3GPP TSG-RAN WG3 Meeting #121 R3-234550

Toulouse, France, 21 – 25 August, 2023

**Agenda item: 12.3**

**Source: Nokia - moderator**

**Title: Summary of offline discussion: CB: # AIRAN5\_MDT**

**Document for: Discussion**

# 1 Introduction

This paper provides a summary of discussions at RAN3 #121 on:

**CB: # AIRAN5\_MDT**

**- Check the solutions proposed by companies in R18**

(moderator - Nok)

Summary of offline discussion in R3-234550

# 2 For the Chairman’s Notes

[To be completed]

# 3 Discussion

Continuous MDT collection may be defined as MDT data collection that enables to collect data from the same UE across RRC states (RRC\_Connected, RRC\_Idle, RRC\_Inactive).

In the previous meeting, we captured the following points as common understanding in RAN3:

**For signaling based MDT, TCE could identify the UE via UE identifier**

**For management based MDT, it is not possible for TCE to identify the UE with UE identifier that can lead to the unique UE identity since m-based MDT is intentionally made anonymous.**

In addition, we captured the following open points for further evaluation:

**Further evaluate the gap of continuous MDT during idle to active transition for both management based MDT and signaling based MDT, e.g. how many milliseconds? What is the maximum acceptable gap for continuous MDT? e.g. consider the report periodic of UE measurement report.**

**Further check whether the management based MDT identifier e.g. IMEI-TAC, NR- CGI, TR/TRSR allows the TCE to correlate logged MDT and immediate MDT collected during continuous MDT.**

**If correlation of log MDT and immediate MDT is possible for management based MDT, FFS whether the current mechanism already support configuration of continuous MDT i.e. when UE connected to a new cell and report the availability of log MDT, the connected cell could configure the UE with immediate MDT immediately.**

**If correlation of log MDT and immediate MDT is possible for management based MDT, FFS on selection of group of UE when deciding to implement continuous MDT.**

## 3.1 Gap Evaluation of Continuous MDT during RRC Idle to RRC connected transition

One of the open points from the last meeting is to evaluate the gap of continuous MDT during RRC Idle to RRC connected transition both for management-based and signalling-based MDT, e.g., how many milliseconds the transition takes and compared it to the logging MDT interval.

In [2], it is discussed that the legacy MDT framework is based on configuration in the UE that is separate for RRC idle and RRC inactive modes (Logged MDT) and RRC connected mode (Immediate MDT). While activation of a Logged MDT configuration configured in the UE takes place automatically when the UE transits to idle or inactive modes, the activation of Immediate MDT measurements in the UE is based on RRC measurement configuration sent to the UE by the network at each transition to connected mode. The obtention of a continuous measurement series therefore depends on the delay required for activation of the Immediate MDT measurement in the UE when the UE connects to the network in comparison with the standardized values for logging interval, which are, in milliseconds (TS 38.331):

*LoggingInterval-r16 ::= ENUMERATED {*

*ms320, ms640, ms1280, ms2560, ms5120, ms10240, ms20480, ms30720, ms40960, ms61440, infinity }*

Thus it can be seen that the defined logging intervals span a range from 320 ms to around 1 minute.

A possible achievable value for the duration of UE initial access can be estimated to be 50 ms, which would then also correspond to the measurement gap in transition from RRC\_Idle to RRC\_Connected in this scenario, with a maximum reasonable value reaching at most 100ms depending on deployment and equipment aspects.

In some scenarios, e.g. with a higher number of ongoing management-based Logged MDT sessions configured in the network, the NG-RAN node implementation may retrieve TR/TRSR (Trace Reference / Trace Recording Session Reference) of the Logged MDT configuration from the UE using the RRC *UEInformationRequest* / *UEInformationResponse* message exchange towards the UE. The NG-RAN node implementation may then map the TR/TRSR of the Logged MDT session with an associated immediate MDT session. A possible value for the delay related to the *UEInformationRequest* / *UEInformationResponse* message exchange can be estimated to be around 20 ms.

The measurement gap induced by transition from RRC\_Idle to RRC\_Connected would in a reasonable scenario not exceed the order of 120 ms, which would also include some internal delay (e.g. 5 ms) in the UE linked to processing and initiation of the immediate MDT measurement. This means that the gap is significantly lower than the shortest Logged MDT measurement interval.

The same conclusion is reached in [11] where the time gap is evaluated to be shorter than the Logged measurement interval.

In [12], it is further discussed that in case continuity in time of the collected dataset cannot be achieved due to constraints posed by the MDT data acquisition process which are needed to avoid significant impacts at UE side, it could be possible to exploit innovative data manipulation techniques that allows to e.g. fill in gaps in collected datasets, such techniques however are AI/ML model implementation dependent and hence are out of RAN3 scope.

Also, in [10] it is discussed that delay in the reconfiguration can be further decreased if OAM preconfigures OAM with Immediate and Logged MDT which can be done by implementation.

**Q1: Do all companies agree that there is no loss of measurements due to the time gap during transition from RRC Idle/Inactive to RRC Connected?**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| Nokia | Yes | As we also discussed in our paper, the measurement gap induced by transition from RRC\_Idle to RRC\_Connected would in a reasonable scenario would not exceed the order of 120 ms, which would also include some internal delay in the UE linked to processing and initiation of the immediate MDT measurement. This is much shorter than the shortest Logged MDT measurement interval which means that there will not be any loss of measurements due to the time gap during transition from RRC Idle/Inactive to RRC Connected. |
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**Summary of Discussion:**

## 3.2 Signalling-based Continuity Enhancements

It is moderator’s understanding that in signalling-based MDT, continuous MDT measurements with respect to a specific UE are supported by default since trace activation is activated per UE and the CN may store the signalling-based MDT configuration and apply it when a UE moves from RRC Idle to RRC Connected state. Therefore, when a UE transits to RRC Idle or Inactive state it activates its configured Logged MDT configuration and logs the corresponding measurements while when it transits to RRC Connected state the CN can immediately configure the UE with an Immediate MDT Configuration. This is because in Signalling-based MDT a UE can be identified through one of its permanent identifiers, e.g., IMSI or IMEI by the CN.

In [7],[8],[9] an extension to signalling-based MDT is provided with the intention to enable UE to execute logged MDT regardless of the RRC state. The motivation is to increase the accuracy of UE trajectory prediction by incorporating fine-grained input information, such as UE geographic location, in addition to historical cell-level UE trajectory information. To support this option, it is proposed to add an indicator in signaling-based logged MDT configuration to indicate that data collection is continuous data collection and to include a measurement periodicity and measurement duration.

**Q2: Do companies agree that signalling-based MDT configuration needs to be enhanced with a new measurement periodicity and measurement duration to enable UE to collect continuous information (e.g., historical cell information, latitude, longitude, altitude, velocity, etc.) across various RRC states (connected, inactive, idle). If yes, do companies agree to the LS to RAN2/SA5 in [9] to check feasibility of this enhancement?**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| Nokia | No | There is no clear evidence that we need to increase the data collection frequency. In addition, such solution would have significant UE impacts. Given the time limitation to finish Rel.18, we think that such enhancements should not be pursued in Rel.18. |
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**Summary of Discussion:**

## 3.3 Management-based MDT Enhancements

Several companies propose that Management-based MDT needs to be enhanced to support MDT continuity and that we cannot rely only on signalling-based MDT. In [2] it is discussed that AI/ML Training, data may need to be collected from specific cells. Cell-level information is not available at the OAM system and hence signalling-based activation is not suitable for scenarios when one or more UEs in a certain area (e.g., in a cell or set of cells) need to be selected. In those scenarios, data collection using management-based methods would be needed. [3] also discusses that signalling-based methods are not viable due to the delays introduced through the core network. [12] proposes to consider and prioritize management-based MDT continuity for data acquisition from a UE in order to be able to collect data from as many UEs as possible, under different radio conditions and RRC states for the purpose of AI/ML model (re-)training.

In addition, another open point from the last meeting is whether IMEI-TAC, NR-CGI and TR/TRSR can be used at the OAM to correlate logged and immediate MDT.

[2] and [12] discuss that IMEI-TAC (International Mobile Equipment Identity – Type Allocation Code) cannot be used for the purpose of allowing the TCE to correlate management-based immediate and logged MDT reports from the same UE. The IMEI-TAC is the initial 8-digit portion of the 15-digit IMEI and 16-digit IMEI-SV (IMEI – Software Version) codes which, in turn, are used to uniquely identify wireless devices. The IMEI-TAC, instead, identifies a particular manufacturer/model of a device. In a general scenario, these UEs will be located in different areas of the cell, and the logs of different trace references from different UEs should therefore not be combined.

Concerning the NR-CGI, it is used to globally identify a NR cell: it is constructed from the PLMN identity to which the cell belongs to and the NR Cell Identity (NCI) of the cell. In TS 32.422, §4.1.1.9.2, it is stated that the serving cell CGI is sent to the TCE by both the AMF (along with TR and TRSR) and the gNB (along with the MDT report received from the UE) only for the case of immediate MDT. Therefore, as discussed in [12] the TCE is not able to exploit the serving cell CGI (NR-CGI) for correlating immediate and logged MDT reports provided by the same UE because such information is provided only when the MDT report is related to an immediate MDT session.

In [2] it is discussed that MDT data from a given UE cannot be combined through the TR and TRSR since TRSR is allocated by a NG-RAN node to identify a session but if a UE reconnects from idle mode it will receive a different TRSR for the immediate MDT session which is uncorrelated from the first one. Similar observations are made in [12].

To enable TCE to correlate different management-based MDT sessions corresponding to different TR and TRSR some additional information is needed at the TCE.

In [2], [3], and [12] the following options are proposed to enable TCE to correlate different management-based MDT sessions.

**Option 1:** Send TR and TRSR of the Logged MDT configuration to the TCE together with the Immediate MDT data record.

**Option 2:** Create a random number at the AMF generated when the UE registers to the network and UE context is created in the CN and maintained in the CN for the duration of the UE context.

**Option 3:** Introduce a new Job Type for “Logged and Immediate” MDT.

* **Option 3a:** The same TR is used for both Logged and Immediate MDT Configuration
* **Option 3b:** Different TRs may be used for Logged and Immediate MDT Configuration with continuous Indication in Logged MDT Configuration

**Q3: Companies are asked to provide their views on whether they support options 1,2,3(a,b) above to enable TCE to correlate different management-based MDT sessions.**

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| --- | --- | --- |
| Company | Option 1,2,3(a,b) | Comment |
| Nokia | Option 1,2 | We think that options 1 and 2 are both simple solutions that enable TCE to correlate different management-based MDT sessions.  Option 1 can be done by implementation. The NG-RAN node would need to retrieve logged MDT records from the UE and store the TR and TRSR of the Logged MDT session in the UE context for later use and send it to the TCE together with the stored Immediate MDT measurements (and the TR and TRSR of the Immediate MDT session).  In option 2, UE identity is not revealed as the number is random but it enables TCE to correlate MDT logs with different TRs and TRSRs pertaining to the same UE. This random number can be sent to the TCE together with the IMEI-TAC, TR and TRSR to enable TCE correlate different MDT logs corresponding to different TR and TRSR without revealing UE identity. In addition, option 2 has mild specification impacts and does not require coordination with other groups.  Option 3a is more inflexible since it does not allow adapting Immediate MDT configurations to specific NG-RAN nodes as the Trace Reference should uniquely identify the MDT configuration. Option 3b has a higher flexibility but comes with UE impacts due to the continuous MDT indication in Logged MDT Configuration. |
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**Summary of Discussion:**

Assuming that Logged and Immediate MDT sessions can be correlated in the OAM for management based MDT, the proponents of management-based continuous MDT provided their views on whether when UE connects to a new cell and reports availability of the logged MDT report the connected cell could immediately configure the UE with Immediate MDT. For this purpose, [2], [3] and [12] propose 3 options to enable MDT continuity for a UE across RRC transitions:

**Option A:** NG-RAN node stores management-based Immediate MDT configuration for which continuity is required to the CN and CN sends Immediate MDT Configuration back to the NG-RAN node when UE transits from RRC Idle/Inactive to RRC Connected in this node to configure UE with management-based Immediate MDT Configuration.

**Option B:** NG-RAN node sends management-based MDT configuration with Job Type “Immediate MDT and Logged MDT” with the same TR to CN. CN sends the management-based MDT configuration to the NG-RAN node when UE transits from RRC Idle/Inactive to connected in this node and reconfigures UE.

**Option C:** NG-RAN node configures UE with Logged MDT configuration that includes a “continuous MDT flag”. UE Reports “continuous MDT” flag when it transits to RRC Connected so that NG-RAN node configures UE with management-based Immediate MDT.

**Q4: Companies are asked to provide their views on which from the options above they prefer to enable MDT Continuity for a UE across RRC transitions.**

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| --- | --- | --- |
| Company | Option A/B/C | Comment |
| Nokia | Option A | We support option A where continuity for enabling MDT Continuity is provided through the core network.  In Option A, when a UE is chosen for management-based MDT is to let a NG-RAN node store the immediate MDT Configuration in the CN (after checking that the MDT Configuration is still valid), including the full reference of the Immediate MDT session (namely the Trace Reference (TR) and the Trace Recording Session Reference (TRSR)). When a UE reconnects back from RRC Idle or RRC Inactive states, the CN may then send back the information to the NG-RAN node and the latter may use this information to configure Immediate MDT measurements. Similarly, the NG-RAN node may store the full reference of the Logged MDT session in the CN.  Option B assumes the introduction of a new Job Type for continuity which in our view is not necessary and further makes the solution inflexible.  Option C impacts the UE. We think that since continuity can be achieved through the core network we should avoid UE impacts since this will also limit the amount of UEs that will provide UE measurements for this continuous MDT feature. |
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**Summary of Discussion:**

A final issue to be addressed is whether we need enhancements in the management-based configuration with respect to selecting a group of UEs to implement continuous MDT. [5] proposes to enhance management-based MDT to enable a more granular selection of UEs based on UE selection criteria, such as UE capabilities that should be selected for MDT measurements. [10] also discusses that if continuous MDT is only needed for a certain subset of UEs then management-based MDT can use appropriate filters.

**Q5: Do companies support to enhance management-based MDT to enable selection of a group of UEs based on UE capabilities when implementing continuous MDT?**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| Nokia | No | We don’t think that such enhancement is essential at this stage. We propose to stop the discussion in Rel.18. We can continue the discussion in Rel.19 and think of the best criteria for UE selection then. |
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**Summary of Discussion:**

# 4 Conclusion, Recommendations [if needed]

If needed

# 5 References

[1] [R3-234346](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234346.zip), Support of continuous MDT measurement collection (Nokia, Nokia Shanghai Bell)

[2] [R3-234347](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234347.zip), Continuous MDT Evaluation (Nokia, Nokia Shanghai Bell)

[3] R3-[234298](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234298.zip), Continuous MDT proposition (Ericsson, AT&T, InterDigital, Deutsche Telekom)

[4] [R3-234299](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234299.zip), [DRAFT] LS on Continuous MDT (Ericsson, AT&T, InterDigital, Deutsche Telekom)

[5] [R3-234300](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234300.zip), Improved UE selection granularity (Ericsson, AT&T, InterDigital, Deutsche Telekom)

[6] [R3-234301](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234301.zip), [DRAFT] LS on Improved UE selection granularity (Ericsson, AT&T, InterDigital, Deutsche Telekom)

[7] [R3-234381](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234381.zip), Discussion on MDT enhancement for continuous AI-ML related information (ZTE, Lenovo, Samsung)

[8] [R3-234382](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234382.zip), (TP to TS38.413) MDT Enhancements for continuous data collection (ZTE, Lenovo, Samsung)

[9] [R3-234383](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234383.zip), [DRAFT] LS on the MDT enhancement to support continuous AI-ML related information reporting from UE (ZTE)

[10] [R3-233989](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-233989.zip), Discussion on MDT enhancement for NG-RAN AI/ML (Qualcomm Incorporated)

[11] [R3-234206](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234206.zip), Continuous MDT supporting for AI (CATT)

[12] [R3-234284](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_121/Docs/R3-234284.zip), Further discussions on MDT enhancements (Huawei)