**3GPP TSG-SA5 Meeting #154 *S5-241833***

Changsha, CHINA, 15 Apr - 19 Apr 2024

**Source: Huawei**

**Title: Discussion on the charging aspects of energy efficiency**

**Document for: Discussion**

**Agenda Item: 7.2**

# 1 Decision/action requested

***This discussion paper collects charging related energy efficiency and energy saving solutions in SA1, SA2 and SA5 OAM, to moderate the Rel-19 topic discussion regarding the charging aspects of energy efficiency.***

# 2 Referencesr

[1] 3GPP TS 22.261: "Service requirements for the 5G system; Stage 1"

[2] 3GPP TR 23.700-66: "Study on Energy Efficiency and Energy Saving"

[3] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)"

[4] 3GPP TS  28.310: "Management and orchestration; Energy efficiency of 5G"

# 3 Rationale

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#### General

To assist the discussion on the charging aspects of energy efficiency, we collect the charging related service requirements by SA1 in TS 22.261 [1], the charging related potential solutions by SA2 in TR 23.700-66 [2] and the energy related KPI collected by SA5 OAM in TS 28.554 [3].

#### Charging related service requirements by SA1

According to the service requirements defined in Clause 6.15a TS 22.261 [1], there are four types of requirement that have potential relevance to the charging aspects of energy efficiency.

- Req #1: Associate energy consumption information with charging information or apply energy credit limit policy

*“Subject to operator’s policy, the 5G system shall support a means to associate energy consumption information with charging information based on subscription policies for services without QoS criteria. It is assumed charging events are assigned a corresponding energy consumption and this is compared against a policy of energy credit limit.” Clause 6.15a.2.2*

- Req #2: Report energy related information as part of charging information

*“The 5G system shall provide a mechanism to include Energy related information as part of charging information.” Clause 6.15a.2.2*

- Req #3: Support different charging mechanisms based on the different energy states

*“The 5G system shall support different charging mechanisms based on the different energy states of network elements and network functions.” Clause 6.15a.3*

- Req #4: Collect charging information associated with serving UEs of other operators for the purpose of saving energy

*“Subject to regulatory requirements and operators’ policies, the 5G system shall enable an operator to temporarily serve UEs of other operators within a geographical area for the purpose of saving energy of the other operators. It is assumed that the 5G system can collect charging information associated with serving UEs of other operators.” Clause 6.15a.6*

#### Charging related potential solutions by SA2

SA2 study is still ongoing with the following three key issues:

- Key Issue #1: Network energy related information exposure

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

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

According to the approved 32 solutions in TR 23.700-66 [2] by SA2#161 in February 2024, we identified 7 solutions that are relevant to the charging aspects of energy efficiency. Here is a list of solutions with brief introduction (for information only).

- Solution #9 proposes to let CHF controls the available energy credit limit of subscribers and is responsible to notify PCF to trigger policy update for a subscriber when credit limit is exceeded. The energy credit may be the daily/monthly enery concumption reaches XX J/WH, or daily/montly energy expenses/phone billings reached XX dollars, or energy efficiency reached a threshold. Nchf\_SpendingLimitControl service shall be enhanced to support this solution. How the CHF track the spending related to energy credit limit is FFS.

- Solution #12 proposes to enhance NWDAF for energy related analytics and expose the output to consumers (e.g. AF, SMF, CHF). If the consumer is CHF, the CHF may record the energy consumption information for charging. The energy consumption information is at various granularity (e.g. UE, PDU Session, Network Slice) over a period of time which can be a value (e.g. in Wh) or a class (e.g. low, medium, high).

- Solution #14 proposes to enhance the subscription information in the UDR by having an Energy Credit Profile and PCF could manage the balance of energy credit units per UE. When UE’s energy credit balance is empty, the UE is either rejected PDU session establishment or being charged at higher service rate based on operator policy. The credit control at PCF is to be justified vs CHF.

- Solution #17 proposes that CN can further process energy related information retrieved from OAM in either fine or coarse granularity. The NWDAF is responsible for the calculation of the energy consumption information for coarser granularities (e.g. per area, per application, per group of UEs, etc.). The SMF is responsible for the finer granularity and relative accurate collection of energy consumption information with the granularity of a PDU Session (or even a QoS Flow). The CHF can receive fine granular and relative accurate energy consumption information a PDU Session (or even a QoS Flow) and can provide energy credit/budget control information to the SMF.

- Solution #19 proposes to allow NG-RAN calculates the PDU session / QoS flow level NG-RAN EC and reports the corresponding energy consumption related information to SMF. SMF reports to the CHF the NG-RAN energy consumption related information. The CHF may use the information for credit limit control or charging purpose.

- Solution #20 proposes to allow RAN reports to the UPF the energy related information per PDU session level. The UPF provide the information to SMF. SMF perform information summarization and report to CHF. The CHF may use the information to generate billing information that takes energy related information into account. The CHF can run an Energy Credit Conversion Algorithm that can enable an energy-credit-based handling of subscribers. The CHF and NWDAF can also classify a UE in different classes of UE Energy Behaviour to determine how to handle the UE from a charging or system behaviour perspective. The CHF and NWDAF can expose information to customers also.

- Solution #30 proposes to perform energy saving in network slice granularity by re-using the NSAC mechanism to adjust the maximum number of UEs or PDU sessions based on the monitored or collected energy state or consumption per S-NSSAI. The NSACF may expose energy related information to CHF and other NFs, including: whether the NSAC energy threshold is exceeded for a network slice, which NSAC energy threshold is exceeded/the next NSAC energy threshold if the current one is exceeded.

#### Energy related KPI collected by SA5 OAM

The network energy related KPI that can be collected by OAM is specified in TS 28.554 [3] and TS 28.310 [4], as summarized in Table A.1.1-1 TR 23.700-66 [2].

Table A.1.1-1: Network energy related information collected by OAM

|  |  |  |
| --- | --- | --- |
| KPI category | Description | Reference in TS 28.554 [3] |
| Energy consumption  | Energy Consumption of a gNB | 6.7.3.4.2 |
| related information  | Energy Consumption of the NG-RAN | 6.7.3.4.1 |
| reflected by Energy  | Energy Consumption of the 5GC | 6.7.3.2.1 |
| Consumption (EC) | Energy Consumption of a 5G Network Function | 6.7.3.1.1 |
|  | Estimated Energy Consumption of a Virtualized Network Function | 6.7.3.1.2 |
|  | Energy Consumption of a Physical Network Function (PNF) as well as other Power, Energy, Environmental (PEE) measurements | Clause 5.1.1.19.2 of TS 28.552 [10] |
|  | Energy Consumption of a network slice | 6.7.3.3 |
| Energy efficiency  | Energy Efficiency of the NG-RAN data | 6.7.1 |
| related information | Energy Efficiency of the 5GC | 6.7.4.1 |
| reflected by Energy Efficiency KPIs | Energy Efficiency of a network slice | 6.7.2 |

#### Discussion for SA5 Charging Group

**Observations:**

Based on the current progress of SA1, SA2 and SA5 OAM, the following aspects may be considered by the charging of energy efficiency.

- The energy related charging scenarios and requirements specified by SA1 in Clause 6.15a TS 22.261 [1].

- The type of energy related information, e.g. energy consumption, energy efficiency, energy credit, renewable energy ratio, carbon emission.

- The unit type for energy consumption, e.g. a value (e.g. in Wh or J) or a class (e.g. low, medium, high).

- The granularity of energy consumption information.

- granularities that are being studied by SA2, e.g. RAN, Core Network, Network Slice, Network Funtion, DNN, Application, Area, group of UEs, UE, PDU session, QoS flow.

- granularities that can be collected by SA5 OAM, e.g. gNB, NG-RAN, 5GC, 5G NF, Virtualized NF, Network Slice.

- The mechanism of energy credit limit control is debatable.

**Identified Key Issues:**

Based on the observations, we identified a few key issues that requires study from the charging perspective.

- The SA5 Charging group shall study the type of energy related information that can be used for charging purpose.

- The SA5 Charging group shall study the unit type and granularity of energy consumption that can be used for charging purpose.

- Whether the energy credit limit control should be studied depends on SA2 conclusion.

**Proposed Study Objectives：**

1. The charging scenarios and requirements for energy efficiency

2. The key issues derived from the energy efficiency charging scenarios, including, but not limited to:

- The type of energy related information to be collected as charging information from different CTF for different scenario.

- The unit type and granularity of energy consumption in charging information.

- Whether energy credit limit is needed.

4. The charging solutions for energy efficiency.

# 4 Detailed proposal

Propose to start the Rel-19 study on the charging aspects of energy efficiency, based on the proposed study objectives.