**3GPP TSG-RAN WG2 Meeting #112 electronic Draft R2-2010785**

**Elbonia, Nov 2nd – 13th 2020**

**Agenda item:** 8.12.2.1

**Source:** Intel Corporation

**Title:** Summary of [Post111-e][913][REDCAP] Definition and constraining of reduced capabilities (Intel)

**Document for:**  Discussion and decision

# Introduction

This contribution provides the summary of following RAN WG2 email discussion:

* [AT112-e][112][REDCAP] Capabilities (Intel)

 Scope: Continue the discussion on remaining proposals from [R2-2009004](file:///C%3A/Data/3GPP/Extracts/R2-2009004%20Report%20of%20913-RedCap-Capabilities.docx)

 Intended outcome: summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals that require online discussions

Initial deadline (for companies' feedback): Monday 2020-11-10 23:00 UTC

Initial deadline (for rapporteur's summary in R2-2010785): Tuesday 2020-11-10 05:00 UTC

Proposals marked "for agreement" in R2-2010785 not challenged until Tuesday 2020-11-10 17:00 UTC will be declared as agreed by the session chair and can be considered for inclusion in the TP for the TR. For the rest there is a (little) chance to continue online in the final CB session on Friday 2020-11-13.

Status: Ongoing

To make it easier to find the correct contact delegate in each company for potential follow-up questions, the rapporteur encourages the delegates who provide input to provide their contact information in this table:

|  |  |
| --- | --- |
| Company | Delegate contact |
| COMPANY\_NAME | NAME (email@address.com) |
| Intel | yi.guo@intel.com |
| Qualcomm | Linhai He (linhaihe@qti.qualcomm.com) |
| OPPO | lihaitao@oppo.com |
| Apple | Naveen Palle (naveen\_palle@apple.com) |
| vivo | Chenli5g@vivo.com |
|  |  |
| Lenovo | Jie Shi(shijie4@lenovo.com) |
| Samsung | Jaehyuk JANG (jack.jang@samsung.com) |
| Sharp | lei.liu@cn.sharp-world.com |
| Huawei, HiSilicon | baokun.shan@huawei.com |
| Nokia | jussi-pekka.koskinen@nokia.com |
| LGE | stella.choe@lge.com |
| Ericsson | tuomas.tirronen@ericsson.com |
| ZTE | liu.jing30@zte.com.cn |
|  |  |
|  |  |
|  |  |

# Discussion

Based on [1], RAN2 have agreed:

Agreements:

1. RedCap UE capabilities can be categorized as:

• Min capabilities all RedCap UEs support (i.e. mandatory for RedCap UE) if identified;

o FFS on whether some features are mandatory with signaling for RedCap UE, i.e. IOT bit;

o (Note: RedCap UEs might have the same set of higher layer capabilities, however this is FFS in RAN2)

• Optional capabilities (signaled explicitly)

1. Following scenarios are considered when design the capability signaling for RedCap UE, but FFS on the details, e.g. what each category of features may include and on the applicability of the cases:

For the features that are mandatory for non-Redcap UEs:

Case1: The Redcap UE mandatorily supports the feature with the same value;

Case2: The Redcap UE mandatorily supports the feature, but with different value (e.g. bandwidth value);

Case3: The Redcap UE optionally supports the feature;

Case4: The Redcap UE does not support the feature at all.

For the features that are optional for non-Redcap UEs:

Case1: The Redcap UE does not support the feature at all.

Case2: The Redcap UE supports the feature with different value;

Case3: The Redcap UE supports the feature with the same value;

Case4: The Redcap UE mandatorily supports the feature

This email discussion is to continue the discussion on the rest proposals in [1].

## How to define the reduced capabilities

### Regarding capability design principle:

|  |
| --- |
| **Summary phase 2-3:**17 companies provided inputs. Regarding the capability design principle for RedCap UE listed in Alt 3:15 companies agree the principle, but with comments;3 companies mentioned the details should be discussed in WI phase. 1 company proposed a new solution as:**Directly define the UE capabilities required for RedCap devices, including:** **---Mandatory features for RedCap Ues (defined in specification);** **---Optional features for Redcap Ues (introduce ignaling fields in an independent container defined specifically for Redcap UE).** Rapporteur would suggest to capture it as**Proposal 3: Following capability design principle is considered for RedCap UE, but details should be discussed in WI phase:*** **The UE capability requirements for a RedCap device type, that are different from those for non-RedCap UEs, are listed in the specifications. That is:**
	+ **Mandatory features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are optional for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are supported for RedCap UE but with different value;**
	+ **Optional features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Optional features for non-RedCap UE that are mandatorily supported for RedCap UE.**

**For a RedCap device type, define new signaling fields in UE Capability for the features that are mandatory w/o capability signaling for non-RedCap UEs but are optional for Redcap UEs, or mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs.** |

**Question 1: Regarding capability design principle in proposal 3, do companies agree the proposal 3? If not, pls provide your concern.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark**  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Apple | Yes | This goes toward stage-3 details but for mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs, what if the different value is something that can be signalled with existing signalling? We assume most of such params are Boolean (supported/not-supported) in which case, RedCap UEs would say “not-supported” in the existing field before filling the new field?Or should we say “**For a RedCap device type, define new signaling fields in UE Capability for the features that are mandatory w/o capability signaling for non-RedCap UEs but are optional for Redcap UEs, or mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs. If the new signaling field defined for the mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs, the legacy field is not used”…?** |
| vivo | Yes | Regarding the comments from Apple, we assume it is related to stage-3 discussion. We could consider this case in WI phase.  |
| Lenovo | Yes | We agree above high level design principle, but it should be confirmed that the mandatory features in first part means the feature with capacity parameter or w/o capacity parameter. Other more details could be discussed in WI phase.[Rapp] It covers both mandatory feature with and without capability. |
| Samsung | Yes | - |
| Sharp | Yes | For "Optional features for non-RedCap UE that are not supported for RedCap UE", maybe these features don’t need to be listed in the specs. We are fine to discuss the details in WI phase. |
| Huawei, HiSilicon | Yes | We are fine with the principles and agree to discuss the details in WI phase. |
| Nokia | Yes |  |
| Intel | Yes |  |
| LGE | Yes |  |
| Ericssson | Yes but | What is really the difference of this proposal compared to the already agreed scenarios? It seems to be at least partly overlapping, or is the intention to mainly propose that the capabilities for RedCap UE type will be captured in the specifications? [Rapp] Yes, the main difference is, to capture in specification. For the possible new introduced signaling fields for RedCap UEs, it needs to be clear that such fields does not apply at all to non-RedCap or legacy UEs for mandatory features w/o capability signaling. [Rapp] good point.  |
| CATT | Yes |  |
| Fujitsu | Yes |  |
| Thales | yes |  |
| ZTE | Yes with comments | Besides, we would suggest to also list following option in the TR. The main difference is that, we don’t have to add clarification to each existing Non-Redcap UE capabilities. We can directly define what we need for Redcap UEs. We understand this is simpler and cleaner solution. Down selection between solutions can be done in WI phase. **Directly define the UE capabilities required for RedCap devices, including:** **---Mandatory features for RedCap UEs (defined in specification);** **---Optional features for Redcap UEs (introduce ignaling fields in an independent container defined specifically for Redcap UE).**  |

**Summary:**

All companies agree the proposal 3. But

1 company suggested to add “**If the new signaling field defined for the mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs, the legacy field is not used**”. But another company commented this is stage 3 details and can be considered in WI phase.

1 company commented, the new introduced signaling fields for RedCap UEs should not apply for non-RedCap or legacy UEs for mandatory features w/o capability signalling.

1 company proposed a candidate solution:

**Directly define the UE capabilities required for RedCap devices, including:**

 **---Mandatory features for RedCap UEs (defined in specification);**

 **---Optional features for Redcap UEs (introduce ignaling fields in an independent container defined specifically for Redcap UE).**

Rapporteur would suggest to agree the updated proposal 3 as

**Proposal 1: RAN2 to agree following capability design principle is considered for RedCap UE, but details should be discussed in WI phase:**

**Alternative 1:**

* **The UE capability requirements for a RedCap device type, that are different from those for non-RedCap UEs, are listed in the specifications. That is:**
	+ **Mandatory features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are optional for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are supported for RedCap UE but with different value;**
	+ **Optional features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Optional features for non-RedCap UE that are mandatorily supported for RedCap UE.**

**For a RedCap device type, define new signaling fields in UE Capability for the features that are mandatory w/o capability signaling for non-RedCap UEs but are optional for Redcap UEs, or mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs.The possible new introduced signaling fields for RedCap UEs should not apply to non-RedCap or legacy UEs for mandatory features w/o capability signaling.**

**Alternative 2:**

**Directly define the UE capabilities required for RedCap devices, including:**

 **---Mandatory features for RedCap UEs (defined in specification);**

 **---Optional features for Redcap UEs (introduce ignaling fields in an independent container defined specifically for Redcap UE).**

### Regarding which option is preferred to let the network know how to handle the UE capabilities based on RedCap or non-RedCap?

|  |
| --- |
| **Phase 1 summary:****Summary 1-3:**Regarding the issue raised by Intel, 12 companies provided inputs.* + - * companies (Futurewei, ZTE, Ericsson) would like to discuss the details in WI phase;
			* companies (Futurewei, Qualcomm, Sharp) mentioned it is related to identification solution during setup procedure, i.e.option 3.

It would be good to check companies’ view on the options although it is related to other discussion. As discussed in Question 1-2, Alt 3, the network needs to know whether the UE is RedCap UE or not in order to know how to handle UE capabilities (that is, when these fields are not included, it should be possible to differentiate whether it is because it is a non-Redcap UE or because it is not supported by a RedCap UE). But the question is how?We see below options: **Option 1:** RedCap device type is indicated as part of the capability signaling**Option 2:** Define a new IE specifically for RedCap Ues containing these additional Redcap specific capabilities that is included only by Redcap UEs.**Option 3:** The network obtains the RedCap based on identification solution during initial access, and forwards it to target during Handover. |

|  |
| --- |
| **Phase 2 summary:****Summary phase 2-4:**17 companies provided inputs. Option 1: 2Option 1+2: 7Option 3: 1WI phase: 8There is no clear majority. Therefore Rapporteur would suggest to capture options in the TR, and continue the analysis on pros/cons in WI phase. **Proposal 4: Regarding how can the network know whether the UE is RedCap UE or not in order to handle UE capabilities properly, following options are considered and to be captured in the TR, the further analysis/down selection should be done in WI phase:****Option 1:** RedCap device type is indicated as part of the capability signaling**Option 2:** Define a new IE specifically for RedCap Ues containing these additional Redcap specific capabilities that is included only by Redcap UEs.**Option 3:** The network obtains the RedCap based on identification solution during initial access, and forwards it to target during Handover. |

**Question 2: Regarding which option is prefer to let the network know how to handle the UE capabilities based on RedCap or non-RedCap, do companies agree the proposal 4? If not, pls provide your concern.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark**  |
| Qualcomm | Yes | We agree with Proposal 4, with the understanding that those three options do not need to be exclusive to each other. For example, UE signals it is RedCap in msg3 or msgA during initial access (i.e. option 3). Then after UE is connected, it uses option 2 during capability signaling. |
| OPPO | Yes, with comments | For option 3, for RedCap identification during initial access, maybe a condition can be added, e.g. up to RAN1 to decide. |
| Apple | More clarification on Op3 | We are not sure about option#3, as even here there would be specific capabilities that are to be provided to the target (like in legacy operation) in which case the target can configure the initial access related capabilities for the handover…? If it just for initial access on the PCell, then we agree atleast the identification of RedCap or Not is needed, but once we are through this, the legacy means of capability handling can cover the RedCap requirements as well….?[Rapp] the question is, if Redcap indication or Redcap specific capabilities are not contained for RedCap UE, how can target node know this is RedCap UE? But if there is redcap specific capability to be provided to target, then no additional work is needed. |
| vivo | Yes, but | We don’t think these options are exclusive, e.g. Option 2 could functionally cover option 1. They could be both introduced.For option 3, we prefer to add more clarification of “if early indication during RACH is introduced” at the end of this option, as it is being discussed in both RAN1 and RAN2. We are not sure whether it could be introduced or not, at least by now.  |
| Lenovo | Yes |  |
| Samsung | Yes | We are fine with rapporteur's suggestion, but also agree with Qualcomm et al. that it should be specified that the options are not exclusive. |
| Sharp | Yes |  |
| Huawei, HiSilicon | Yes | We have concern on option 3 as it may have problem in handover case but we are fine to capture the options and make down-selection in WI phase. |
| Nokia |  | All options may be needed in the end. |
| Intel | Yes | Agree with Qualcomm, options are not exclusive. Regarding OPPO and vivo’s comments on the clarification of option 3, ok to add “The network obtains the RedCap based on identification solution during initial access (up to RAN1 discussion)” |
| LGE | Yes |  |
| Ericsson | Yes but | What does the part “to handle UE capabilities properly” mean in the proposal? Isn’t the purpose just for the NW to identify whether UE is a RedCap UE?[Rapp]yes, the purpose is for the network to identify whether UE is a RedCap UE. And then can know what RedCap specific capabilities the UE can support. Agree with QC the cases are not mutually exclusive. Also, perhaps this is not an exhaustive list either. For example: Option X: NW identifies RedCap UE based on the reported capabilities. That is, assuming there are capabilities specific to RedCap UEs not used by non-RedCap UEs, it should be clear to NW the UE is Redcap without any additional type indication (if such is not needed e.g. during initial access). This could also be simplified version of Option 2 which goes into stage-3 territory.We also think that the handover case may need a deeper look during normative phase. It should be fine to also clarify (in TR) that Opt 3 is pending RAN1 conclusions.  |
| CATT | Yes |  |
| Fujistu | Yes, but modification is needed for Opt.3 | According to offline-113, the determination of the exact solution for identification are still waiting for more input from RAN1, all options that are included in offline-113 would be captured in TR. So other solutions for identification should not be excluded here. We would like to modify Opt. 3 as follow: **Option 3:** The network obtains the RedCap based on identification solution (e.g. during Msg1, Msg3, MsgA or Msg5) ~~during initial access~~, and forwards it to target during Handover. |
| Thales |  | Options should not be made exclusive. May be a bit more discussion on options can shed light on which options is best. To us, maybe we need more discussions on option 2 to see impact. |
| ZTE | Yes |  |

**Summary:**

All companies agree the proposal 4 although some companies have comments on option details.

Some companies commented “**the cases are not mutually exclusive. Also, perhaps this is not an exhaustive list**”.

Companies commented the identification of Redcap UE during initial access in option 3 is pending RAN1 conclusion.

1 company provided a new option as

Option X: NW identifies RedCap UE based on the reported capabilities.

That is, assuming there are capabilities specific to RedCap UEs not used by non-RedCap UEs, it should be clear to NW the UE is Redcap without any additional type indication (if such is not needed e.g. during initial access).

Rapporteur would suggest to agree the updated proposal 4 as

**Proposal 2: RAN2 to agree, regarding how can the network know whether the UE is RedCap UE or not in order to handle UE capabilities properly, following options are considered and to be captured in the TR, the further analysis/down selection should be done in WI phase (following options may not be mutually exclusive, and may not be an exhaustive list):**

**Option 1:** RedCap device type is indicated as part of the capability signaling

**Option 2:** Define a new IE specifically for RedCap Ues containing these additional Redcap specific capabilities that is included only by Redcap UEs.

**Option 3:** The network obtains the RedCap based on identification solution, e.g. during Msg1, Msg3, MsgA,etc, (pending RAN1 conclusion), and forwards it to target during Handover.

**Option 4:** NW identifies RedCap UE based on the reported capabilities. That is, assuming there are capabilities specific to RedCap UEs not used by non-RedCap UEs, it should be clear to NW the UE is Redcap without any additional type indication (if such is not needed e.g. during initial access).

## Constraining of reduced capabilities

Regarding the constraining of reduced capabilities, following has been discussed in [1]:

|  |
| --- |
| **Summary in phase 2-5**17 companies provided inputs. 16 companies agreed to capture the options listed in the email discussion in the TR. 1 company commented further options are not precluded, 1 company commented further decision should be done in WI phase. **Proposal 5: Regarding how to ensure the RedCap UE is only used for intended use cases, following potential solutions are considered in the SI phase (other solutions are not precluded), and to be captured in the TR. The decision should be made in WI phase.** * **Option 1**:

*One potential problem could be when a RedCap UE requests a service that does not match the RedCap UE type. This would be similar to if e.g. an NB-IoT UE requested a video call to be set up. RAN can already reject an RRC connection establishment attempt e.g. based on the establishment cause provided in Msg3 or through higher layer mechanisms.*RAN can reject an RRC connection establishment attempt for a RedCap UE if the service the UE requested is not allowed for the RedCap UE. That is, the RAN needs to identify whether the UE is a RedCap UE or not, and be aware of the requested service, e.g. based on the cause value or other ways. * **Option 2: subscription validation**

During RRC connection setup, UE indicates it is a RedCap UE to core network, e.g. • UE includes this indication in its NAS signaling message to core network; or• UE informs this indication during its RRC connection establishment procedure to RAN; RAN then informs core network of UE’s RedCap type in its Initial UE Context message to core network.After network receives UE’s RedCap indication, it validates UE’s indication against its subscription plan, which includes information such as the set of services allowed for the UE. Based on the outcome of this validation, network then decide whether to accept or reject UE’s registration request. For example, network may reject UE if UE indicates RedCap but its subscription does not include any RedCap-specific services.* **Option 3. Verification of RedCap UE**

Network can additionally perform capability match procedure between UE’s reported radio capabilities and the set of capability criteria associated with UE’s RedCap type, to prevent a hacked or misconfigured UE from falsely reporting as a RedCap UE. **Option 4. Left up to network implementation** |

**Question 3: Regarding constraining of reduced capabilities, do companies agree the proposal 5? If not, pls provide your concern.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark**  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Apple | Yes, but | Ideally we should be able to achieve opt-1 with opt-2 itself (for eg., the for the video call by the NB-IOT) as UE needs to indicate to the CN that it is RedCap along with subscribed/allowed services?We would like to simplify in gNB to just provide the RAN specific configurations for initial access (which might be need by MSG2 time itself) and then the rest of the sequence can follow the current framework ( using UAC if gNB needs to do access control etc..).While we are not implying it, but adding more RedCap info at MSG3 and other RRC before capability exchange also allows transfer of capability before security context, and we can prevent this unless it is absolutely required. P5 states that the down-selection can be done in WI phase, so we request to just capture the implications of each option in the SI. Rapp] Looks like a new option. Could you pls add it as Option x? Thanks |
| vivo | Yes |  |
| Lenovo | Yes |  |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Nokia |  | We are not convinced that standardized solution is needed for ensuring the RedCap UE is only used for intended use cases. We assume that the network knows whether the UE is RedCap UE or not and based on that network is able to control which features and configurations are configured for the UE. Therefore, we think it would be sufficient to leave this up to network implementation. |
| Intel | Yes | Note: The proposal is to list the potential solutions in the TR instead of down selection.  |
| LGE | Yes, but  | We would like to clarify the meaning of “intended use cases for RedCap UEs”. Are they possibly the type of services that can be distinguished by e.g. establishment cause such as video, emergency service? Could it be the group of applications categorized in IWSN, Video surveillance and Wearables? |
| Ericsson | Yes | Agree to include Nokia’s option on leaving up to NW implementation.Also Option 3 motivation is not completely clear to us, why would a hacked UE indicate it is a RedCap UE but then report capabilities which would make it a non-RedCap UE? Is the intention to have some kind of limit on which capabilities UE can report, so that if it reports “too advanced” capabilities the network would reject service? [Rapp]The example provided in R2-2006605 is * Network needs to prevent a non-RedCap UE from falsely indicate it is a RedCap, because otherwise network may allocate unnecessarily more resources to support that UE (e.g. coverage enhancements).

 The formulation of the options should be discussed before capturing in the TR. [Rapp] Agree. |
| CATT | Yes |  |
| Fujitsu | Yes |  |
| Thales |  | We agree with Nokia here. It should be left to network implementation and we should not standardize solution to limit the use cases of REDCAP. |
| ZTE | Yes |  |

**Summary:**

A new option is proposed in the discussion as ”Left up to network implementation”;

1 company would like to clarify the meaning of “intended use cases for RedCap UEs”. Are they possibly the type of services that can be distinguished by e.g. establishment cause such as video, emergency service? Could it be the group of applications categorized in IWSN, Video surveillance and Wearables?

1 company commented the formulation of options should be discussed before capturing in the TR.

Rapporteur would suggest to agree the updated proposal 5 as

**Proposal 3: RAN2 to agree, Regarding how to ensure the RedCap UE is only used for intended use cases, following potential solutions are considered in the SI phase (other solutions are not precluded), and to be captured in the TR (The formulation of the options should be discussed before capturing in the TR.). The decision should be made in WI phase.**

* **Option 1**: **RRC Reject based approach**

*One potential problem could be when a RedCap UE requests a service that does not match the RedCap UE type. This would be similar to if e.g. an NB-IoT UE requested a video call to be set up. RAN can already reject an RRC connection establishment attempt e.g. based on the establishment cause provided in Msg3 or through higher layer mechanisms.*

RAN can reject an RRC connection establishment attempt for a RedCap UE if the service the UE requested is not allowed for the RedCap UE. That is, the RAN needs to identify whether the UE is a RedCap UE or not, and be aware of the requested service, e.g. based on the cause value or other ways.

* **Option 2: subscription validation**

During RRC connection setup, UE indicates it is a RedCap UE to core network, e.g.

• UE includes this indication in its NAS signaling message to core network; or

• UE informs this indication during its RRC connection establishment procedure to RAN; RAN then informs core network of UE’s RedCap type in its Initial UE Context message to core network.

After network receives UE’s RedCap indication, it validates UE’s indication against its subscription plan, which includes information such as the set of services allowed for the UE. Based on the outcome of this validation, network then decide whether to accept or reject UE’s registration request. For example, network may reject UE if UE indicates RedCap but its subscription does not include any RedCap-specific services.

Note: SA1, CT1 confirmation is needed.

* **Option 3. Verification of RedCap UE**

Network can additionally perform capability match procedure between UE’s reported radio capabilities and the set of capability criteria associated with UE’s RedCap type, to prevent a hacked or misconfigured UE from falsely reporting as a RedCap UE.

**Option 4. Left up to network implementation**

**Proposal 4: RAN2 to discuss the meaning of “intended use cases for RedCap UEs”. Are they possibly the type of services e.g. establishment cause such as video, emergency service? Or the group of applications categorized in IWSN, Video surveillance and Wearables?**

# Summary

Based on the discussion, we have following proposals:

**Proposals for agreement:**

|  |
| --- |
| **Proposal 1: RAN2 to agree following capability design principle is considered for RedCap UE, but details should be discussed in WI phase:****Alternative 1:*** **The UE capability requirements for a RedCap device type, that are different from those for non-RedCap UEs, are listed in the specifications. That is:**
	+ **Mandatory features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are optional for RedCap UE;**
	+ **Mandatory features for non-RedCap UE that are supported for RedCap UE but with different value;**
	+ **Optional features for non-RedCap UE that are not supported for RedCap UE;**
	+ **Optional features for non-RedCap UE that are mandatorily supported for RedCap UE.**

**For a RedCap device type, define new signaling fields in UE Capability for the features that are mandatory w/o capability signaling for non-RedCap UEs but are optional for Redcap UEs, or mandatory with capability signaling for non-RedCap UEs but with different value for RedCap UEs.The possible new introduced signaling fields for RedCap UEs should not apply to non-RedCap or legacy UEs for mandatory features w/o capability signaling.****Alternative 2:****Directly define the UE capabilities required for RedCap devices, including:** **---Mandatory features for RedCap UEs (defined in specification);** **---Optional features for Redcap UEs (introduce ignaling fields in an independent container defined specifically for Redcap UE).** **Proposal 2: RAN2 to agree, regarding how can the network know whether the UE is RedCap UE or not in order to handle UE capabilities properly, following options are considered and to be captured in the TR, the further analysis/down selection should be done in WI phase (following options may not be mutually exclusive, and may not be an exhaustive list):****Option 1:** RedCap device type is indicated as part of the capability signaling**Option 2:** Define a new IE specifically for RedCap Ues containing these additional Redcap specific capabilities that is included only by Redcap UEs.**Option 3:** The network obtains the RedCap based on identification solution, e.g. during Msg1, Msg3, MsgA,etc, (pending RAN1 conclusion), and forwards it to target during Handover.**Option 4:** NW identifies RedCap UE based on the reported capabilities. That is, assuming there are capabilities specific to RedCap UEs not used by non-RedCap UEs, it should be clear to NW the UE is Redcap without any additional type indication (if such is not needed e.g. during initial access).**Proposal 3: RAN2 to agree, Regarding how to ensure the RedCap UE is only used for intended use cases, following potential solutions are considered in the SI phase (other solutions are not precluded), and to be captured in the TR (The formulation of the options should be discussed before capturing in the TR.). The decision should be made in WI phase.** * **Option 1**: **RRC Reject based approach**

*One potential problem could be when a RedCap UE requests a service that does not match the RedCap UE type. This would be similar to if e.g. an NB-IoT UE requested a video call to be set up. RAN can already reject an RRC connection establishment attempt e.g. based on the establishment cause provided in Msg3 or through higher layer mechanisms.*RAN can reject an RRC connection establishment attempt for a RedCap UE if the service the UE requested is not allowed for the RedCap UE. That is, the RAN needs to identify whether the UE is a RedCap UE or not, and be aware of the requested service, e.g. based on the cause value or other ways. * **Option 2: subscription validation**

During RRC connection setup, UE indicates it is a RedCap UE to core network, e.g. • UE includes this indication in its NAS signaling message to core network; or• UE informs this indication during its RRC connection establishment procedure to RAN; RAN then informs core network of UE’s RedCap type in its Initial UE Context message to core network.After network receives UE’s RedCap indication, it validates UE’s indication against its subscription plan, which includes information such as the set of services allowed for the UE. Based on the outcome of this validation, network then decide whether to accept or reject UE’s registration request. For example, network may reject UE if UE indicates RedCap but its subscription does not include any RedCap-specific services.Note: SA1, CT1 confirmation is needed.* **Option 3. Verification of RedCap UE**

Network can additionally perform capability match procedure between UE’s reported radio capabilities and the set of capability criteria associated with UE’s RedCap type, to prevent a hacked or misconfigured UE from falsely reporting as a RedCap UE. **Option 4. Left up to network implementation** |

**Proposals for further discussion:**

**Proposal 4: RAN2 to discuss the meaning of “intended use cases for RedCap UEs”. Are they possibly the type of services e.g. establishment cause such as video, emergency service? Or the group of applications categorized in IWSN, Video surveillance and Wearables?**

# Reference

[1] R2-2009004 Report of [POST111e][913][REDCAP] Definition and constraining of reduced capabilities (Intel) Intel Corporation