT&T | See AT&T comment in final section |  |
| China Telecom | Agree | There is a risk if completely relying on UE side according to CMCC’s data. |
| BT | Agree | It will be really difficult to upgrade all the devices on the field so a better understanding of the problem will be beneficial. We can take DOCOMO’s UE list as baseline where LTE legacy devices can be categorized into smartphone or IoT capable. |

[Rapporteur’s summary]

Roughly speaking, UE/NW vendor’s views were aligned that they would like to learn how serious it is and how much percentage of the UEs cannot be software upgraded. Likewise, operator’s views (12 operators) were aligned as well that in reality, it is quite difficult to perform software upgrade for all of the concerning UEs. There was the up-to-date information from CMCC that more than 5 million UEs facing this issue are present in the network. There was also the comment that it is hard to predict the precise number given the presence of open market devices and roaming UEs.

From Operator’s feedback, the assumption discussed in this clause sounds valid, whilst it is hard to assess the severity of this issue. The degree of the severity is too subjective and up to the mindset of every company. At least, the assumption can be confirmed from this discussion.

**Assumption:** Not all of the concerning UEs can be upgraded, and so there remains the UE in the network which cannot handle the uncomprehending field in SIB1 properly.

NOTE: One operator shared the statistics in the live network that more than 5 million UEs facing this issue are present in the network to which software upgrade is not supported.

## Potential workarounds

With regards to potential workarounds (i.e. NW implementation solutions which do not require changing the standards), the following options were proposed:

**Option 1:** Broadcast SIB1 ALTERNATING between with and without SIB24 scheduling information, (Solution 1 in [1]);

**Option 2:** Do not broadcast SIB24, but relying on release with redirection from LTE to NR [2];

**Option 3:** Broadcast SIB24 only on a subset of LTE frequencies [3];

**Option 4:** Broadcast SIB24 without SIB24 scheduling information in SIB1 [3].

All of the options have the advantage that it does not require the standard change and can be supported by NW implementation/configuration. On the other hand, there might exist limitation and drawback of each option. Furthermore, for future proofing, it should be assessed whether each option can be applied for the other SIBs than SIB24 which are defined after the extension marker (i.e. SIB19 and onwards). On these two points, the rapporteur would like to collect company views.

|  |  |
| --- | --- |
| Company name | Option 1 |
| Limitation/drawback | Applicability to other SIBs |
| NTT DOCOMO | If the concerning UE receives SIB1 w/o SIB24 scheduling information by chance, the problem can be ironed out, In contrast, the problem exists if the concerning UE receives SIB1 with SIB24 scheduling information. Likewise, NR SA UE has the same problem that 50% of NR SA UEs can obtain SIB24, whilst the rest of 50% cannot.  | Can be used for the other SIBs, but the same drawback as for SIB24 can be foreseen. |
| Nokia | Solution 1 in [1] does not provide full details but we consider at least the following limitations:* Additional network functionality in SIB scheduling to multiplex and transmit Type 1 and Type 2 SIB content for legacy and upgraded UEs respectively
* Wastage in broadcasting capacity
* Network node interaction to keep track of percentage of legacy and upgraded UEs and take the percentage into account to schedule Type 1 and Type 2 SIB content
* Type 1 and Type 2 SIB multiplexing solution will need to co-exist for a very long period of time
* Needs additional checking for feature interworking issues e.g. with existing features like CMAS/ETWS.

Cost of implementing new solution in network and UE  | Currently Rel-15 also has SIB19 (sidelink), SIB20 (SC-PTM), SIB21 (LTE V2X), SIB25 (UAC for LTE connected to 5GC) and SIB26 (more V2X), and if the problem is the same, those could never be broadcast. And for Rel-16, we added SIB26a (extended 5G indicator), SIB27 (inter-RAT NB-IoT), SIB28 (NR sidelink) and SIB29 (NR V2X coexistence), all of which would suffer from the same issueSolution does not scale well i.e. Solution may be applied to other SIBs but the drawbacks indicated add up further limiting the system capacity for SIB broadcast  |
| Ericsson | The problem UE and the NR UE may acquire the “wrong” SIB1, with a quite high probability, in which case the solution does not work.  | Applicable to other SIBs |
| Qualcomm | Does not solve the issues described above (only reduces the probability of UEs discarding SIB1 when SIB24 is included in scheduling info without solving the issue completely). | No difference in terms of handling SIB24 and other SIBs (SIB19+) after extension marker. |
| Apple | 1. The requirement is very demanding and complex from UE side.
2. A UE in excellent serving cell condition should read SIB1 5 times (which takes 100ms ) in the worst case in comparison to current 3GPP spec requirement of 1 time ( which takes 20ms) which can cause unnecessary delay in camping/re-selection.
3. Power and other KPI impact may be seen due to multiple SIB1 reads
 | Yes  |
| Lenovo | We don’t think that this is a pure NW implementation solution as standard-compliant UEs need to know the scheduling of the alternating SIB1 messages (with and w/o SIB24 scheduling info). | Yes |
| T-Mobile USA | This isn’t a viable option, impact on other UE’s is unknown and it is impossible to determine the impact on legacy UE’s without testing 100’s of UE models.  |  |
| Samsung | Release 15 UEs already in the field need to be upgraded to understand that two different SIB 1s are alternated (otherwise, R15 UE would wrongly consider a cell not supporting SIB24 when the UE decode SIB1 without SIB24 scheduling info). It works only 50% for legacy UE as Nokia indicated |  |
| Vivo | It can just reduce the problem for a certain degree, but the problem still exists. | Yes |
| MediaTek | It ease the problem in certain level but may not solve it completely. It request more testing effort to identify whether the solution works.  | Yes |
| Huawei, HiSilicon | This can reduce the probability of barring the cell, but not sure whether legacy UEs will meet new problems on handling two different SIB1s. | Yes |
| SoftBank | The problem still exists, only half of the UEs can potentially mitigate this problem. |  |
| Telecom Italia | Our main concern is the waste of radio resources due to the need to broadcast two types of SIB1 (one with SIB24 scheduling info and the other without such information), as mentioned by Nokia. | Same as NTT DOCOMO (and in general we have also concerns on a similar issue potentially happening to legacy problematic UEs when an eNB broadcasts SIB1 with SIB26a scheduling information for the purpose of displaying the 5G icon on EN-DC capable devices) |
| LG Uplus | Same view as Ericsson. There is still a possibility that the problematic UE could receive SIB24. | Can be used for the other SIBs, but the same drawback as for SIB24 can be foreseen. |
| KDDI | Same view as Ericsson. |  |
| CMCC | If the concerning UE receives SIB1 w/o SIB24 scheduling information by chance, the issue cannot be addressed totally, since some problematic UE still receiving the SIB1 with SIB24 scheduling information. And if the new UE supporting reselection to 5G cell and receiving the SIB1 without SIB24 scheduling information at the first time, it is possible that the new UE regards the cell as a cell not supporting mobility to 5G cell. | Can be used as a kind of implementation solution, but the issue cannot be addressed completely. |
| ZTE | This may solve the issue partially, but there is still a chance that the legacy UEs will have received the copy of SIB that they cannot process and hence will have the problem. Chipset vendors have to confirm whether this solution solves the issue or not | Can be a partial solution but chipset vendors need to confirm its effectiveness. Our understanding is that at least for some chipsets this will work.  |
| Turkcell | The problem still exists if it’s mitigated for only half of the UEs | Yes |
| Vodafone | Does not seem to work. Once an existing UE has received SIB-1 and decoded it correctly, the UE need not receive SIB 1 again until the RAN tells it that the SI has changed.  | Does not seem to work. |
| CATT | We are not sure how option 1 solves the issue. Even if the problematic sib24 is only sent in a alternative manner still those legacy UEs would have trouble if failed to decoding. This does not even reduce the issue… | Maybe yes |
| OPPO | Solution1 doesn’t resolve the problem but release it bit.  | Yes  |
| AT&T | See AT&T comment in final section |  |
| BT | This solution only mitigates the problem but it doesn’t solve it. It will penalize UEs with a correct standard implementation to support the ones with the wrong implementation.  |  |

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| --- | --- |
| Company name | Option 2 |
| Limitation/drawback | Applicability to other SIBs |
| NTT DOCOMO | Once NR SA capable UEs camp on the LTE network, the UE will never reselect an NR cell (except if the UE returns back from out of coverage). For NR SA capable UEs in such a case, the terminal display cannot show “5G” since the UE camps on an LTE cell (except if the upper layer indication is used). Furthermore, every time when the NR SA capable UE transits to the connected start to originate or terminate a call, the LTE NW has to redirect the UE to an NR carrier. This is an extra burden for the LTE NW to offer NR SA services. It is also noted that redirection from LTE to NR involves the core network change (EPC to 5GC), unless LTE is connected to 5GC. | SIB19 (sidelink discovery):SIB20 (SC-PTM):SIB21 (V2X sidelink):SIB25 (UAC):SIB26/28 (V2X sidelink):SIB26a (NR band list for EN-DC):SIB27: cell selection for NB-IoTSIB29: coexistence with NRFor all cases, the corresponding (LTE) functionality and service cannot be provided on the cell. |
| Nokia | Based on the discussion in [2] at least the following drawbacks are understood:* Unless all of the UEs who cannot handle the uncomprehending value properly are upgraded to fix the bug, LTE NW cannot broadcast SIB24 for NR SA and has to redirect the UE to NR whenever the UE originates terminates a call
* As long as the problematic UEs exist on the field the standard solution from specifications is useless

Cost of implementing solution in network (including testing) is a factor  | Currently Rel-15 also has SIB19 (sidelink), SIB20 (SC-PTM), SIB21 (LTE V2X), SIB25 (UAC for LTE connected to 5GC) and SIB26 (more V2X), and if the problem is the same, those could never be broadcast. And for Rel-16, we added SIB26a (extended 5G indicator), SIB27 (inter-RAT NB-IoT), SIB28 (NR sidelink) and SIB29 (NR V2X coexistence), all of which would suffer from the same issueSolution works for SIB24 and does not impact UE at all which is a good aspect but is non-optimalSolution for other SIBs need to be evaluated for alternative solution on case by case basis |
| Ericsson | When the NR UE goes to connected mode, the NR UE will be redirected to NR, and then also stays there, as long as there is NR coverage. There is some additional delay, but this will diminish when the NR coverage grows, which can be expected.  | Not applicable |
| Qualcomm | Acceptable workaround without impacting correctly implemented UE in the field. | Not applicable |
| Apple | 1. In most cases the SA capable UE can only camp on an LTE cell, and the network needs to redirect the UE from LTE to an NR cell when UE setups the connection to the network, which causes extra signalling overhead, latency and potential increased failure rate
2. User will see 4G often on the UI since UE is unable to reselect to NR cells degrading user experience. Limiting camping on NR via reselection will prevent user from utilizing NR enhancements like early measurements for NR-DC, network slicing etc.
 | Yes  |
| Lenovo | Is a potential workaround but at the cost of limiting UE mobility to NR based on cell reselection and increasing NW resources for conducting redirection from LTE to NR. | Not applicable |
| T-Mobile USA | Agree with Nokia’s comments |  |
| Samsung | Increased delay occurs to correctly implemented NR UEs camping on LTE cells.  | Case by case analysis is needed |
| vivo | Agree with Qualcomm. But, this would introduce additional signalling | Not applicable |
| MediaTek | If we understand this correctly, the solution means that NO SIB24 but use redirection only. The solution works but will have some performance lost on idle mode mobility. | No |
| Huawei, HiSilicon | There is cost from network side and also extra delay, but this solution does not impact legacy UEs in the field, so at least feasible. | Not applicable |
| SoftBank | It can be a workaround, but the drawbacks mentioned from other companies will be foreseen.  |  |
| Telecom Italia | We think this limits the network flexibility and imposes extra burdens to the LTE network due to the need to redirect every single SA UE to NR since cell reselection from LTE to NR cannot be performed autonomously by the SA UE itself (as it can’t rely on SIB24 not being broadcasted)  | Same as NTT DOCOMO |
| LG Uplus | From problematic UE perspective, anyway this workaround is applicable with some drawbacks as mentioned by other company. | Not applicable |
| KDDI | Agree with docomo. |  |
| CMCC | What we concerned is the signalling cost and introduced delay of the redirection command. And this approach is limited to the connected UE. | Not applicable |
| ZTE | This solution seems extremely signalling intensive since each and every UE has to be released and redirected.  | Not applicable.  |
| Turkcell | Workaround is applicable, the drawback will be foreseen. |  |
| Vodafone | Undesirable workaround | Does not work. |
| CATT | This works. but as some companies mentioned there are impact to network.  | Maybe not |
| OPPO | Technically it is feasible. | Not applicable |
| AT&T | See AT&T comment in final section |  |
| BT | Agree with Nokia |  |

|  |  |
| --- | --- |
| Company name | Option 3 |
| Limitation/drawback | Applicability to other SIBs |
| NTT DOCOMO | It works only if there exists the frequency bands which the concerning UE does not support, but the other normal UE supports. Different operators may have different spectrum holding, and so it is not always true if such a frequency band exists. Even so, the coverage of such a band is limited. For instance, the legacy UE is likely to support lower frequency bands (e.g. Band 1, 3), since the nation-wide coverage is quite important when a new service is launched. After that, when new spectrum is available, the new may supports both the legacy band and the new frequency band. Nevertheless, the new band seems to be higher frequency band, e.g. Band 42. In that case, the coverage where SIB24 can be broadcasted would be quite limited. | The corresponding (LTE) functionality and service can be provided only on a subset of LTE frequencies. So, the service availability is restricted to those subset frequencies. |
| Nokia | Based on the discussion in [3] at least the following drawbacks are understood:* Requires additional frequencies to isolate legacy and Rel-15 UEs i.e. reserve some low band LTE carrier (e.g. 700M, or 900/1800M) without SIB24 broadcast, to guarantee service availability of those problematic old UEs which may not be efficient spectrum usage
* May require additional effort on radio network planning
* As long as the problematic UEs exist on the field the standard solution from specifications is useless

Cost of implementing solution in network (including testing) is a factor | Currently Rel-15 also has SIB19 (sidelink), SIB20 (SC-PTM), SIB21 (LTE V2X), SIB25 (UAC for LTE connected to 5GC) and SIB26 (more V2X), and if the problem is the same, those could never be broadcast. And for Rel-16, we added SIB26a (extended 5G indicator), SIB27 (inter-RAT NB-IoT), SIB28 (NR sidelink) and SIB29 (NR V2X coexistence), all of which would suffer from the same issueSolution works for SIB24 and does not impact UE at all which is a good aspect but is non-optimalSolution for other SIBs need to be evaluated for alternative solution on case by case basis |
| Ericsson | This solution requires additional effort to separate the problem UEs and NR UEs on different frequencies, e.g. via redirection or dedicated priorities. A perfect separation may in practice not be achievable, i.e. UEs may end up on the “wrong” frequency, dependent on the deployment scenario (i.e. available frequencies to separate the UEs and their coverage conditions). This may result in poor spectrum usage.  | Only applicable on the frequencies where SIB24 is broadcasted. |
| Qualcomm | Since network needs to make sure the frequencies for impacted legacy UEs vs non-impacted NR SA UEs are different, there is no standards impact, and could be acceptable. | Similar solution could be applied for other SIBs (SIB19+) if needed. |
| Apple | Impacts to certain UEs that select an LTE cell (frequency) as it is the best cell at the location but lacks SIB24 broadcast resulting in degraded user experience (stuck on LTE problem) for such UEs until NW redirects such UEs to NR frequency when entering connected mode. | Yes  |
| Lenovo | Is a potential workaround but depends on the availability of LTE frequencies in a NW. It further restricts UE mobility based on cell reselection and load balancing for the NW. | Yes |
| T-Mobile USA | Option 3 works for a subset of bands assuming that NR SA capable UE’s are able to access a band that the defective UE’s can’t access, and the NR SA UE’s can access. That’s not typically the case and is operator specific and as traffic increases it places a burden on the LTE band used to transfer NR SA capable UE’s from LTE to NR SA bands.  | No impact to existing specification  |
| Samsung | Inefficiency occurs to correctly implemented NR UEs in the concerned frequency band (i.e UE will not search for NR frequencies in such bands). The limitation can be minimized by cell reselection priority | Case by case analysis is required |
| vivo | Impacts are restricted to just UEs that select LTE cells | Yes |
| MediaTek | Limitation on flexibility (on cell reselection, on load balancing). It also require the availability of LTE frequencies as Lenovo pointing out. | Yes |
| Huawei, HiSilicon | This has no impact on legacy UEs. However on the other hand the network has no idea which UEs have problems in idle mode, and thus it is difficult for the network to justify which UEs should camp on those LTE frequencies where SIB24 is not broadcast. So unless we have multiple frequency layers for same coverage, it is not so easy to be deployed. |  |
| SoftBank | It requires the re-planning of network policy and spectrum efficiency therefore it would not be workable in practical network. |  |
| Telecom Italia | We think this strongly limits the operator flexibility when configuring the LTE network, especially considering that the whole set of LTE frequencies of an operator may not be available nationwide. This solution, other than not allowing for efficient LTE spectrum usage, may also negatively impact the NW load balancing operations | Similar solution could be applied for other SIBs (SIB19 onwards) and, even though it does not impact the current standard and considering that the number of LTE frequencies of an operator is not so high and available everywhere, the legacy problematic UE’s segregation on a certain frequency will represent a strong constraint from a network planning point of view |
| LG Uplus | In general, the frequency band that supports the problematic UE is the low frequency band since the low frequency has the highest possibility of nationwide coverage for this operatorWhen the NR UE is handover from NR to LTE, the UE selects a low-frequency band (with problematic UEs) with high possibility because of supporting frequencies’ coverage characteristics. Thus, this solution is non-optimal. | Same view as Docomo |
| KDDI | Agree with Nokia, T-Mobile USA |  |
| CMCC | This approach fix the issue at cost of LTE frequencies and will restrict UE mobility scope. Therefore, it is not an optimal approach in practical network. |  |
| ZTE | This solution is feasible if there is enough spectrum for the operator. So, this may work in some cases.  |  |
| Turkcell | Agree with SoftBank |  |
| Vodafone | Undesirable workaround | Undesirable workaround. |
| CATT | This works, but as said this seems to base on certain spectrum availability assumption. This should be a workaround to consider if operators having this issue think it workable.  | Maybe yes |
| OPPO | From the description it seems problematic UEs belong to some specific IoT service which could be covered by some specific frequency. | Yes  |
| AT&T | See AT&T comment in final section |  |
| BT | This is not acceptable for us as it completely limits our deployment. |  |

|  |  |
| --- | --- |
| Company name | Option 4 |
| Limitation/drawback | Applicability to other SIBs |
| NTT DOCOMO | Given that the specification does not guarantee the UE behaviour that UE is able to acquire SIBs even without scheduling information, it is doubtful if all of the UEs across different vendors can do so. We believe that it is neither solution nor workaround. | The same drawback as for SIB24 can be foreseen. |
| Nokia | Based on the discussion in [3] at least the following drawbacks are understood:* Not transmitting SIB24 in the scheduling list but only directly transmitting the SIB24 might not be 3GPP compliant and even probably not work well on some UEs as they may still ignore the SIB24.
* As long as the problematic UEs exist on the field the standard solution from specifications is useless

Cost of implementing solution in network (including testing) is a factor | Currently Rel-15 also has SIB19 (sidelink), SIB20 (SC-PTM), SIB21 (LTE V2X), SIB25 (UAC for LTE connected to 5GC) and SIB26 (more V2X), and if the problem is the same, those could never be broadcast. And for Rel-16, we added SIB26a (extended 5G indicator), SIB27 (inter-RAT NB-IoT), SIB28 (NR sidelink) and SIB29 (NR V2X coexistence), all of which would suffer from the same issueSolution works for SIB24 but may not work for all UEs as this is might be non-compliant to 3GPP specifications Solution for other SIBs need to be evaluated for alternative solution on case by case basis |
| Ericsson | In our understanding this solution is not standard compliant, and for that reason it is also not guaranteed that the UE will receive SIB24 when SIB24 is not scheduled, i.e. whether the solution works.  | It is not clear if this solutions works, i.e. thus also not clear if it would work for other SIBs. |
| Qualcomm | While this (i.e. include SIB24 in SI message broadcast but do not include SIB24 scheduling info in SIB1) could probably work in theory, we cannot be sure about it given a lot of testing for multiple legacy products is needed. Otherwise some unforeseen/unpredictable behaviour may surface later. So far the interpretation of relation between scheduling info and SI messages did not need to be in line with the interpretation in this solution. So, this solution is not preferable. | If this works for SIB24, this should work for other SIBs (SIB19+) as well. |
| Apple | 1. This seems not a safe solution to guarantee all UEs can handle it correctly.
2. Piggybacking non-comprehended SIBs other than SIB24 will need several of such SIBs to be piggybacked on regularly broadcasted SIBs.
3. If SIB24 (or higher order SIB) is modified, then UE has to reread all the non-modified SIBs that SIB24 is piggybacked with resulting in suboptimal performance.
 | Yes  |
| Lenovo | We don’t think that this is a viable solution as it require non-standard-compliant changes in UE for acquiring SIBs. How does UE know whether SIB24 is scheduled or not (either piggybacked with other SIBs in the same SI message or standalone)? The UE may end up in monitoring continuously SI messages for SIB24 content. Furthermore, this solution would affect the SIB update procedure for SIB24 as well. | No |
| T-Mobile USA | This isn’t a viable option, impact on other UE’s is unknown and it is impossible to determine the impact on legacy UE’s without testing 100’s of UE models.  |  |
| Samsung | Release 15 UEs already in the field need to be updated to perform new behaviour | Case by case analysis is required |
| vivo | Seems workable, but we are not sure what may happen in practical deployment without extensive testing | Yes |
| MediaTek | Some UE may still ignore SIB24 if there is no scheduling info for it. | Yes |
| Huawei, HiSilicon | This solution has UE impact as we need to ensure it works that the UE will still decode SIB24 even without SIB1 scheduling. If the UE is originally standards compliant, this actually requires UE to upgrade. |  |
| SoftBank | It would cause other problem as there is no guarantee to read SIB24 without scheduling info in SIB1. |  |
| Telecom Italia | Not a viable solution for us: other than being not standard compliant, there are no means to ensure not only that the issue may not appear again in case another SIB (from SIB19 onwards different from SIB24, e.g. SIB26a) is scheduled in SIB1 but that the NR SA UEs will effectively receive and correctly decode SIB24 if it is not scheduled in SIB1. | It should be analysed case-by-case: e.g. for SIB26a (NR frequency bands for EN-DC, to be used for the 5G icon), if this SIB is not scheduled the EN-DC UE won’t be able to display the 5G icon as per the enhancement specified in Rel-16 for the *upperLayerIndication* bit |
| LG Uplus | It is not a clear solution because the UE behavior is not specified accurately. | Unclear(don’t know) |
| KDDI | Agree with docomo, we are not sure this solution works. |  |
| CMCC | What our concern is whether this approach can guarantee that the similar issue of receiving SIB24 will not occur in the problematic UE since there is no alignment between the network and UE on the received message in standard way.  |  |
| ZTE | It is not clear that this approach can work since now we have to rely on implementations to be able decode SIB24 without scheduling information.  |  |
| Turkcell | Agree with NTT Docomo and KDDI |  |
| Vodafone | Requires modification of correctly implemented R15 StandAlone UEs that ALSO support measurement of NR cells while on LTE 🡪so there might not be too many of these UEs yet | Does not solve other SIBs. |
| CATT | This sounds like an interesting way. We are not sure at the moment whether UE implementation support this way, i.e., no scheduling info but anyway the SI message is decoded in a complete manner.  | Maybe Yes |
| OPPO | Considering some legacy UE might not be able to interpret SIB1 correctly it is doubtable that they can do this job | No  |
| AT&T | See AT&T comment in final section |  |
| BT | This is not acceptable for us. It is completely unknown the UE behavior that complains with current spec. |  |

[Rapporteur’s summary]

From the received comments, the limitation/drawback and applicability to the other SIBs can be summarised as in the following table.

Table 2.3-1: Summary of the analysis on the potential workaround options

|  |  |  |
| --- | --- | --- |
| Work around options | Limitation/drawback | Applicability to other SIBs |
| Option 1: Broadcast SIB1 alternating between with and without SIB24 scheduling information | The majority thinks that Option 1 does not solve the issue completely, but merely reduces the probability of facing the issue (e.g. 50 %). To resolve the issue completely, the standard impact is expected, like Solution 2 in clause 2.4. | Applicable, but the same limitation and drawback as for SIB24 are foreseen. |
| Option 2: Do not broadcast SIB24, but relying on release with redirection from LTE to NR | The followings are foreseen:1) extra signalling and latency by using release with redirection2) “5G” icon cannot be shown for NR SA UEs. | Not applicable |
| Option 3: Broadcast SIB24 only on a subset of LTE frequencies | Especially from operators, strong limitation is foreseen that network/cell re-planning is required, depending on frequency bands supported by the problematic UEs and the normal UEs. However, it is not feasible in practise. | Applicable, but the same limitation as for SIB24 is foreseen that the services and functionalities are available only on the subset of frequencies. |
| Option 4: Broadcast SIB24 without SIB24 scheduling information in SIB1 | The majority is not sure if Option 4 is a viable solution, since 1) it is not 3GPP compliant behaviour, 2) it is not sure if the existing UE works as such, 3) it requires the software update of the existing UE, etc. | Applicable, but seems not a viable solution as commented for the SIB24 case. |

Finally, the rapporteur would like to collect company views on whether the above options are enough to address the problematic issue **for all concerning SIBs (i.e. SIB19 and onwards)** as workarounds.

|  |  |  |
| --- | --- | --- |
| Company name | Yes/No | Comments (reason of your opinion) |
| NTT DOCOMO | No | All of the options have considerable drawback and limitation, not only for SIB24, but also for the other concerning SIBs. It is a serious pitfall to launch NR SA services, as well as deploying any other functionalities using SIB19 and onwards. |
| Nokia | Yes, but there was one more | There was an option also from [2] on the lines of “SIB24 is scheduled via the additional SI scheduling information list, whilst the legacy SI scheduling information list is untouched and kept as it is”. As mentioned in [2], one drawback of this solution is that this can work only if all NR SA capable UEs support the additional SI scheduling information list and this requires to invalidate current specification and implement new solution in UE and network. |
| Ericsson | - | In our view ALL solutions have certain drawbacks, including the solutions with 3GPP changes. Before we agree on a solution, we need to know what the population size of problem UEs is that cannot or will not be upgraded. In selecting a solution we may also want to consider how urgent the problem is, and if certain solutions can be deployed to all UEs more quickly then others.  |
| Qualcomm | - | See comments above in each option. |
| Apple | Yes | If we have to find a workaround, option 3 is preferred, as it is less intrusive to the UE performance and will work reliably across all UEs. |
| Lenovo | Yes, but | Option 2 + 3 are candidate solutions which can be considered as temporary workarounds w/o impacting specifications. |
| T-Mobile USA | No | Agree with NTT DOCOMO’s comments |
| Samsung | Yes but | We think solution 1 and 4 are not workaround in a sense that they require R15 UE change. We acknowledge the limitation of solution 2 and 3 but also think the limitation/inefficiency would be manageable with proper network implementation  |
| vivo |  | All solutions have drawback as described above. If we have to select one of them, we have to guarantee the solution would apply to most problematics UEs. Solution option 2 can be acceptable. |
| MediaTek | Yes | We understand there is some limitation on the work arounds and testing effort is almost unavoidable in any kind of solution (including standard solution). However, we consider that it is short term solution and is acceptable to us.We are not sure whether we have to fix the issue other than SIB24 at this moment. |
| Huawei, HiSilicon |  | We understand there are no perfect solutions, and it also applies to potential solutions with 3GPP changes, i.e. it also requires UEs to upgrade, otherwise it cannot be supported. So it depends on how serious the problem is. |
| SoftBank | No | Before we go for the above options, it is necessary to investigate the impact on each service related to other SIBs.  |
| Telecom Italia | No | Agree with NTT DOCOMO |
| LG Uplus | No | All options have some drawback and also we have same understanding for one more solution mentioned in Nokia’s comment which will be discussed next section Overall agree with Docomo and Nokia’s comments |
| KDDI | No | Agree with docomo. |
| CMCC | No | All the approached can be used as a kind of implementation solution, however, they all cannot address the issue completely. |
| ZTE |  | The final solution needs to be designed by understanding the chipset vendor views (especially on the feasibility of upgrading legacy/new UEs).  |
| Turkcell | No | Agree with NTT Docomo’s comments |
| Vodafone | No |  |
| CATT | Seems no | As discussed all the options seem not solving the issue perfectly. At least we need to hear the operators’ view regarding option 3 (availability of spectrum resources) and UE vendors’ view on option 4 (whether it actually works that way)… |
| OPPO | Yes | Solution3 is feasible for SIB19 onwards. Of course there maybe some concern on the spectrum cost. |
| AT&T | No | See AT&T comment in final section |
| BT | No | We agree with DOCOMO |

[Rapporteur’s summary]

In a nutshell, there was a clear-cut difference of opinions between vendors and operators. 6 vendors thought that some of the workaround options, in particular, option 2 and 3 can work and so enough to address the issue. Even though an explicit answer was not provided, there were also the other vendors inclined to that viewpoints (4 vendors). In contrast, 11 operators and 1 vendor were of opinion that all of the potential workaround options are not feasible and limitations of their network planning, especially for Option 3. If the problem is extended for the other SIBs, there is no workaround option to address the issue.

## Potential solutions

With regards to potential solutions (i.e. solutions which require changing the standard), the followings were proposed:

**Solution 1:** Introduce an additional scheduling information for SIB24 in SIB1 [2] or SIB3 (Solution 5 in [1]);

**Solution 2:** Broadcast two variants of SIB1 (with/without SIB24 scheduling information) in time domain or frequency domain (Solution 2, 3 in [1]);

**Solution 3:** Deliver SIB24 via RRC connection reconfiguration or RRC connection release (Solution 4 in [1]).

All of the solutions can iron out the problematic scenario. On the other hand, the amount of standard changes is different amongst the solutions. In addition, the other impacts (e.g. increased broadcast overhead) need to be analysed. Applicability to the other SIBs (SIB19 and onwards) has to be investigates, as well. In the light of these viewpoints, the rapporteur would like to seek company views on which solution is preferred, if the standard change is deemed as necessary to iron out the problem. If companies prefer Solution 1 or Solution 2, please also share your preferred sub-option.

|  |  |  |
| --- | --- | --- |
| Company name | Preferred solution | Reason of your opinion) |
| NTT DOCOMO | Solution 1 with the additional scheduling info in SIB1 | Solution 2 requires twofold radio resources to broadcast two variants of SIB1. Increased broadcast overhead is larger than Solution 1. Solution 3 requires the UE to connect the LTE cell at first. One could imagine that the validity time is defined for SIB24. Every time when the validity timer is expired, the NW has to deliver the SIB24 again. It is not clear how the NW knows if the timer is expired or not for each UE. Furthermore, it is not clear how to update SIB24, when the content is modified.With regards to the solution variant of Solution 1, we prefer to introduce the additional scheduling information in SIB1. The reason and benefit of defining SI scheduling information into the other SIB is not clear to us. |
| Nokia | Prefer a solution which is a network workaround but would prefer network being able to broadcast SIB24 in the future and keep the same specification as today. | All solutions have pros and cons and it is rather difficult to make a choice as this means new network and/or UE implementation and invalidating correctly specified behavior. If we now introduce a solution that will cause new UEs to rely only on the new signalling, then that signalling cannot be removed in the future because it would again create a legacy UE problem (for the “new UEs” using that, which will become “legacy UEs” in the future). In this case we are just moving the problem around and not really solving anything.We also agree to the following and quoting from [3], “*3GPP has claimed Rel-15 ASN.1 freeze for quite a long time. At this stage, NBC change on Rel-15 specification is not acceptable to us. The Rel-15 UE with correct implementation should NOT be mandated to use another solution due to wrong implementation of some legacy UEs. This is really a bad practice if 3GPP decides to favor the wrongly implemented UEs and add additional effort to the UEs with correct implementation*”.In the end, no matter which standardized solution is adopted, it will penalize UEs that were correctly implemented. We have to figure out means to handle this (in the network) but the only real way to solve this problem will be to phase out the faulty UEs or upgrade them. |
| Ericsson | Our preferred solution is a NW workaround, i.e. option 2, but only in case a solution is justified. 3GPP does not need to discuss further NW workarounds that do not impact 3GPP.  | We do not prefer a 3GPP change, but we think that solution 1 is the most direct solution to the actual problem. We think solution 2 wastes resources, which is not needed. We think that solution 3 does not directly solve the problem, i.e. NR UE not receiving SIB24 in Idle mode, but requires the UE to go to connected mode, which introduces some delay before the UE re-selects to NR.  |
| Qualcomm | Our preferred solution is a NW workaround, i.e. option 2 in section 2.3. See comments.  | Regarding Solution 1: Our understanding of solution in [2] is not the same as solution 5 in [1]. Clarification would be helpful. In our understanding, sol 5 in [1] means to include SIB24 in SI message broadcast but do not include SIB24 scheduling info in SIB1, which is similar to solution 2 in [3] already covered in Option 4 in section 2.3 (see comment there). Any standard based solution such as Annex of [2] brings additional disadvantages to already compliant UEs and networks by requiring further updates.Regarding Solution 2: * Broadcast two variants of SIB1 (with/without SIB24 scheduling info) in time domain would not solve the issues discussed above (similar comment as option 1 in section 2.3).
* Broadcast two variants of SIB1 (with/without SIB24 scheduling info) in frequency domain – we understand this is similar to solution 1 in [3], option 3 in section 2.3 and could be acceptable solution.

Regarding Solution 3: This solution has disadvantages of both worlds – not only this needs (newer) compliant UEs as well as networks to be updated regardless, this also increases signalling overhead. As such, this cannot be acceptable.In summary, 1. our first preference would be to solve the issues for the impacted UEs by using the workarounds in option 2 in section 2.3 (redirection from LTE to NR)
2. second preference is option 3 in section 2.3 (SIB24 only on a subset of LTE frequencies)
3. or it can be left up to the UE vendors to find and implement solutions for impacted (wrongly implemented) UEs.

All of the above options avoid penalizing rightly implemented UEs in the field.  |
| Apple | None | Any spec change will lead to a legacy RAT like LTE to be impacted and we would prefer not to modify anything as basic as SIB scheduling at this stage, as this will involve certification, IODTs and field testing to validate any of the potential changes in the above solutions.We may also want to understand how many UEs among those with problematic implementation cannot be upgraded. To make a spec change for a relatively smaller number of UEs (given there are an order of magnitude high number of devices worldwide) seems to be more burdensome on vendors who do not have any issue handling SIB24 scheduled in SIB1. |
| Lenovo | None (for the time being) | As commented earlier, in general, we should avoid introducing workarounds in our specifications to handle bad UE implementations, esp. if we don’t know for how long the problematic UEs may exist. Any changes we introduce in the specifications require extra implementation efforts in both UE and NW. We are concerned that we may open Pandora’s box if we adopt any of the proposed solutions 1, 2 or 3. It may happen that the problematic UEs may cause further issues other than the known SI scheduling issue for SIB24, which then require further specification changes. |
| T-Mobile USA | NW workaround is preferred. Also support Nokia’s comment “but would prefer network being able to broadcast SIB24 in the future and keep the same specification as today.”  |  |
| Samsung | None in specification impacting solutions. Prefer NW workaround like 2, 3  | We want to avoid correctly implemented and already deployed UEs to be punished. We should focus on finding acceptable workaround first.  |
| vivo | None. Any solution considered should guarantee the solution would apply to most problematics UEs.Solution **Option 2** may be better**:** Do not broadcast SIB24, but relying on release with redirection from LTE to NR [2]; |  |
| MediaTek | None | As indicated in our paper, it will really be a bad practice if 3GPP decides to favor the wrongly implemented UEs and add additional effort to the Rel-15 UEs with correct implementation. We prefer solutions without standard impact if there is a need for workaround.  |
| Huawei, HiSilicon | Prefer workaround solutions | We think option 2 in Sec 2.3 could be one candidate solution as workaround solutions, as also other companies commented, we’d like avoid punishing UEs which have already implemented correctly.  |
| SoftBank | Solution 1 | Solution 2 cannot be acceptable as it will cause significant impact on network/spectrum policy. Solution 3 may work but signalling overhead will be increased.  |
| Telecom Italia | Solution 1 | We acknowledge that this solution affects the correctly implemented UEs but we do think that Solution 1 is the easiest solution to solve the issue. Solution 2 for us is similar to Option 1 in Section 2.3 (wasting radio resources due to the need to broadcast two types of SIB1) while Solution 3, as mentioned by Ericsson, may introduce excessive delay for a NR SA UE to eventually reselect to a NR cell |
| LG Uplus | Our preferred solution is 1, But Options 2 & Solution 3 can also be considered. | Although it is difficult to modify a standard that has already been stabilized, it is an important issue for commercial users. There are many solutions, but Solution 1 seems to be an optimal solution.It is worth to mention below. For Option2 & Solution3 as DOCOMO mentioned in Sec 2.3, for other higher number of SIB (SIB19 and onwards), the corresponding (LTE) functionality and service cannot be provided on the cell.  |
| KDDI | Solution 1 | Agree with docomo. With regard to which SIB (SIB1 or SIB3) will have an additional scheduling info, we don’t have a strong preference. |
| CMCC | Solution 1 | In our understanding, the solution 1 (solution 5 in [1]) can address the issue completely. As comments above, the workaround solutions cannot fix the problem completely. Meanwhile, in our understanding that any SIB after the ellipsis marker in the ENUMERATED list end up is possible to cause the same issue as SIB24. Furthermor, the latest number of such problematic UEs provided from our colleagues involved in network operations is more than 5 million, and most of them are used for IOT field, which are just not equipped with NB-IoT or MTC chipset, but rather regular 4G chipsets, and cannot support remote software upgrade. In the contrast, the SA UEs can be software updated upon the specification is enhanced.  |
| ZTE | Solution 1 | We understand solution 1 can address the issue. Indeed, it increases the overhead, but this is temporary fix (as long as the legacy UEs that have problem exist in the field) and once these are not there anymore network need not use this fix.  |
| Turkcell | Solution 1 | Solution 1 is the most direct solution to the actual problem |
| Vodafone | Combined use of option 2 and option 3 | The problematic devices can be camped on a subset of LTE frequencies. Use option 2 on these frequencies. |
| CATT | Solution 1 is acceptable | If after discussions we cannot agree on workaround, we are willing to accept solution 1. |
| OPPO | None and we prefer workaround solution | Solution 2 in section 2.3 can at least work for SIB24 issue. Solution 3 in section 2.3 can work for SIB19 and onwards. |
| AT&T | See following Comment | We believe additional analysis is needed to ensure other problems don’t eventually appear (due to work arounds) either in the short term or longer term. There will be numerous cases where legacy devices that are in the field which cannot be firmware updated due to a number of reasons, such as OEM is no longer in business or device is EOL, device is an IoT device and does not support FOTA, BYOD devices etc, etc; therefore, we can’t support a device fix. |
| China Telecom | Solution 1 | Solution 1 is the most direct one to solve the actual problem and acceptable to us. |
| BT | Not ready to agree any solution at this stage | At the moment we are not ready to compromise without the full picture of the issue. Initially, our preferences are solution 1 or NW workaround.If we go for solution 1, our question is what happens with other SIB that potentially triggers the same issue? And it is sure we need to upgrade all current 5G capable devices.If the problem has a severe impact, NW workaround cannot be the optimal solution.  |

[Rapporteur’s summary]

Roughly speaking, vendors were of opinion that none of the solution requiring standard change is preferred (of course, not of all vendors). In contrast, Solution 1 received the majority support from operators (of course not all of operators, as well) and some vendors.

## Summary and proposal

As the outcome of this email discussion, the following problematic scenarios and assumptions were identified:

**Problematic scenario:**

**Case 1:** When an eNB broadcasts SIB1 which includes scheduling information of SI messages including SIB19 and onwards, some legacy UEs that do not handle the *SIB-Type IE* correctly are unable to acquire SIB1 and consider the cell as barred.

- It happens no matter whether SIB19 and onwards are scheduled separately from the other legacy SIBs (SIB2 to SIB18) via the different SI message, or SIB19 and onwards are scheduled together with the legacy SIBs in the same SI message.

**Case 2:** When an eNB broadcasts a SI which includes both legacy SIB(s) and SIB19 and onwards, some legacy UEs that do not handle the *SIB-Type IE* correctly will discard the SI even if it understands the corresponding scheduling information in SIB1.

**Types of UEs:**

- The problematic UEs are used not only for IoT service, but also for any types of services including smartphones.

**Assumption:**

- Not all of the concerning UEs can be upgraded, and so there remains the UE in the network which cannot handle the uncomprehending field in SIB1 properly.

NOTE: It is hard to assess the severity of this issue, since it is subjective and up to the mindset of every company how many and percentage of UEs are thought as problematic. For information. one operator shared the statistics in the live network that more than 5 million UEs facing this issue are present in the network to which software upgrade is not supported.

With regards to the potential workarounds (i.e. NW implementation solutions which do not require changing the standards), there was no consensus since opinions were somehow split between vendors and operators, though not all of the vendors or operators share the same view. The workaround option 2 and 3 are thought as acceptable by 10 vendors, whilst they are not acceptable by 11 operators and 1 vendor. Nevertheless, the following limitation/drawback and applicability to the other SIBs seem to be the common understanding of Option 2 and 3, amongst all companies. It seems to be the common consensus that Option 2 cannot be a solution if the other SIBs than SIB24 are considered.

|  |  |  |
| --- | --- | --- |
| Workaround options | Limitation/drawback | Applicability to other SIBs |
| Option 2: Do not broadcast SIB24, but relying on release with redirection from LTE to NR | 1) extra signalling and latency by using release with redirection2) “5G” icon cannot be shown for NR SA UEs. | Not applicable |
| Option 3: Broadcast SIB24 only on a subset of LTE frequencies | From operators, strong limitation is foreseen that network/cell re-planning is required, depending on frequency bands supported by the problematic UEs and the normal UEs. However, it is not feasible in practise. | Applicable, but the same limitation as for SIB24 is foreseen that the services and functionalities are available only on the subset of frequencies. |

With regards to the potential solutions (i.e. solutions which require changing the standard), there was no consensus since opinions were split likewise the potential workarounds. Solution 1 (i.e. introduce an additional scheduling information for SIB24) received the majority support from operators (of course not all of operators, as well) and some vendors.

Therefore, the email discussion was not able to conclude to suggest a direction for resolution, and so on-line discussion is deemed as necessary to conclude. The followings are proposed:

**Proposal 1: RAN2 strives against the SIB scheduling issue, not only for SIB24, but also for all the other SIBs defined after the extension marker.**

**Proposal 2: Decide whether the workaround options (below) are enough, or standard amendment is needed:**

 **Option 2: Do not broadcast SIBs, but relying on release with redirection from LTE to NR (only applicable to SIB24, but not applicable to the other SIBs)**

 **Option 3: Broadcast SIBs from SIB19 and onwards only on a subset of LTE frequencies.**

**Proposal 3: If the standard amendment is needed, introduce an additional scheduling information for SIB19 and onwards in SIB1 or SIB3 (i.e. Solution 1).**

## References

[1] [R2-2008367](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2008367.zip), “Discussion on SIB24 issue,” CMCC.

[2] [R2-2008083](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2008083.zip), “Problem on SI scheduling via an extended field,” NTT DOCOMO, INC.

[3] [R2-2008107](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2008107.zip),” Workaround for LTE SIB24 issue,” MediaTek

[4] [R5-202138](https://www.3gpp.org/ftp/tsg_ran/WG5_Test_ex-T1/TSGR5_87_Electronic/Docs/R5-202138.zip), “Discussion paper on the need for testing UE handling of extended and spare fields in SI,” NTT DOCOMO, INC.

[5] [R5-203060](https://www.3gpp.org/ftp/tsg_ran/WG5_Test_ex-T1/TSGR5_87_Electronic/Docs/R5-203060.zip), “Addition of new RRC TC for checking extended / spare field handling in SI,” Rel-16 CR to 36.523-1, NTT DOCOMO, INC.

[6] [R5-203067](https://www.3gpp.org/ftp/tsg_ran/WG5_Test_ex-T1/TSGR5_87_Electronic/Docs/R5-203067.zip), “Addition of new NB-IoT RRC TC for checking extended / spare field handling in SI”, Rel-16 CR to 36.523-1, NTT DOCOMO, INC.