**3GPP TSG-SA WG4 Meeting post 130 S4-242027r03**

**Orlando, 4**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **26.942** | **pCR** |  | **rev** | **3** | **Current version:** | **0.3.2** |  |
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| *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:***  | Potential solution to Key Issue #3: Evaluation framework  |
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| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | S4 |
|  |  |
| ***Work item code:*** | FS\_MediaEnergyGREEN |  | ***Date:*** | 2024-11-06 |
|  |  |  |  |  |
| ***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 canbe 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)* |
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| ***Reason for change:*** | The latest draft of 3GPP TR 26.942 contains Key Issue #3: Evaluation Framework under clause 6.3. Add a potential solution for KI#3 Evaluation Framework |
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| ***Summary of change:*** | This CR proposes new solution based on ETSI ES 203 228 V1.3.1 |
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| ***Consequences if not approved:*** | Proposed objectives will not be met. |
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| ***Clauses affected:*** | 7.2, 7.2.1, 7.2.2 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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| Additional references |

# 2 References

[ES203228] ETSI ES 203 228: "Environmental Engineering (EE); Assessment of mobile network energy efficiency".

[ES202336] ETSI ES 202 336-12: "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (power, cooling and building environment systems used in telecommunication networks); Part 12: ICT equipment power, energy and environmental parameters monitoring information model".

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| Relevant background information(all new text) |

#### 4.2.3.6 ETSI

##### 4.2.3.6.1 Summary of energy efficiency standards drafted by the ETSI Environmental Engineering (EE) Working Group

Editor’s Note: Text from TDoc S4-242030.

##### 4.2.3.6.2 Definition of Mobile Network Energy Efficiency

#### ITU-T L.1310 [L1310] defines energy efficiency as the relationship between the specific functional unit for a piece of equipment (i.e., the useful work of telecommunications) and the energy consumption of that equipment. For example, when transmission time and frequency bandwidth are fixed, a telecommunication system that can transport more data (in bits) with less energy (in Joules) is considered to be more energy-efficient. For this reason, metrics that can evaluate the performance of a piece of equipment against its energy consumption are to be defined.

#### From Release 15 onwards, the definition of Energy Efficiency is clarified in 3GPP. The definition does not come directly from 3GPP itself, but rather is adopted from the ETSI Working Group on Environmental Engineering, in ETSI ES 203 228 [ES203228] which aims to define the topology and level of analysis to assess the energy efficiency of mobile networks. In particular, [ES203228] defines metrics for mobile network energy efficiency and methods for assessing (and measuring) energy efficiency in operational networks.

#### Per ETSI ES 203 228 [ES203228], Energy Efficiency (EE) of a Mobile Network is defined as the relation between the useful output and power consumption, where power consumption is defined as the power consumed by a device to achieve an intended application performance.

#### Mobile Network data Energy Efficiency $EE\_{NE}$ is the ratio between the performance indicator Data Volume ($DV\_{MN}$) and the Energy Consumption ($EC\_{MN}$) when assessed during the same time frame (T) as as defined in clause 7.1 of ITU-T recommendation L.1331 [L1331]. This is also shown by the formula:

#### $$EE\_{NE}= \frac{DV\_{MN}}{EC\_{MN}}$$

#### where *DV* is the Data Volume, expressed in bits, transported across a network element. The Data Volume measurements are collected via OAM. *EC* is the Energy Consumption, expressed in Joules, of the same network element. The MN suffix stands for Mobile Network.

#### Clause 8.2 of ITU-T L.1331 [L.1331] illustrates how to measure/collect the information about data volume (for capacity), coverage area (for coverage) as well as energy consumption over a measurement period called *T*, that can span one week, one month, or longer periods.

#### This formula is reproduced in several 3GPP TSs and TRs dealing with energy efficiency (EE).

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| Solution mappings |

## 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

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

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| Solution proposal(all new text) |

## 7.2 Solution #2: Evaluation Framework to measure energy efficiency of a UE

### 7.2.1 Key Issue mapping

This solution addresses Key Issue #3 (Evaluation Framework) described in clause 6.3.

### 7.2.2 Functional description

#### 7.2.2.1 UE Energy Efficiency metric

Similar to the definition of the Mobile Network Energy Efficiency KPI (see clause 4.2.3.6.2), one possible example to represent the UE energy efficiency is *bits per Joule.* A UE is considered to be more energy-efficient when the data usage (in bits) is high with less energy consumption (in Joules), assuming that battery capacity and consumption rate are fixed when assessed during the time frame (*T*). The metric is defined as below:

$$EE\_{UE}=\frac{Data Volume}{\sum\_{i=power state}^{}Energy Consumption (i)}$$

* **Data Volume [bit]** represents the traffic volume for the UE for a given duration.
* **Energy Consumption [*estimated* Joule]** represents the total energy consumption of the UE for a given duration, which is the summation of power consumption.

The data volume consumed by *k* sub-applications is defined as the summation of the data volume consumed by the User Equipment under investigation during the time frame *T* of the energy consumption assessment for these sub-applications. This could be shown as:

$$DV\_{k,app}=\sum\_{i=1}^{k}DV$$

where $DV\_{k,app}$, measured in bits, is the data volume over the measurement period *T* of the UE for a given duration.

The overall UE Energy Efficiency, *EEUE* is then calculated as follows:

$$EE\_{UE}=\frac{DV\_{k,app}}{\sum\_{i=power state}^{}Energy Consumption (i)}$$

### 7.2.3 Procedures

The following methodology is proposed to measure the Energy Efficiency of a test application running on a UE:

1. A test scenario is defined, and test conditions described:

a. Network (connection type, upload and download bandwith, latency).

b. User devices (type, model, SoC, OS version, video player). At least 2 devices should be used.

c. Test environment (number of devices, number of iterations, etc.).

d. Anchor against which the specific features will be evaluated (i.e., 5GMS service delivering a 720p video at 2 Mbps in HEVC).

e. Reference sequence(s) used.

2. Launch the application under test which implements the collection of energy-related information, including either battery discharge rate or else total energy discharged and duration.

3. The test is done for the anchor and the implementation including the feature evaluated.

4. Extract data from the data collector for non-real-time analysis. Characterization is documented in terms of expected energy savings, and may include additional comparison parameters such as impact on the end user’s Quality of Experience, etc.

5. The time duration of the measurement, denoted as *T*, shall be one of the following alternatives:

- Weekly measurement: *T* = 7 days.

- Monthly measurement: *T* = 30 days.

- Yearly measurement: *T* = 365 days.

 The minimum duration is therefore one week: monthly and yearly measurements are extensions of the basic week test per the guidelines in ETSI ES 203 228 [ES203228].

6. The Energy Consumption of the mobile network is measured by means of metering information provided by utility suppliers or by measurement systems integrated into the mobile network. Moreover, sensors can be used to measure the energy consumption of individual sites or pieces of equipment, following the requirements set by ETSI ES 202 336-12 [ES202336].

7. The data volume is measured using network counters for data volume in the UE under test.

- For Packet Switched traffic, the data volume is considered as the overall amount of data transferred to and from the UE under test. Data volume is measured separately for each application present in the UE.

- For Circuit Switched traffic (e.g. CS voice or VoLTE), the data volume is considered as the number of minutes of communications during the time *T* multiplied by the data rate of the corresponding service and the call success rate per ETSI ES 203 228 [ES203228].

### 7.2.4 Summary

The solution described in clauses 7.2.2 and 7.2.3 has the following limitations:

1. The solution proposes to evaluate the energy efficiency of the entire UE as a whole device, while individual energy consuming aspects such as the media energy consumption, energy consumed during radio transmissions (4G, 5G, Wifi), etc. have additional impact on the energy efficiency of the UE.

2. The solution is UE implementation-specific, i.e. the same feature may result in different evaluations of energy efficiency on different UEs.

3. The solution may result in different evaluations of energy efficiency of the same UE depending upon the test conditions that may vary over time (e.g. environmental changes and radio conditions, etc.).

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| End of changes |