**3GPP TSG-SA WG4 meeting #131 S4-250185r01**

**Geneva, 5**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **26.942** | **pCR** |  | **rev** | **01** | **Current version:** | **1.0.1** |  |
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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:*** | Text reference for Energy Information Function (EIF) | | | | | | | | | |
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| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
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| ***Work item code:*** | FS\_MediaEnergyGREEN | | | | |  | ***Date:*** | | | 2025-02-11 |
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| ***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)* | |
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| ***Reason for change:*** | | The latest draft of 3GPP TR 26.942 contains “clause 4.2.2.3 Collection and exposure of energy consumption information at NF”. The proposed text is relevant to the contents of the existing clause. | | | | | | | | |
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| ***Summary of change:*** | | This pCR proposes new text to be added in TR 26.942 on “4.2.2.3 Collection and exposure of energy consumption information at NF”. | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete section. | | | | | | | | |
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| ***Clauses affected:*** | | 4.2.2.3, 4.2.3.6.2 | | | | | | | | |
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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:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

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| 1st Change |

#### 4.2.2.3 Collection and exposure of energy consumption information at NF

TR 23.700-66 [20] studies and identifies potential enhancements to the 5G System (e.g., including network energy-related information exposure, enhancement for subscription and policy control to enable energy efficiency as a service criterion) to improve energy efficiency and to support energy saving in the network.

Three different key issues have been identified in that study:

- KI#1: Network energy related information exposure

- KI#2: Subscription and policy control to support energy efficiency and energy saving as service criteria

- KI#3: 5GS enhancements for network energy saving and efficiency

KI#2 is not in scope of this study. The conclusions of KI#1 and KI#3 in clause 8 of TR 23.700-66 [20] and the normative work following will be used for collection and exposure of Energy Consumption information at Network Functions (NFs) and are summarised as follows:

1. A new network functionality will be defined to collect and calculate energy-related information and expose it to authorised consumers subject to the network operator's policy:

- If the authorised consumer is a 5GC Network Function, the information exposure granularities that can be configured in this policy will include per application, per UE, per-UE-per-QoS Flow, per PDU session.

- If the authorised consumer is an Application Function, the information exposure granularities that can be configured in this policy will include: per UE, per UE per application, per PDU session.

2. The energy-related information that can be exposed according to the above exposure granularities will include:

- Energy Consumption information as defined in TS 28.310 [2].

- Renewable energy information defined as energy from renewable non-fossil sources. For example (but not limited to) wind, solar, aerothermal, geothermal, hydrothermal.

3. A consumer of energy-related information (i.e., 5GC NF or AF) may request different modes of exposure (e.g. periodic reporting or threshold-based reporting) as part of its subscription request.

4. The new network functionality supporting the calculation of the Energy Consumption information includes the following aspects:

a) OAM: provides the NF/Node-level Energy Consumption information at the gNodeB(s) and UPF(s) serving the UE.

b) OAM: provides the overall data volume of the gNodeB.

c) The information of a) and b) received from OAM could be used by the new network functionality for all the UEs served by the NF/Node.

d) UPF: provides the overall data volume of the UPF.

e) UPF: provides the data volume for the QoS Flow or the Service Data Flow (SDF).

f) When the gNodeB and/or the (I-)UPF(s) which are serving the UE change, the serving gNodeB ID and UPF ID will be sent to the new network functionality through AMF/SMF.

5. The new network functionality determines the end-to-end energy consumption based on energy consumption per the granularities above at the serving Network Function (i.e. NG-RAN and UPF).

6. In Release 19, only the energy-related information of user plane communication (not control plane signalling) is supported.

7. Enhancements to NF discovery and (re-)selection procedures based on energy-related information:

- The NF profile may be extended (e.g. by including the new energy-related information or by reusing existing NF profile parameters) to allow an operator to influence NF discovery and selection based on its energy strategy.

- NF discovery and (re-) selection will be enhanced to consider the energy-related information from the NF profiles and/or discovery requests from the NF consumer.

8. Enhancements to existing operations and procedures for energy saving and energy efficiency:

- The User Plane path of a PDU session may be adjusted so that it consumes less energy.

The recommendations of the present document focusing on media services will need to be aligned with the conclusions in clause 8 of TR 23.700-66 [20] impacting Application Functions used for media services.

According to the conclusions of TR 23.700-66 [20], and as specified in clauses 5.51 and 6.2.34 of TS 23.501 [72], the new network functionality referred to in point 1 above is called the Energy Information Function (and has the following responsibilities:

- Collect data from OAM and 5GC Network Function(s) to assist in the calculation of energy-related information.

- Calculate the energy-related information (including energy consumption information and renewable energy information) of user plane communication.

- Expose the calculated energy-related information to authorised consumers.

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| 2nd Change |

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

ITU-T L.1310 [29] 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 [66] which aims to define the topology and level of analysis to assess the energy efficiency of mobile networks. In particular, [66] defines metrics for mobile network energy efficiency and methods for assessing (and measuring) energy efficiency in operational networks.

Per ETSI ES 203 228 [66], 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 is the ratio between the performance indicator Data Volume () and the Energy Consumption () when assessed during the same time frame (T) as defined in clause 7.1 of ITU-T recommendation L.1331 [67]. This is also shown by the formula:

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.

NOTE: This relationship assumes a simplified linear relationship between data transfer and energy consumption. New evidence suggests a marginal relationship between throughput and energy [79, 80, 81]. It would be useful to consider how new understanding influences this energy efficiency measurement equation.

This formula is reproduced in several 3GPP Technical Specifications and Technical Reports dealing with energy efficiency (EE).

Clause 8.2 of ITU-T L.1331 [67] 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*, spanning one week, one month, or longer periods.

In addition, annex T of T 26.501 [72] provides examples of how the Energy Information Function (EIF) described under clause 4.2.2.3 calculates the energy consumption for required granularities.

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| 3rd Change |

##### 4.2.3.6.3 Calculating energy consumption at UPF and gNodeB

The energy consumed at a UPF (*EUPF*)or a gNB (*EgNB*) is known over a time interval *T* and the EIF is aware of the data volume (*DV*) consumed over the same time interval *T*:

* by a UE at a UPF (*DVUE,UPF*),
* by a UE PDU Session at a (*DVSession,UPF*) and
* by a UE QoS Flow (*DVFlow,UPF*).

The EIF is also aware of the overall data volume at the gNodeB (*DVgNB*) and UPF (*DVUPF*) which are serving the UE.

Then, based on the above, the energy consumption of the gNodeB and UPF can be derived at the three required granularities using the following example formulas.

To derive the of energy consumed at a gNodeB over a time interval *T* by a UE, PDU Session, QoS Flow, the formulas are:

To derive the energy consumed at a UPF over a time interval *T* by a UE, PDU Session, QoS Flow, the formulas are:

It should be noted that the coefficients and are common across all granularities within time interval *T* for the gNodeB and UPF respectively and are a measure of their respective energy efficiency in handling the unit of data volume used in the calculations (e.g. Joules per bit).To derive the energy consumed in the network in the time interval *T* by a UE (*EUE*), PDU Session (*ESession*), QoS Flow (*EFlow*), the formulas are:

where are all gNodeBs used by the UE over time interval *T*, and are all UPFs used by the UE in an interval T.

where are all gNodeBs used by the PDU Session over time interval *T*, and are all UPFs used by the PDU Session over time interval *T*.

where are all gNodeBs used by the QoS Flow over time interval *T*, and are all UPFs used by the QoS Flow over time interval *T*.

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| End of change |