**3GPP TSG-SA WG4 Adhoc Telcos post 130 *S4aI250008r01***

**Adhoc eMeeting, 5** revision of S4-242024

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **26.942** | **pCR** |  | **rev** | **01** | **Current version:** | **1.0.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network | **x** |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Solution #2: Potential solution to Key Issue #1: UE energy index as abstract metric for energy credits | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Interdigital, BBC | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_MediaEnergyGREEN | | | | |  | ***Date:*** | | | 2024-12-19 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The latest draft of 3GPP TR 26.942 contains clause 7 on Potential Solutions to the already defined and described key issues. In this context, under KI #1; the following questions were defined:  In this context, the subsequent analysis by this Key Issue should consider:  1. How should UE energy-related information be reported by a UE to the 5G System?  2. Which reference points should be used to report UE energy-related information to the Data Collection AF?  3. Would it be useful to expose energy-related information of the network to the Media Session Handler to help it optimize its media session in an energy-efficient way?  4. How to allow a UE to report its energy-related information without exposing its energy consumption rate?  It is proposed to add the proposed content to the latest draft of TR 26.942 v 0.3.2 under clause 7.1 as one of the potential solutions so that it is not left incomplete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This CR proposes new text to be added in TR 26.942 on “Clause 7 Potential Solutions”. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Proposed objectives will not be met. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7 (new), 7.1 (new), 7.2 (new), 7.2.1 (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

|  |
| --- |
| 1st Change |

# 2 References

[22261] 3GPP TS 22.261: "Service requirements for the 5G system".[x] "[Electrochemical Energy Storage for Renewable Sources and Grid Balancing", 2015, pp. 411–435](https://www.sciencedirect.com/science/article/pii/B9780444626165000206).

[y]R1-2206921: "Summary for low power high accuracy positioning".

[z] Accubattery: <https://play.google.com/store/apps/details?id=com.digibites.accubattery>

[26565] 3GPP TS 26.565: "Split Rendering Media Service Enabler".

|  |
| --- |
| 2nd Change |

## 7 Potential solutions

## 7.1 Mapping of solutions to Key Issues

Table 7.1-1: Mapping of solutions to Key Issues

|  |  |  |  |
| --- | --- | --- | --- |
| Solutions |  |  |  |
|  | KI#1 | KI#2 | KI#3 |
| #1 |  |  |  |
| #2 | X |  |  |
| #3 |  |  |  |
| #4 |  |  |  |
| #5 |  |  |  |
| #6 |  |  |  |
| #7 |  |  |  |
| #8 |  |  |  |
| #9 |  |  |  |

|  |
| --- |
| 3rd Change (all new text) |

## 7.2 Solution #2: UE energy related information exposure for energy credits

### 7.2.1 Key Issue mapping

This solution addresses Key Issue #1.

### 7.2.2 Functional description

#### 7.2.2.1 Introduction

Clause 6.15a.5 of TS 22.261 [22261] defines information exposure, which clearly states that information related to energy consumption and efficiency is not only necessary for network internal optimization, but also will benefit the service adjustment for third parties such as Application Service Providers.

This Candidate Solution to Key Issue #1 determines the method of obtaining this additional energy-related information. In this regard, this candidate solutiongives a summary of energy related information relevant to UE that can be exposed by the UE to external entities in an abstract way, without exposing any internal information related to the UE.

#### 7.2.2.2 Energy credit abstraction

*Energy credit* is defined in clause 6.15a.2 of TS 22.261 [22261] as a service criterion which can be used as an abstract measure of the energy impact on the network of delivering a service to a UE. According to this clause, subject to operator policy, the 5G System is required to support a mechanism to perform energy consumption credit limit control for services without specific QoS requirements. Energy credits, associated with a subscriber and used by the operator network’s "credit control" funcionalities, are consumed depending on the UE behaviour, for example:

- The number of simultaneously active services.

- The volume of data transferred via the network over a certain period of time.

- The type of media data transferred.

- The geographical area in which the UE is located

- The amount of energy consumed by the network to provide the services.

#### 7.2.2.3 Energy-related information relevant to UE

Table 7.2.2.3-1 lists several device properties which are UE energy-related information. Alongside the entries defined by the deviceCapabilities object in table 8.4.2.2-1 of TS 26.565 [26565], these may be useful in calculating an energy credit metric.

Table 7.2.2.3-1: UE-related energy information

|  |  |
| --- | --- |
| Property | Description |
| UE battery life | Level of the battery of the UE (e.g. in %).  Based on an estimate of how long the battery will power the device on a single charge. In simple terms, it indicates long the device can run before needing a recharge which, depending on usage, can be a matter of hours or an entire day [y] |
| UE energy consumption rate (power in W) | UE charging/discharging rate or speed (e.g. in Watts, negative or positive).  Calculated as the integral of power consumption over time as defined in TS 28.310 [28310]. |
| UE energy preference | Remaining time during which the UE wants to be considered in energy saving (e.g. in mn). “0” means that the end time in unknown. |
| UE battery capacity | The total UE battery capacity (e.g. in mAh).  The total amount of electricity generated due to electrochemical reactions in the battery and is expressed in ampere hours. For example, a constant discharge current of 1 C (5 A) can be drawn from a 5 Ah battery for 1 hour [x] |
| UE source of power supply | e.g. “battery”, “pluged in”.  Indicates whether the UE is currently operating on battery or is plugged in to an external power supply, which may or may not be renewable energy (e.g., solar panel).  This could include the ratio of renewable energy over different time granularities (e.g. 30% renewable over the last 24 hours [as described in TS 28.310]). |
| UE battery discharge rate | e.g. between 0 and 1000.  Calculated as the battery capacity (in Ah) divided by the number of hours it takes to charge/discharge the battery. For example, a battery capacity of 500 Ah that is theoretically discharged to its cut-off voltage in 20 hours will have a discharge rate of 500 Ah/20 h = 25 A [x] |
| UE measurement duration | Energy Measurement interval. |
| UE carbon intensity | In -e /  A measure of the global greenhouse gases emitted per unit of generated electricity, measured in grams of CO₂ equivalents per watt-hour (for conversion to carbon emissions as defined in TS 22.261 [22261] and TS 23.700-66 [23700]). |

#### 7.2.2.4 Estimating the energy usage of media applications running on the UE

The Accubattery application [y] is an example, where we can understand that it allows the user to visualise the battery usage of each individual application installed on an Android UE, as illustrated in figure 7.2.2.4‑1 below.

A screenshot of a phone

Description automatically generated

Figure 7.2.2.4-1: Example of UE application showing per-application battery consumption  
(source: [z])

NOTE: Further study is needed to identify the UE APIs used to obtain per-application battery consumption information on different UE operating systems.

Similar techniques could be used to determine the battery consumption of individual media applications as input to an energy credit metric.

#### 7.2.2.5 UE energy related information abstraction



UE energy-related information is private UE information, and it is possible that UE manufacturers do not want to share this raw information with third parties, network operators or with the Application Service Provider. Hence, this candidate solution proposes that the UE-energy related information is sent as an abstract information which does not reveal any internal properties of the UE such as the UE battery discharge rate, UE battery capacity, etc.

This abstract value of the UE energy related information could be an integer value corresponding to a particular UE battery capacity, UE supply and UE energy consumption rate. Each value is different from the other. Moreover, this information from two UEs having similar UE energy capacity and UE energy supply, whether from the same or different manufacturers, would also likely be different.

For example, two UEs from the same manufacturer have 4000 mAh battery capacity. But the way that each of these UEs consume their energy (drain their batteries) will be completely different, for some or all of the following reasons, amongst others:

1. Different battery drain rate due to the age of each of the UEs. The older the UE’s battery drains faster than that of the newer UE.

2. Different battery drain rate at different ambient temperature (e.g. 40°C versus -5°C) as a result of different electrical efficiency in the UE.

3. A premium flagship model might consume energy at a different rate than a basic model, even if both are using the same application under the same conditions.

4. Different user behaviours that result in different energy consumption.

The set of criteria used to calculate such an abstraction could be extended to take additional criteria into account, such as the energy usage of individual applications as described in clause 7.2.2.4.

In summary, the UE Energy information abstraction is unique to each UE, which allows the energy consumption rate using a particular energy supply to be identified. How such a value is derived is implementation-specific: it is left to each UE manufacturer to implement specific methods to derive this value, taking into consideration the UE energy capacity, UE energy supply and UE energy consumption rate of each individual UE model. This does not reveal any direct information about how a UE consumes its energy, allowing only an abstract value to be exposed beyond the UE. Hence, this information is unique to every UE and should not be compared with any other UE.

Because of this abstraction, any external entity (e.g., a Network Function) receiving this information is not aware of which UE (device type, model, battery capacity, etc.) has exposed that value. Rather, it is only aware of the corresponding energy consumption of a particular device (running a particular application).

### 7.2.3 Procedures

This Candidate Solution proposes a new metric; procedures for reporting this metric from the UE to an external entity are described in solution x in clause 7.x.

### 7.2.4 Summary

This candidate solution describes an abstract *for* UE energy-related information that could be used as an energy credit metric as envisaged in clause 6.15A.5 of TS 22.261 [22261]..

Further study is needed to determine the exact APIs available to interrogate this energy-related information on the UE, and to assess the accuracy of the information they expose to the API invoker.

|  |
| --- |
| End of change |