**3GPP TSG RAN WG2 Meeting #130 R2-250xxxx**

Bengaluru, India, Aug 25th – 29th, 2025

Agenda Item: 8.1.x

Source: Xiaomi

Title: Report of [POST130][038][AI PHY] UE capabilities (Xiaomi)

Document for: Discussion and Decision

# Introduction

* [POST130][038][AI PHY] UE capabilities (Xiaomi)

 Intended outcome: Discuss RAN2 specific AI/ML capabilities and submit agreable proposals and RAN2 UE capability CRs

 Deadline:  Long

Rapporteurs will provide proposals for RAN2#131 and a UE capability running CR based on the outcome of this post email discussion after the deadline.

Companies providing input to this email discussion are requested to leave contact information below.

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| Huawei, HiSilicon | Jun Chen | jun.chen@huawei.com |
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# Discussion

It is observed by rapporteur that BM/CSI prediction inference-related capabilities and UE-side data collection related capabilities are being discussed in RAN1. In this email discussion, for RAN2 specific capabilities, we will mainly focus on RAN2 specific features, including NW-side data collection, LCM, and candidate UE-side data collection.

***UE logging AS layer memory size***

It was agreed in RAN2 #126 meeting with following agreement,

1. For gNB centric and OAM centric (for RRC signaling between UE and gNB), reporting multiple instances of logged L1 measurement result from UE to gNB via a RRC message as configured by gNB is an optional feature. FFS how to handle case when single RRC message is not sufficient. FFS if there will be any further enhancement needed pending RAN1 agreement.

Following agreements were made during RAN2 #127 meeting, a minimum AS layer memory size is needed if UE supports UE logging and reporting for NW-side data collection. However, the memory size of AS layer memory is not decided.

1. UE stores the logged training data at AS layer with a minimum AS layer memory size supported by the UE. FFS on the memory size. This is across all use cases
2. When UE reaches its buffer limitation the UE stops measurement for data collection purposes and logging.

In logged MDT feature, a minimum AS layer memory size of 64kB is introduced. Furthermore, QoE also has additional 64kB for QoE pause and another 64kB for QoE measurement report in RRC\_IDLE/INACTIVE state.

Similar as logged MDT and QoE, UE logging for AI/ML air NW-side data collection can also introduce additional 64kB as baseline minimum AS layer memory.

##### Q1. Do you agree additional minimum AS layer memory size is 64kB (compared to logged MDT and QoE), which is shared by all AI/ML use cases?

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| **Company** | **Yes/No** | **Comment** |
| Samsung | Yes | In our understanding, 64KB may not be enough.  - Regarding beam management use-case, as RAN1 has indicated in LS (i.e., R1-2310681), a single data sample for L1-RSRP of 128 resources accounts for about 500 bits. However, L1-RSRP combinations for 128 resources a UE can observe could be almost infinite due to multi-path fading and UE’s location/pose and surroundings/environment. So, numerous data samples would be needed to train practical AI/ML model with a quality of prediction performance. Besides, the more data generally is beneficial to model performance.  - Moreover, we assume the shared memory among use-cases (i.e., not only beam management but also CSI prediction). It means larger memory capability would be needed. For example, the RAN1 LS indicated 1.5Mbits per data sample as an example for CSI prediction.  Thus, while we are okay to adopt 64KB as the baseline capability, UE should also be able to indicate the larger sizes (e.g., hundreds of KB or tens of MB) if supported. Otherwise, NW cannot distinguish the UE with large memory. For example, even if NW needs large size of data (e.g., to train model for CSI prediction) per UE, there is no way for NW to choose UEs with larger memory.  So, we suggest to define the UE capabilities as follows: (which is similar to QoE measurement in RRC\_IDLE and RRC\_INACTIVE):  1) UE mandatorily supports the fixed size (i.e., 64KB) of minimum AS layer memory without UE capability signalling, if UE supports NW-side data collection  2) UE optionally reports a larger minimum AS layer memory size (e.g., 128KB, 256KB, 512KB, …) |
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| Qualcomm | Yes | UE AS memory is expensive, therefore, we think that the minimum memory size should be the same as MDT, as 64KB. |
| CATT | Yes | The minimum memory size could be the same as MDT, i.e. 64KB. It is not needed to define memory size per e.g. AI/ML use case. For different use cases, the associated ID together with the training data report could be used for usage indication. |
| Nokia | Yes | In general, minimum AS memory size of 64KB could be sufficient for Release 19 use cases. We suggest the following proposal.  Proposal: UE minimum AS layer memory size is 64KB as a baseline. |
| Huawei, HiSilicon | Yes |  |
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##### Q2. Do you think UE can support other memory sizes and indicate to network via optional capability signaling?

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| **Company** | **Yes/No** | **Comment** |
| Samsung | Yes | Please refer to our previous response in Q1. |
| Qualcomm | No | UE can allocate additional memory (based on its implementation). Note that in logged MDT, the UE can allocate additional memory for logged measurements; but the UE does not need to indicate this to the network.  Furthermore, on UE assistance for data availability, we agreed to use absolute value as threshold to avoid the scenario where different UEs may have different additional memory allocated.  Thus, we do not see a need for indicating additional memory to the network. |
| CATT | No | It’s sufficient to specify that 64KB is the minimum memory size, and it’s up to UE implementation to support larger size. We notice that for logged MDT the UE could store a large amount of data (more than 5M) if supported without additional indication to network. |
| Nokia | Yes | Additional memory gives network flexibility in retrieving the data from the buffer and can be used to support more configurations. |
| Huawei, HiSilicon | Yes | We think it is helpful for the network to know that the UE supports larger size, and it allows the network to set higher threshold value. |
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***UE periodic and event-based logging***

In addition, RAN2 also introduced periodic and event-based data collection/logging with following agreements, where radio-condition based event data logging is supported, including L3 measurement triggered, beam-based event triggered and L1 beam measurement triggered.

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| * Periodic logging is supported for training data collection procedure in R19 * Event-triggered data logging will be supported. At least radio condition based event triggered logging will be supported. FFS the details of radio condition based event. FFS if other events are supported. * Support the use of L3 measurement event triggered (i.e. L3 serving cell measurements becoming worse/better than a threshold for TTT) to determine whether the UE performs logging or not. L1 measurement event triggered will not be supported. FFS what to log |

##### Q3. Which option do you prefer as optional UE capability for UE logging?

Option 1) Single optional UE capability with signaling for both periodic logging and L3 measurement event triggered logging (all events).

Option 2) One optional UE capability with signaling for periodic logging, another optional UE capability with signaling for L3 measurement event triggered logging.

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| **Company** | **Option 1/2** | **Comment** |
| Samsung | Option 2 | BTW, we would like to ask there is a separate capability for generic NW-side data collection (i.e., 1 bit capability whether UE supports NW-side data collection) and this Option 1 or 2 is a capability in addition to the generic capability. |
| Qualcomm | Option 2 | To support periodic and event-trigger logging different level of UE complexities can occur at the UE, therefore, two separate UE capabilities are needed.  We also agree with Samsung that there should be a blanket capability indicating “whether UE support data collection for NW-side training”. Periodic and event-trigger UE capability can be conditional, i.e., UE indicate whether it support periodic and/or event triggered data collection logging if it supports data collection for NW-side training. |
| CATT | Option 1 | One optional UE capability is enough for AI/ML data logging capability for NW-side training, and when a UE indicates the support of this feature, it supports both periodic logging and event triggered logging. |
| Nokia | Option 1 | The following excerpt from 37.320 shows that in logged MDT, periodic and event-triggered are supported as part of the baseline feature. We see no reason to break the precedent.  *For NR:*  *- The UE indicates one capability bit for support for Logged MDT in RRC idle and inactive mode, to indicate that the UE supports logging of downlink pilot strength measurements, periodical logging and event-triggered logging.* |
| Huawei, HiSilicon | Option 2 with comments | We think that at least "Support the use of L3 measurement event triggered" can be a separate capability.  For periodic logging, we think it is necessary for network-side data collection and should be e pre-requisite for event-based logging. Also periodic-logging capability should be broader and cover not only logging as such, but also the reporting procedure and assistance information from the UE, as discussed below. |
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***Availability Indication Reporting***

As agreed in RAN2 #129bis meeting, UE can send a UAI to provide assistance information for NW-side data collection.

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| **Agreements on availability indication**   * Availability indication can be triggered due to:   + Full buffer being reached (if configured)   + Buffer threshold being reached (if configured).   + Low power (if configured) * The UE send a UAI that indicates:   + Data is available   + Reason for trigger (full buffer, threshold)   + Low power indication * The encoding of the data is available/UAI and the cause value is FFS   NOTE: it is up to UE Implementation how buffer threshold reached and low power is determined |

Similar as other assistance information (e.g., *overheatingInd, referenceTimeProvision-r16, releasePreference-r16, flightPathAvailabilityIndicationUAI-r18, ul-TrafficInfo-r18*) reported via UAI, an optional UE capability with signaling can be introduced for NW-side data collection assistance information.

Q4. Do you agree to introduce an optional UE capability with signaling to indicate UE can provide assistance information (e.g., data is available, reason for trigger, low power indication) for NW-side data collection?

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| **Company** | **Yes/No** | **Comment** |
| Samsung | Yes | We agree (i.e., as in legacy UAI), and we assume one common capability is defined for all assistance information (i.e., data availability, reason for trigger, low power indication) of NW-side data collection  BTW, we have a similar question with Q3 i.e., we wonder if this UAI capability is additional to the generic capability for NW-side data collection. |
| Qualcomm | Yes | We prefer to have two separate UE capabilities   * One for power issue indication at the UE, and * Another for data availability indication.   UE may have different complexities needed to implement power indication and buffer status indication. |
| CATT | Yes | We agree to introduce an optional UE capability with signalling as for legacy UAI information, and one bit is enough for supporting all the NW-side data collection assistance information. |
| Nokia | No | It was decided that a UE Information procedure would be used to retrieve data from the buffer. Without a mechanism for the UE to report the availability indicator, the network only has the option to blindly request from UE buffers. Buffer status reporting and all its possible indications should be included in the baseline feature if NW side data collection is supported. |
| Huawei, HiSilicon | No | There is no need to separately define it, i.e. it can be merged to the general capability for NW side data collection of any use cases covering also periodic logging, reporting procedure. |
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***Applicability Reporting***

RAN2 agreed to report applicability reporting via *RRCReconfigurationComplete* message as initial reporting, while reporting the update of applicability reporting via UAI if there’s a change. Similar as NW-side data collection assistance information reporting via UAI, UE can also indicate the support of reporting update of applicability reporting via UAI as optional capability.

Q5. Do you agree to introduce an optional UE capability with signaling to indicate UE can provide update of applicability reporting via UAI?

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| **Company** | **Yes/No** | **Comment** |
| Samsung | No | There is no big motivation to have additional capability and also it might be more essential to have UAI considering UE is supposed to indicate UAI when functionality status has changed from applicable to non-applicable. |
| Qualcomm | No | UE need to support update of applicable configuration for feature to work properly. Therefore, it should be supported mandatorily. |
| CATT | No | If UE can provide the initial applicability reporting, it can also use UAI for the update purpose, so it can be the same UE capability. |
| Nokia | No | Agree with Samsung, Qualcomm, CATT.  During RAN2#130, the following agreement was reached: “The UE shall report when *CSI-ReportConfig* becomes not applicable.” To realize the agreement, the UAI reporting of applicability cannot be optional.  Additionally, applicability update reporting is a necessary part of baseline capability. Without the capability to provide updates, the UE would be forced to operate an inapplicable, poorly performing model until its next RRC Reconfiguration when it could provide the update.  The capability should be conditionally mandatory if at least one RRC-based use case is supported, i.e., Beam Management, CSI Prediction, and CSI Compression. |
| Huawei, HiSilicon | No | Relevant to Q6.  UAI is always needed regardless of Option A or B for indicating applicability status change, so there is no need to separately define it. Applicability is something that may change dynamically over time (this is why it is different from capability reporting) and it is unacceptable to have applicability update reporting as an optional feature |
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For companies’ information, following RAN1 inference FGs of AI/ML-based BM are copied below (note that similar inference capabilities are also introduced by RAN1 for AI/ML-based CSI prediction):





Furthermore, as agreed in RAN2 #130 meeting, both Option A and Option B are supported for applicability reporting. It was also proposed in R2-2503714 to introduce a separate UE capability is introduced for option B to allow more flexibility.

1. (RRC8) RAN2 confirm that option A and option B can be configured in the same RRCReconfiguration message with the unified applicability report procedure.

##### Q6. What is your view on UE capability for Option A and Option B applicability reporting procedure?

Option 1) Implicitly indicated UE supports both options if UE supports one or more of RAN1 defined inference related capabilities (e.g., FG58-0-1 and/or FG58-1-2/3/4/5, the details of those feature group depend on RAN1 progress). RAN2 will add applicability reporting procedure related UE capability description in RAN1 introduced related capabilities. (details will be implemented after RAN1 feature groups are implemented in RAN2 UE capability mega CR)

Option 2) Two conditional mandatory capabilities (with signaling) for Option A and Option B, respectively, if UE supports FG58-0-1 and/or FG58-1-2/3/4/5 (the details of those feature group depend on RAN1 progress).

Option 3) Mandatory of supporting one option and define the other option as optional capability.

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| **Company** | **Option 1 or Option 2** | **Comment** |
| Samsung | Option 3 or Option 2 | Given that two options provide a same functionality, there is no big motivation to support both of them. If RAN2 can decide which option can be mandatory as explained in Option 3, we prefer option 3. Otherwise, option 2 is acceptable. |
| Qualcomm | Option 2 | While we agree that one should be mandatorily supported, we think it may be very hard for RAN2 to agree that which option should be mandatorily supported.  Therefore, we prefer to have two conditional mandatory capability (with signaling) for Option A and Option B. |
| CATT | Option 2 | It may be controversial to define which one should be mandatory supported, so two conditional mandatory capabilities could be accepted easier. |
| Nokia | See comments | In RAN2#129 it was agreed that “upon receiving a full inference configuration, the UE sends the initial applicability report in *RRCReconfigurationComplete*. UAI can be sent to update applicability.”  Therefore, Option A is mandatorily supported for AI/ML applicability reporting. Option B can be optional. |
| Huawei, HiSilicon | See comments | Q6 is related to Q5.  We think there are following options for Option A and B:  **Opt1: both option A and B are mandatory.**  **Opt2: the UE needs to support at least one (i.e. either option A or B, or both A and B)**  **Opt3: one option is mandatory while the other is optional.**  Opt1 may be better for the NW, as the NW may choose which to support. Opt1 may put a high requirement to UE side as the UE needs to support both.  Opt2 is better for the UE as it provides some flexibility, but the NW needs to support both.  Opt3 seems to be in the middle.  **We slightly prefer Opt2 or Opt3.**  **In addition, no matter which of options are to be selected, we think the UE supporting Option A/B should support RAN1 defined inference related capabilities (as Rapp mentioned).** |
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***UE preferred data collection configuration***

During Rel-19, RAN2 has agreed UE can indicate preferred configurations for UE-side data collection, and following agreements were made:

Agreements on data collection configuration

* The UE can request measurement configuration for data collection of AI/ML based beam management. The request can contain one or more of the following:

• An indication on start/stop of data collection

• Preferred configuration from a list of candidate configurations provided by NW. Details of signaling are FFS. It is up to network what it configures at the end.

* Introduce UAI message for UE request of data collection measurement configuration. And it is up to UE implementation when to send the request.

##### Q7. Do you agree to introduce an optional UE capability signaling for UE preferred configuration for UE-side data collection? If yes, do you think 1) it can be added as part of RAN1 FG58-1-7 or 2) a separate capability is introduced?

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| **Company** | **Yes/No** | **If yes, Option 1/2** | **Comment** |
| Samsung | Yes | Option 1 | We believe this would be the conditional mandatory capability if UE supports UE-side data collection. i.e., No separate capability signalling is needed. |
| Qualcomm | Yes | We are not sure what is option 1 / option 2 here | We agree with Samsung. |
| CATT | Yes | Option1 | Agree with Samsung. |
| Nokia | Yes | Option 2 | UE preferred configuration definitely should be separate capability. |
| Huawei, HiSilicon | No for separate UE capability | Option 2 | 58-1-7 (for BM) and 58-3-4 (for CSI prediction) have multiple components already, so it is simpler to add the request part as another component. If we are to introduce a separate bit on top of existing L1 UE features, it may also work, but it adds unnecessary signalling as these two will have to be anyway always indicated together.  **Our suggestion:**  **The UE supporting 58-1-7/58-3-4 (pending for UE data collection request for CSI prediction) should also support the request and indication of preferred configuration of UE-sided BM/CSI prediction. In this case, the description of 58-1-7/58-3-4 can be updated and no new UE capabilities are needed.**  LPP UE capability on case 1 may have similar issues, but it can be separately discussed. |
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***Use cases***

##### Q8. Do you think the above capabilities need be defined 1) for all use cases (e.g., BM Case 1, BM Case 2, CSI-prediction) or 2) per use case, except minimum AS layer memory size?

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| **Company** | **Option 1/Option 2** | **Comment** |
| Samsung |  | Q1/Q2 (i.e., UE memory size): We think a common memory size could be shared for the use-cases for efficient usage of memory.  Q3 (i.e., periodic and event-based logging): RAN2 only discussed this for BM use-case. So, it should be per use case (or only for BM). And we do not see the needs for separate capability per sub-use cases (i.e., BM Case 1 and BM Case 2)  Q4 (i.e.,UAI for NW-side data collection): It is not use-case specific capability. i.e., common capability for use-cases.  Q5 (i.e., UAI for updated applicability): As answered in Q5, we do not think separate UE capability is needed.  Q6 (i.e., Option A and Option B): RAN2 only discussed this for BM use-case. So, it should be per use case (or only for BM). And we do not see the needs for separate capability per sub-use cases (i.e., BM Case 1 and BM Case 2)  Q7 (i.e., UE preferred configuration): It could be included as part of 58-1-7, 58-3-4 (i.e., per use-case) |
| Qualcomm |  | Q1/Q2: for all use case  Q3: Agree with Samsung.  Q4: for all use case  Q5: No UE capability needed. Mandatory support at the UE  Q6: Per use case. No RAN1 discussion on option B for CSI prediction.  Q7: per use case. |
| CATT |  | Q1/Q2/Q4: Memory and UAI support for all use cases  Q3: For BM use case only  Q5: No additional UE capability needed  Q6: Per use case, for BM and PoS use cases if any.  Q7: Per use case. |
| Nokia | See comments | Q1/Q2 [minimum AS layer memory]: Option 1  Q3 [UE capability for UE logging type periodic, event triggered]: Option 1. See our comments in Q3.  Q4 [Assistance information for logging]: See our comments in Q4. We think this is part of baseline for NW side data collection and no additional UE capability is needed.  Q5 [Update of applicability reporting via UAI]: See our comments in Q5.  Q6 [Implicit vs conditional mandatory for Option A and B]: Option 1. This should be a common capability of a UE for all use cases.  Q7 [UE preferred configuration]: Option 1. This should be a common capability of a UE for all use cases. |
| Huawei, HiSilicon | See comments | **Q1, Q2, Q4:** for all use cases  **Q3:** Only for BM. There is no difference between BM Case-1 and BM Case-2, i.e. the same data is supposed to be collected, hence there is no need for separate capabilities.  **Q5:** no need to have separate UE capability  **Q6:** for applicability reporting, if the UE supports inference, then some applicability reporting must be supported (as we commented above). On one hand, there is also no need to have capability reporting per use case, i.e. when the UE supports inference, it needs to also support applicability reporting (details depend on conclusion of Q6). One the other hand, Q6 is about capability indication details, and perhaps different use cases require different options, and then per use case may be more appropriate.  **Q7:** per use case. No need to have separate UE capbility |
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***AI/ML co-exist with other features***

It is observed that there are many features not supported by (e)RedCap UE, IAB-MT, and NCR-MT, for example, CA, MR-DC, DAPS, etc. It is mainly to reduce complexity for such UEs, especially for (e)RedCap UE(s), where they are expected to be reduced capability.

##### Q9. Do you think all AI/ML features can be supported by (e)RedCap UE, IAB-MT, NCR-MT?

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| **Company** | **Yes/No** | **Reason/Any other features** |
| Samsung | No | We do not think the scenario where such UEs are used for data collection or performing inference. |
| Qualcomm | Yes |  |
| CATT | No | Other features should be discussed separately, and we do not think these scenarios are needed. |
| Nokia | No | NW side data collection can be supported but if we agree with minimum 64KB in general, then the question Q10 becomes irrelevant. It is better to keep Release 19 feature as simple as possible and not to extend for reduced capability of (e)RedCap UE, IAB-MT, and NCR-MT. |
| Huawei, HiSilicon | Yes with comments | For AIforPHY features, we think they can be supported by (e)RedCap UE and others, and the standard should be able to allow such "combinations" unless some issues are found. In other words, no special handling is needed for now and it can be up to UE implementation, e.g. if (e)RedCap UE wants to support AIML based BM, it can simply include such capability as it is optional anyway. If some modifications are needed, they can be discussed on a case-by-case basis. |
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If AI/ML is supported by (e)RedCap, similar as logged MDT, minimum AS layer memory size can be 16kB.

##### Q10. If AI/ML is supported by (e)RedCap, do you agree the minimum AS layer memory size of UE logging measurement results for NW-data collection is 16kB?

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes |  |
| Nokia | See comment from Q9 |  |
| Huawei, HiSilicon | Yes |  |
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##### Q11. If there’s other UE capability for AI/ML based beam management and/or CSI prediction that is not covered by above questions, please list in below table.

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| **Company** | **Comment** |
| Nokia | Similar to RAN1 introducing features (such as, FG 58-1-7 for Data collection for UE-side beam prediction, FG58-3-4 for UE side data collection for CSI prediction), RAN2 should introduce generic NW side data collection as an FG 58-x-x. This may allow UE to indicate one bit capability to support for NW side data collection and to indicate UE supports additional procedures, such as providing additional assistance information for logging, periodic and event-triggered logging etc. |
| Huawei, HiSilicon | We have one more comment as below:  For NW-sided data collection for BM, we think the following aspect may need some discussions:  How many simultaneous resource configurations for data collection the UE supports (per use case?) |
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# Conclusion