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**Title: Interim evaluation and conclusion for KI3**

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*Abstract of the contribution: This contribution tries to provide the Interim evaluation and conclusion for KI3.*

# Introduction

This paper is trying to evaluate the solutions captured for KI#3(5GS enhancements for network energy saving and efficiency), provide the conclusions for the KI#3 based on the captured solutions.

# 2 Proposal

It is proposed to capture the following solution in TR 23.700-66.

Start of Changes

## 7.X Evaluation of solutions for Key Issue #3: 5GS enhancements for network energy saving and efficiency

There are 11 solutions (solutions#3, #5, #11-#15, #20, #29, #30 and #32) proposed to this KI according to the mapping table 6.0-1. Overall, these solutions can be classified to the following 3 aspects:

- NWDAF-Based Energy Analytics for network energy saving and efficiency (Sol#3, #5, #11, #12, #20 and #32)

- Enhancements on NF (re)selection based on energy related information (Sol#29)

- Enhancements on existing operations and procedures for energy saving and energy efficiency (#13, #14, #15, #30)

**NWDAF-Based Energy Analytics for network energy saving and efficiency**:

- Captured solutions (Sol#3, #5, #11, #12, #20 and #32) basically have similar idea to leverage the analysis and prediction functionalities of the NWDAF for network energy saving and efficiency with following adaptations:

- Consumers e.g. AF, PCF or NEF, requests or subscribes to analytics for energy related analytics from NWDAF and provides the input information e.g., table 6.12.2.1-3.

- After that, the NWDAF collects and analyses the data from multiple sources including e.g, 5GC NFs, OAM,

- NWDAF provides various analytics including e.g., energy info, UE behaviour, network performance, service experience (table 6.12.2.3-1, 6.12.2.3-2) to the consumers.

- Consumers e.g. AF, PCF or NEF, do actions according to the analytics from NWDAF on the network energy saving and efficiency operations (e.g, AM policy, SM policy determination, energy saving configuration).

**Enhancements on NF (re)selection based on energy related information**:

- Sol#29 proposes to extend NF profile at NRF to include the energy related information (e.g., Energy Efficiency Level Energy States) for the registered NF. During the NF Discovery procedure, energy-related NF discovery query parameters from consumer NF are considered for the candidate Target NF filtration for the NRF, consumer NF then takes the new energy related information from the NF profiles (defined in Table 6.29.2-1) discovered from NRF into account for a target 5GC NF selection. Sol#29 also provides some examples on NF selection considering energy related information, e.g., the AMF selection, SMF selection and UPF (re)selection. In addition, Sol#19 also includes a NF selection based on time-based energy states/information from NRF, which requires the energy related information to associate to time, or NFs can directly interact their energy information for NF selection, but this potentially needs to interacts with multiple NFs.

**Enhancements on existing operations and procedures for energy saving and energy efficiency**:

- Sol#13 proposes the user plane path adjustment based on energy-related and load information of the UPFs. In this solution, a new function EECF is introduced for the energy-related and load information of the UPFs collection, after that EECF configures the N9 traffic steering paths in SMF to reroute the traffic to new UPF. The EECF also asks PCF to update PCC rules according to the optimized N9 traffic steering policies. These related processes need the EECF have an overall view for multiple UPFs and multiple impacts on SMF and PCF.

- Sol#14 proposes there is a Energy Credit units as UE subscription info in the UDR, PCF retrieves the UE's Energy Credit from UDR and check it whether the Energy Credit units are used up before PDU session establishment. At the PDU session release, the PCF updates the Energy Credit units. When there is not Energy Credit units left, the PDU session is rejected with no Energy Credit left cause value. it is not clear how the PCF obtain the Energy consumption and updates the Energy Credit left in UDR.

- Sol#15 proposes that the AMF can decide Access and Mobility parameters based on network energy control information, and SMF can decide Session Management parameters related based on network energy control information, AM policy and SM policy derivation need to take the requirements of network energy saving into account for the PCF. A new NF is introduced for AMF and the SMF to request network energy control information. After that, the AMF or SMF provides the energy saving assistance information in N2 message to the NG-RAN for NG-RAN performs energy saving operations.

- Sol#30 performs the network optimization for energy saving per S-NSSAI, existing NSAC mechanism is re-used taking the monitored or collected energy state or consumption per S-NSSAI by the EECF, NWDAF, and/or OAM, into account for the limitation on maximum number of UE or PDU session. In this solution, New NF is introduced to monitor energy states per S-NSSAI and provides the determined the maximum number of UEs, maximum number of PDU sessions for S-NSSAI(s) based on AF input, local operator policy or collected energy information to the NSACF. The NSACF also can directly receive the current level of energy consumption analytics or measurements from the NWDAF and OAM respectively and admit based on energy consumption threshold set based on agreement with the network slice customer.

Next change

## 8.X Conclusion for Key Issue #3: 5GS enhancements for network energy saving and efficiency

Following interim conclusions for KI#3 are proposed for normative work:

**For Enhancements on NF (re)selection based on energy related information**, Sol#29 can be used as baseline for normative work with following principles:

- NF profile is extended to support energy aware (re)selection.

- Existing NF profile parameters may be updated to reflect energy related states and support energy aware (re)selection.

- NF service consumer considers the new energy related information from the NF profiles discovered from NRF for the target NF selection.

Editor's note: Additional energy related information elements included in the NF profile is FFS.**Enhancements on existing operations and procedures for energy saving and energy efficiency**, following principles can be considered in normative work:

- Access management and session management enhancement e.g., AM policy and SM policy generation by PCF taking the energy related information/Analytics into account.

NOTE: Policy control enhancement is relative to conclusion of KI#2.

- The UP path of PDU sessions e.g., DNAI, UPF (re-)selection maybe adjusted based on energy related information.

- Energy saving control in slice granularity is introduced:

 - If NSAC is supported, Maximum number of UEs and maximum number of PDU sessions for a network slice is subject to energy related information/Analytics.

 - If NSAC is not supported, determination of accept/reject of requested S-NSSAIs or PDU session, and modification/release of PDU session are subject to energy related information/Analytics.

**For NWDAF-Based Energy Analytics for network energy saving and efficiency**, following principles can be considered in normative work:

- NWDAF is taken as the role of energy related analysis/prediction/statistics.

- New network data analytics event for energy saving and efficiency are needed, and the granularity for analytics includes at least NF level, slice level, UE level, PDU session level and QoS flow level.

- The network energy related analytics can be provided to PCF/AMF/SMF/EECF for network energy related control.

- Input/output Data of Energy Related Analytics and Energy Related Output Analytics can be further adjusted in normative work. (Yellow highlight deleted?)

End of Changes