**3GPP TSG-RAN WG4 Meeting #94-e R4-2002197**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 7.15 - Support for NavIC Navigation Satellite System for LTE [LCS\_NAVIC-Perf]

**Source:** Moderator (Reliance Jio)

**Title:** Email discussion summary for RAN4#94e\_#74\_LCS\_NAVIC\_RRM

**Document for:** Discussion and Approval

# Introduction

In RAN#85, LCS\_NAVIC work item was approved for A-GNSS suport for NavIC constellation in LTE Release-16. This change request captures the minimum performance requirements expected from GNSS receivers supporting NavIC constellation.

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List of candidate, target of email discussion, for 1st round and 2nd round

* 1st round: Qualcomm, Thales, Broadcomm, Nokia, ZTE, OPPO, APPLE, SAMSUNG, Media-tek, Huawei
* 2nd round: Everyone

# Topic #1: GNSS Receiver Peformance for NAVIC

Minimum performance requirements for GNSS receivers supporting NavIC constellation.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000071 | Reliance Jio, ISRO | Proposal 1: Minimum performance requirements for GNSS receivers supporting NavIC constellation.  Observation 1: Addition of L5 band only constellation. |

## Open issues summary

### Minimum performance requirements for NAVIC constellation

Issue 1-1: Navic requires 12 sec for the time sync. Hence ‘max-response-time’ in minimum requirements criterion of TS 36.171 needs to be updated.

* Proposals
  + Option 1: ‘max-response-time’ shall be updated for all GNSS
  + Option 2:
* Recommended WF
  + ‘max-response-time’ shall be updated to 40ms to meet 95% success criterion

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Spirent Communications | For all RAN 4 requirements except Nominal Accuracy we have never before defined any requirements for a regional NSS system (only for global systems). Having a regional NSS raises many issues. We will need to discuss how we intend to do this and agree a way forward. I suggest a discussion paper with proposals should be generated …  Once we have an agreed approach, then another paper will be needed that details and justifies the various values proposed for the requirements (2-D accuracy, TTFF and SV levels etc.) |
| Ericsson | Agree with Spirent, we need to have a discussion and justification for the approach and the numbers. |
| Qualcomm | We have the following comments:  (1) The current specification framework of 36.171 supports requirements for global constellations only, as specified in clause 4.7 of TS 36.171. NavIC is a non-global GNSS having regional coverage only. The change in section 4.7 (and at other places) require some correction:  “Minimum performance requirements are defined for each global GNSS constellation (GPS, Galileo, Modernized GPS, GLONASS , BDS and NavIC).”  since NavIC is not a global GNSS constellation.  (2) We agree that NavIC capable receiver require longer response time due to NavIC data structure and L5 signal only; we agree that 40 sec is reasonable. However, we cannot change the existing requirements. Therefore, separate Requirements Tables should be introduced for NavIC. For example:   | System | Success rate | 2-D position error | Max response time | | --- | --- | --- | --- | | ~~All~~NavIC | 95 % | 100 m | 40 s | |
| Spirent 2 | To help the discussion, here are the questions we would like to be answered.  **Background:** The only regional NSS we have so far is QZSS. For QZSS for RAN 4 requirements we treat QZSS as an “add-on” to GPS for Nominal Accuracy only. It is not treated as a “standalone” NSS.  **Questions:**  1. Do we treat NavIC like QZSS or more like the global NSSs? What is the reason/use case for this decision?  [Moderator]: We will treat NavIC QZSS.  2. If we treat NavIC more like a global NSS do we treat it as a standalone system (so not in combination with any other GNSS)? Do we treat it in combination(s) with other GNSSs (so for example NavIC + GPS + Galileo)? Or both the above?  [Moderator]: NavIC is a standalone system.  3. Do we define requirements for all the existing RAN 4 tests? Including “moving scenario”?  [Moderator]: Since NavIC will be treated as Regional GNSS. Moving Scenario is not valid.  4. For the requirements/tests, for NavIC as a **standalone** system:  a) Are the current HDOP conditions realistic? What are the min/max/typical HDOPs for system?  [Moderator]: Min: 1.2, Max: 2.8, Typical: 1.9.  b) Is the current condition for six visible satellites realistic? How many SVs are typically visible?  [Moderator]: The condition of six visible satellites is realistic since NavIC system has 7 visible satellites across the service region in a typical scenario.  c) Given the answers above, are the current 2-D accuracy requirements still achievable?  [Moderator]: The specifications for NavIC system are CEP accuracy of 3m and a 2D 2σ error value of 7m. The measured values are much better than specifications across the service region so the accuracy requirements are very much achievable.  d) Is the current TTFF achievable? (Seems not) Is it acceptable to have an exception for NavIC (standalone)?  [Moderator]: NavIC L5 signal has a sub-frame length of 12sec with FEC so the worst case TTFF would be 24sec. It is acceptable to have an exception for NavIC to cater to this in the standalone NavIC case.  e) SV power levels: what values and how are they calculated/justified (compared to levels for GPS)? These calculations/justifications should be documented somewhere.  [Moderator]: The SV power levels are calculated using reference receivers across at IRNSS Range and Integrity Monitoring Stations spread across the service region and specified in the NavIC SPS Signal In Space ICD available in public domain on ISRO website.  5. For the requirements/tests, for NavIC as one NSS in a **multi-constellation** case:  a) Do we just treat it as the other GNSSs? (In particular the GEO SVs treated like BDS?)  [Moderator]: NavIC will be treated as Regional GNSS.  b) How would we set the TTFF?  [Moderator]: NA  c) For the Nominal Accuracy requirement, how do we treat QZSS and SBAS (which are normally added in with GPS)? Presumably we would have to exclude at least QZSS in this case?  [Moderator]: We will add NavIC just like SBAS.  **Other points:**  1. The calculations for the values for the parameters in Annex C need documenting somewhere.  [Moderator]: I believe it is not applicable now.  2. In the case of **multi-constellation requirements** including NavIC, the current GNSS scenarios used for many years in RAN 5 will be unusable and a decision will have to be made as to how to handle this – this might require a joint RAN 4 / RAN 5 discussion and decision.  [Moderator]: I believer it is not applicable now. |
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### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*   * 1. *NAVIC will be treated as Regional Constellation.*   2. *Section 6.2 of TS 136.171 will be modified as*      1. *New column for NAVIC in the Table 6.7 as*   Table 6.7: Test parameters   | **System** | **Parameters** | **Unit** | **Value** | | --- | --- | --- | --- | | Navic | Reference signal power level for all satellites | dBm | -129 |  * + 1. *New table 6.9a for minimum requirements*   Table 6.9a: Minimum requirements   | System | Success rate | 2-D position error | Max response time | | --- | --- | --- | --- | | L5-only | 95 % | 15 m | 40 s |     *Candidate options:*  *Recommendations for 2nd round:* |
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*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Modify the CR to accommodate the tentative changes. | Reliance Jio |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2000071 | 1. Modify the CR to change Navic as Regional GNSS Constellation 2. Add Table 6.9a for Minimum Requirements for L5 receivers only |

## Discussion on 2nd round (if applicable)

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| **CR/TP number** | **Comments collection** |
| R4-2000071 | Spirent Communications  1. We believe NavIC should be treated like QZSS, not like SBAS – therefore the one NavIC SV should **replace** a GPS (or other GNSS) SV, not be in addition … but see next point.  [Moderator]: NavIC is not a GPS-like signal (like QZSS). Replacing a GPS SV with NavIC does not seem reasonable. It should be treated like SBAS as an additional SV  2. Unfortunately, we have realized that for a single constellation, the existing test for QZSS (and SBAS) does not work. This is not the fault of NavIC, but it needs resolving anyway.  For a single constellation, with a modern UE GNSS receiver, in these “ideal” conditions and with a good HDOP, only **four** SVs are needed to be generated for the UE to “pass” the requirement (test). In this case having a fifth or a sixth SV does not improve the position accuracy in any meaningful way and any improvement is hard to detect in the testing. This implies that having one of the (six) SVs as QZSS (or NavIC) does not prove that this QZSS or NavIC SV was used in the position calculation – the UE could very easily just use four or five SVs from the “main” constellation and simply ignore the QZSS or NavIC SV. In particular, NavIC, being only L5 could very easily be ignored.  The situation with SBAS requirement/testing is even more unsatisfactory.  In our opinion this issue needs to be resolved now and not just ignored until some future date.  Possible solutions are to reduce the number of SVs to four for this case. This would require some study to ensure that other parameters can remain unchanged. In theory, for the case of UE-assisted mode, the number of SVs could remain at six but the UE pseudoranges could be checked to see that the QZSS/NavIC SV was indeed measured – however it is not clear that the UE is indeed required by the core specs to measure the QZSS/NavIC SV under these circumstances ….  Note that the above issue applies to the single constellation case. For the dual and triple constellation cases the situation is a little different, but they also need studying to ensure they are still really testing what was originally intended.  [Moderator]: This issue is independent of NAVIC inclusion. Will be difficult to meet with REL 16 timeline. This should be taken separately.  2. A more general question: what happens in the case that both QZSS and NavIC are supported?  [Moderator]: QZSS has no coverage in NavIC service area.  3. In addition to the issue raised above, in the case of QZSS and now NavIC, currently only a GPS SV is replaced by the QZSS/NavIC SV – this anyway should be modified so that other GNSSs could be used, not just GPS.  [Moderator]: This issue is independent of NAVIC. Will be difficult to meet with REL 16 timeline. Also please note that suggestion is to treat NavIC like SBAS and not like QZSS  4. For the TTFF for the case where NavIC SV is included we are unsure if the TTFF requires changing or not. Certainly, NavIC will not be used for initial acquisition or for the determination of time, therefore it will only be used for ranging – does this still require 40 s to perform?  [Moderator]: Yes. To meet a 95% success rate, UE needs to have two possibilities to capture time. If the receiver misses one instance, the test would be a failure. That’s why two possibilities to capture time from NavIC is required. Also note that only single NavIC SV is visible for the test. For L5-only, the receiver must first find this single SV and then must get the time from this SV. Having only a single chance to get time looks not feasible for a 95% success rate. Two successful time capture require 40sec as minimum time.  5. If a 40 s TTFF is indeed required, then we believe the tests will need to be run twice to avoid losing test coverage: the original tests were designed to ensure the requirements are met **with a 20 s TTFF** and this should still be tested. Therefore, the test will need to be run once without NavIC but with 20 s TTFF and a second time with NavIC and a 40 s TTFF.  [Moderator]: The updated response time does not apply to existing L1 GNSS receivers. This has been introduced as a special case when standalone L5 only GNSS reception is tested for Minimal accuracy.  6. If a 40 s TTFF is required, then the “responseTime” IE in Request Location Information will need to be updated.  [Moderator]: Agreed. This will be modified  7. The text “Table 6.9a for L5 only receivers” needs reconsidering – this does not apply to just L5-only receivers we believe, but L1 + L5 receivers as well …It will need more explanation ….  [Moderator]: For L1+L5 receivers, GPS will be used for initial acquisitions and therefore can easily meet 20sec requirement. The problem is only with L5 only receiver where GPS acquisition as primary GNSS may not be reliable and therefore require relaxation in time. A L5 only receiver can only acquire NavIC. Once the NavIC SV is found, the additional GNSS SVs can be acquired.  8. Clause B.1.4 also needs “NavIC” adding in and the case where both QZSS and NavIC are supported needs to be covered.  [Moderator]: Agreed. This will be added. |
| Qualcomm  1. NavIC should not be treated like QZSS, since it is not a GPS-like signal. Treating it like SBAS as proposed in the CR would be O.K.  2. For a L5-only receiver, only NavIC can be used for initial acquisition. There is no other L5 signal which is suitable.  3. The proposed requirements look generally O.K. to us. |
| Spirent Communication  1. QZSS or SBAS – logically it should be treated like QZSS as that is a similar regional system with similar orbital characteristics etc. SBAS is more of an “anomaly” and in 3GPP is only used for ranging and nothing else. However, this discussion is not relevant as the main issue here is that, as discussed above, this requirement/test is of no value for either QZSS or SBAS and needs to be re-designed. The reason this has never been discussed before is that this test has never been implemented due to lack of industry interest – if we are now serious about NavIC, then this test must be re-analyzed and modified if necessary (and we think it will be necessary).  2. L5-only receivers: we have never considered L5-only receivers before in RAN 4. If you are seriously stating that L5-only receivers will appear in UEs going forward, then we need to consider the implications for the RAN 4 requirements. This will likely require different TTFF requirements as you have already discussed and possibly others as well. At a minimum we will need to have some explanatory text about L5-only receivers and probably different clauses in the requirements/tests to cater for these.  3. L5-only receivers – initial acquisition: you say  *There is no other L5 signal which is suitable*.  This is not correct – there are other L5 signals that can be used for initial acquisition (GPS, Galileo …), we suspect you actually mean that other L5 signals require a lot more processing power for initial acquisition and therefore you have chosen not to use them – this is then an implementation decision, not a specification issue.  4. L5-only receivers: implementation for NavIC: it seems from your description that for NavIC you will have special L5-only receivers that have to use NavIC for initial acquisition and will then use other L5 signals (like GPS, Galileo …) for ranging. Is this correct? This implies these receivers will only work at all within the footprint of the NavIC system. If this is correct, then these receivers will FAIL the current test as you have proposed it and will also FAIL all the other tests in 36.171 as you have not proposed any changes to these tests. If this is correct, then we need to consider what to do and indeed whether such receivers really should come under the RAN 4 requirements at all or whether you should not bother to try to specify RAN 4 requirements for them.  5. L1+L5 receivers: from what you say above, if I have a more normal L1+L5 receiver, what happens if I try to use the NavIC signals? Am I somehow forbidden to use these signals in this case? (I don’t see that in the core specifications!) Or are you saying that RAN 4 should ignore this case? If so, this should be justified and explained in the text in 36.171.  **Way forward:**  We doubt we are going to understand all these issues in the time remaining this week, so we propose that we start an off-line discussion where you explain how a NavIC receiver works and what you want to test (if anything). We can then work to define suitable requirements and tests. If you want to agree a CR this week with just the basic NavIC information added (introduction, abbreviations, references etc.) then we could agree that if you simply state: “Requirements and testing of the NavIC system is FFS” and you do not make any changes to the requirements etc. |
| IIT Madras  IIT Madras agrees with the proposed changes to the CR. |
| Spirent Communications  It seems we now have two cases:  1. “Normal” L1 + L5 receivers:  You have confirmed above that “normal” L1+L5 receivers can work with NavIC. However, the current CR does not seem to cover this case or is not very clear that this is the case being covered. As this is the most likely case (see next point) we should concentrate on defining the requirements for an L1 + L5 receiver. For this we now all agree that this receiver will acquire GPS/Galileo etc. and will just use one NavIC signal for ranging (only) in the position solution. So, we agree we can add NavIC to the requirement in your CR, however if you do not want to sort out the issue with the number of SVs, then you will have to add a note to the effect that:  “In the case of NavIC (and QZSS and SBAS), this requirement/test is not effective and requires further study” (or similar wording).  We can then sort out this issue in the next meeting under TEI maintenance.  2. L5-only receivers:  It is now clear from the discussion above that these are “special” NavIC receivers in that their behavior is specific to the NavIC system – the particular implementation here has chosen to work only with the NavIC system and will not, for example, work world-wide. In our view this is such a “special case” that only applies to NavIC receivers and it should not be considered in RAN 4. Any requirements for this type of receiver should simply be determined by the interested parties and not within 3GPP. If other companies believe that 3GPP/RAN 4 should consider this case, then it will have to be clearly identified in 36.171 that this requirement(s) apply only to specific “NavIC L5 receivers”.  Other issues above can be discussed once we have agreement on the basic way forward. |
| YYY | Company A |
| Company B |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |