**3GPP TSG-SA WG4 Meeting post 129e** ***S4aI240159r01***

**Adhoc, 4** revision of S4aI240136

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **26.942** | **pCR** |  | **rev** | **1** | **Current version:** | **0.3.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network | **x** |

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| ***Title:*** | Update to Potential solution to Key Issue #1: Information exposure | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Interdigital | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_MediaEnergyGREEN | | | | |  | ***Date:*** | | | 2024-10-14 |
|  |  | | | |  | |  | | |  |
| ***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  It is proposed to add the proposed content to the latest draft of TR 26.942 v 0.3.0 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), 7.1.2 (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:*** | |  | | | | | | | | |

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| 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”.

[26119] 3GPP TS 26.119: “Media Capabilities for Augmented Reality”.

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| 2nd Change |

## 7 Potential solutions

Editor’s note: Description of 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 | X |  |  |
| #2 |  |  |  |
| #3 |  |  |  |
| #4 |  |  |  |
| #5 |  |  |  |
| #6 |  |  |  |
| #7 |  |  |  |
| #8 |  |  |  |
| #9 |  |  |  |

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| 3rd Change (all new text) |

## 7.2 Solution #1: Energy-related information exposure from UE

### 7.2.1 Key Issue mapping

This solution addresses Key Issue #1

### 7.2.2 Functional description

#### 7.2.2.1 Introduction

Energy credit is a service criterion introduced by clause 6.15a.5 of TS 22.261 [22261] 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 QoS criteria. Energy credits, associated with a subscriber and used by the operator network’s “credit control”, are consumed depending on the UE behaviour, e.g. depending on the number of active services, the data volume over a time period, the type of media data, geographical area, and based on the amount of energy consumed by the network to provide the services.

This potential solution to Key Issue #1 determines the method of obtaining this additional energy-related information, enhancements to the entities involved in obtaining relevant information, and the impact of them on taking into consideration the media context (e.g., the 5G Media Streaming System defined in TS 26.501 [26501], 5G Multicast–Broadcast User Services as defined in TS 26.502 [26502], the Real-time Media Communication System defined in TS 26.506 [26506], Split rendering for media Session Enabler as specified in TS 26.565 [26565], etc. including UE-related energy information exposure.

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

It is proposed that the following energy-related information is collected by the UE:

* .
* UE battery discharge rate: the discharge rate is given by 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 battery life : It denotes how long the battery will power the device on a single charge. In simple terms, 'battery life' is about how long your phone can run before needing a recharge, which can be a matter of hours or a day, depending on usage [y].
* UE battery capacity: Battery capacity is defined as 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: whether the UE is currently operating on battery or being powered by grid (“plugged-in”) or by renewable energy (e.g. solar panel). This can include the ratio of renewable energy over different time granularities (e.g. 30% renewable over the last 24h [TS 28.310]).
* UE energy consumption: integral of power consumption over time (defined in the TS 28.310 [28310])
* UE carbon intensity: 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]).

The energy information can be provided by the UE client through the configuration message. This can be transmitted as part of the “DeviceCapabilities” object, or through a dedicated new object. This may use the procedures similar to what is defined in TS 26.565 [26565] clause 8.4, 26.119 [26119] clause 12.5. The new object could be defined as depicted below:

Table 7.2.2.2-1. Device energy information object

|  |  |  |  |
| --- | --- | --- | --- |
| Property | Type | Cardinality | Description |
| DeviceEnergyInformation | Array | 0..1 | This contains a list of energy-related information from the device |
| UE energy state | Number | 0..1 | Level of the battery of the UE (e.g. in %) |
| UE energy consumption rate (power in W) | Number | 0..1 | UE charging/discharging rate or speed (e.g. in Watts, negative or positive) |
| UE energy preference | Number | 0..1 | 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 energy capacity | Number | 0..1 | The total UE battery capacity (e.g. in mAh) |
| UE energy supply | enum | 0..1 | e.g. “battery”, “plug-in”, “renewable” |
| UE Energy | Number | 1..1 | e.g. between 0 and 1000 |
| UE measurement duration | Number | 1..1 | Energy Measurement interval |
| UE carbon intensity | Number | 1..1 | In -e / |

#### 7.2.2.3 UE energy index abstraction

UE energy-related information is private UE information, and it is possible that UE manufacturer does not want to share that information with third parties, operators or with the Application Service Provider. Hence, a new abstract “UE energy index” concept is introduced in this clause.

Table 7.2.2.3-1: Example representation of UE energy index calculations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| UE energy index | UE battery discharge rate (in %/h,) | UE battery life (in minutes) | UE battery capacity | UE power Supply | UE energy consumption rate (in Watts) at a nominal voltage of 5V |
| a | 20%/hour | 120 minutes | 4000 mAh | Battery | 3 W |
| b | 50%/hour | 30 minutes | 4000 mAh | Battery | 1 W |
| c | 95%/hour | 15 minutes | 4000 mAh | Green | 7.5 W |
| d | — | — | 4000 mAh | Socket | 15 W |

The table above is a representative example of how UE energy index would allow to expose energy related information through the newly defined ‘**UE** Energy Related-Information Collection and Reporting entity”’inside the MSH. From the table above, we notice that the energy index has different values, e.g. a, b, c and d, each integer value corresponding to a particular UE battery capacity, UE supply and UE energy consumption rate. Each value of the energy index (a, b, c and d) is different from one another and the UE energy index of 2 UEs having similar UE energy capacity and UE energy supply, whether it is from the same manufacturer or different manufacturer will still also be different.

For example, a UE from manufacturer 1 may have 4000 mAh battery capacity and from the same manufacturer, there could be another UE 2 model, also having the same 4000 mAh battery capacity. But the way that each of these UEs consume their energy (drain their batteries) will be completely different from one another. This could be, for instance, (i) due to the age of each of the UEs – the older the UE gets the faster the battery is drained, the higher the energy is consumed, (ii) it is possible that one UE is premium flagship model, and the other UE is a basic model, both having 4000 mAh; the rate at which both these UEs consume energy will be totally different even if both are using the same application under the same conditions, (iii) one UE could be present in a region where the average temperature is 40 degree Celsius and another UE could be present in a region where the average temperature is -5 degree Celsius; both being the same model from the same manufacturer (iv) 2 UEs having the same battery capacity of 4000 mAh, but each user exhibiting different user behaviours, which would result in different energy consumption. The above table 1 could be for instance extended to incorporate other criteria into account while calcaulting the UE energy index. For instance, the Accubattery App [y] is a commonly used app, which allows the user to visualise the battery usage of each individual applications that are installed inside a UE, which is available only to the UE. Similar techniques could be used by the UE manufacturers to determine the battery consumption of individual media applications in order to convert to UE energy index.



Figure 7.2.2.3-1: Example of UE application showing per-application battery consumption  
(source: [z])

Thus, the UE Energy index is unique to each UE, which allows the energy consumption rate using a particular energy supply to be identified. How the UE energy index is derived is implementation-specific. It is left to each UE manufacturer to implement specific methods to derive UE energy index values, taking into consideration the UE energy capacity, UE energy supply and UE energy consumption rate of each individual UE model. This unique index value does not reveal any direct information about how a UE consumes its energy, allowing only an abstract value to be derived. This energy index value is unique to every UE and should not be compared with any other UE.  By doing this, the network entity receiving this value is not aware of what UE (device type, model, battery capacity, etc.) is sending such index value and only is aware of the corresponding energy consumption of that particular individual device (for that particular application).

It is left for further study what is done by the UE upon deriving the UE energy index of a particular running application.

#### 7.2.2.4 UE Energy-Related Information Collection and Reporting functionality

To obtain and maintain the UE energy-related information, a new generic functionality in the UE called the *Energy-Related Information Collection and Reporting entity* is defined. It is responsible for collecting UE energy-related information in the UE.

Based on the generic architecture for UE data collection, reporting and event exposure defined in TS 26.531 [26531], figure 7.2.3-1 shows different interfaces between the UE and the Data Network, including the new UE Energy-Related Information Collection and Reporting functionality in the Direct Data Collection Client. In this case, UE energy-related information is reported to the Data Collection AF at reference point R2 for onward exposure to the NWDAF (at reference point R5) or to the Application Service Provider’s Event Consumer AF (at reference point R6).



Figure 7.2.2.4-1: UE energy information handler entity within generic Direction Data Collection Client

When the Direct Data Collection Client is instantiated in the 5G Media Streaming System per clause 4.7.1 of TS 26.501 [26501], the UE Energy Related-Information Collection and Reporting functionality plays the role of UE energy information collection and reporting to the Data Collection AF inside the Media Session Handler.



Figure 7.2.2.4-2: UE energy information handler entity instantated within  
5GMS Media Session Handler

### 7.2.3 Procedures

### 7.2.4 Impacts on existing services, entities and interfaces

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| End of change |