**3GPP TSG-SA5 Meeting #148-e *S5-233458***

**e-meeting,** **17 -25 April 2023.**

**Source: Huawei, Deutsche Telekom, China Mobile**

**Title: pCR TR 28.910 Add potential solutions for Key Issue #6-1: Autonomous network level for RAN energy saving use case**

**Document for: approval**

**Agenda Item: 6.7.1.4**

# 1 Decision/action requested

***The group is asked to discuss and approval.***

# 2 References

[1] 3GPP draft TR 28.910: “Management and orchestration; Study on enhancement of autonomous network levels v0.4.0”.

[2] 3GPP TS 28.100: "Management and orchestration; Levels of autonomous network"

# 3 Rationale

In TR 28.910 [1], the workflow and classification of autonomous network level for RAN energy saving is defined, however the MnS requirements and solutions for RAN energy saving is missing. This contribution proposes to add MnS requirements and solutions for RAN energy saving.

# 4 Detailed proposal

It proposes to make the following changes to TR 28.910[1].

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| **1st Change** |

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 28.310: "Management and orchestration; Energy efficiency of 5G"

[3] 3GPP TR 28.813: "Management and orchestration; Study on new aspects of Energy Efficiency (EE) for 5G"

[4] 3GPP TS 28.100: "Management and orchestration; Levels of autonomous network"

[5] 3GPP TS 28.312:" Management and orchestration; Intent driven management services for mobile networks"

[6] 3GPP TS 28.104: "Management and orchestration; Management Data Analytics"

[7] 3GPP TS 28.532: "Management and orchestration; Generic management services".

[8] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[9] 3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

[10] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[11] 3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".

[12] 3GPP TS 28.313: "Management and orchestration; Self-Organizing Networks (SON) for 5G networks".

[13] 3GPP TS 28.535: "Management and orchestration; Management services for communication service assurance; Requirements".

[14] 3GPP TS 28.105: "Management and orchestration; Artificial Intelligence / Machine Learning (AI/ML) management".

[X] 3GPP TR 28.912: " Study on enhanced intent driven management services for mobile networks V1.2.0".

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| **2nd Change** |

6.1 Key Issue# 6-1: Autonomous network level for RAN energy saving use case

6.1.1 Description

6.1.1.1 Use case

The massive deployment of mobile network has brought about a rapid increase in energy consumption. The energy cost and carbon emission also become great challenges for the NOP. Operators are aiming at reducing power consumption in 5G networks to lower their OPEX with energy saving solutions. RAN energy saving represent the energy saving aspects (including capacity booster cell - gNB is fully or partially overlaid by the candidate cell(s) in TS 28.310[2], area based energy saving in TR 28.813[3], and other energy saving aspects) for RAN. So, introducing the autonomous network level for energy saving will benefit for operator to achieve the full autonomy goal step by step and have clear view on which typical issues can be addressed by telecom system in corresponding steps. The requirements for each autonomous level for energy saving are different. So it is important to introduce the autonomous network level definition for energy saving.

The concrete energy saving solutions should not be defined in this document. This key issue only focus on autonomous network level defined for energy saving.

6.1.1.2 Workflow

**Intent handling:**

- **Task A**: RAN energy saving control information generation and determination. The tasks of generating and determining the RAN energy saving related control information (e.g., threshold value of high energy consumption issue analysis) and RAN energy saving actions generation) based on received RAN energy saving intent (e.g. expectation on energy saving targets in the specified areas with considering network performance (e.g. RAN UE throughput) assurance, as well as the frequencies and RATs to be considered).

- **Task B**: RAN energy saving intent fulfilment evaluation. The tasks of evaluating RAN energy saving intent fulfilment information (e.g. energy saving targets (e.g., target RAN energy consumption and RAN UE throughput in the specified area are satisfied or not).

**Awareness:**

- **Task C**: RAN energy saving related information collection. The tasks of collecting energy efficiency measurements (e.g., Data Volume measurement, PEE (Power, Energy and Environmental) measurements, network performance data (e.g., RAN UE throughput), network configuration data (e.g. energy saving state), environment data (e.g. electronic map, site location) and alarm data.

**Analysis:**

- **Task D**: RAN energy saving issues identification. The tasks of identifying energy saving issues (including energy efficiency issues (e.g., high energy consumption, low energy efficiency) as TS 28.104 [6] described and performance issue (e.g. low RAN UE throughput) which may be caused by energy saving actions.

- **Task E**: RAN traffic and performance prediction. The tasks of analysing current and historical RAN traffic load (e.g., PRB utilization rate, RRC connection number, etc.) and network performance (e.g. RAN UE throughput) to predict the traffic load trend and network performance trend over a period of time which could be used as references for energy saving solutions, analysis evaluation and determination.

- **Task F**: RAN energy saving issue demarcation. The tasks of analysing the RAN energy saving issues and determine the RAN energy efficiency issue categories (e.g., high energy consumption, low energy efficiency) and corresponding area (which can be identified by geographical area, RAN NEs or cells), as well as determining the performance issue is caused by energy saving actions.

- **Task G**: RAN energy saving issue root cause analysis. The tasks of analysing the root cause of the RAN energy saving issue, including RAN energy efficiency issues and performance issues caused by energy saving actions).

- **Task H**: RAN energy saving solutions analysis. The tasks of generating the recommended energy saving solution (e.g. activate or deactivate energy saving state for the energy saving objects, adjust the carrier configuration or transmit power, adjust the energy saving thresholds for different service types.) which can address the identified energy saving issues.

**Decision:**

- **Task I**: RAN energy saving solutions evaluation and determination. The tasks of evaluating the energy saving gains, as well as evaluating the RAN performance if such energy saving actions to be executed, and determining the optimal energy saving solutions (i.e. a set of energy saving actions) to be executed.

**Execution:**

- **Task J**: RAN energy saving solutions execution. The tasks of adjusting the RAN energy saving actions (e.g., activate or deactivate energy saving state for the energy saving objects, adjust the carrier configuration or transmit power, adjust the energy saving thresholds for different service types.) which can address the identified energy saving issues).

6.1.1.3 Classification of autonomous network level

**Level 0:**

- All the tasks in the RAN energy saving workflow (Task A, Task B, Task C, Task D, Task E, Task F, Task G, Task H, Task I, Task J) are accomplished by human.

**Level 1:**

- Telecom system executes the part of RAN energy saving solutions execution tasks (e.g. activate or deactivate energy saving state for the energy saving cell) based on the specified RAN energy saving solutions (Task J). Telecom system also can execute the tasks of collecting part of energy saving related information (including energy efficiency related information (including Data Volume measurement, PEE (Power, Energy and Environmental) measurements etc.), network performance data, network configuration data and alarm data) based on the specified collection control information (Task C). At this level, telecom system can assist human to improve the execution and awareness efficiency for RAN energy saving.

- All the other tasks in the RAN energy saving workflow (Task A, Task B, Task D, Task E, Task F, Task G, Task H, Task I) are accomplished by human.

**Level 2:**

- Compared to Level 1, telecom system additionally executes the tasks of RAN energy saving issues identification, part of RAN energy saving demarcation and RAN energy saving issue root cause analysis for the energy efficiency issues based on the specified RAN energy saving issue analysis control information (Task D, Task F, Task G). In this level, telecom system also can execute the task of collecting RAN energy saving related information (including energy efficiency data, performance data, network configuration data, environment data, alarm data) based on the specified collection control information (Task C), The tasks of RAN energy saving solutions execution (Task J) are fully accomplished by telecom system. At this level, telecom system can assist human to achieve the closed loop for RAN energy saving based on human defined control information.

- All the other tasks in the RAN energy saving workflow (Task A, Task B, Task E, Task H, Task I) are accomplished by human.

**Level 3:**

- Compared to Level 2, telecom system additionally executes the tasks of RAN energy saving solutions analysis (Task H) and RAN energy saving solutions evaluation and determination (Task I) based on the specified RAN energy saving solution analysis and decision control information. In this level, telecom system also can execute the tasks of RAN traffic load and performance prediction (Task E) based on the specified RAN traffic load and performance prediction control information. The tasks of RAN energy saving related information collection (Task C), RAN energy saving issues identification (Task D) and RAN energy saving demarcation (including RAN energy efficiency issues demarcation and RAN performance issues caused by energy saving actions) (Task F) are fully accomplished by telecom system. At this level, the telecom system can achieve the closed loop automation for RAN energy saving based on the human defined control information.

- All the other tasks in the RAN energy saving workflow (Task A, Task B) are accomplished by human.

**Level 4:**

- Compared to Level 3, the telecom system additionally executes the tasks of RAN energy saving control information generation and determination (Task A), and RAN energy saving intent fulfilment evaluation (Task B) based on received RAN energy saving intent and intent handling control information. The tasks of RAN energy saving issue root cause analysis (including root cause analysis for energy efficiency issues and performance issues caused by energy saving actions) (Task G), RAN energy saving solutions analysis (Task H), RAN energy saving solutions evaluation and determination (Task I), and RAN traffic load and performance prediction (Task E) are fully accomplished by telecom system. At this level, telecom system can achieve the intent driven closed loop automation for RAN energy saving based on human defined intent handling control information.

- The intent handling control information maybe pre-defined and specified by human to assist the telecom system.

**Level 5:**

- Telecom system can autonomously execute the entire workflow of RAN energy saving for all scenarios, which means the telecom system can achieve the full autonomy for RAN energy saving for full scenarios.

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**Figure 6.1.2.2-1 Autonomous network level for RAN energy saving scenario**

#### 6.1.1.X Autonomy capability description for RAN energy saving

**Level 1 for RAN energy saving:** The 3GPP management system has the following autonomy capabilities:

* Adjust network based on the specified energy saving solution.
* Collect energy saving related information (including energy efficiency related information (including Data Volume measurement, PEE (Power, Energy and Environmental) measurements etc.), network performance data, network configuration data and alarm data).

**Level 2 for RAN energy saving:** The 3GPP management system has following autonomy capabilities:

- Identify the RAN energy saving issues based on the specified RAN energy saving issue demarcation control information.

- Demarcate the RAN energy saving issue (including the RAN energy efficiency issue categories (e.g., high energy consumption, low energy efficiency) and corresponding area) based on the specified RAN energy saving issue demarcation control information.

- Analyse the root cause of RAN energy saving issue (including RAN energy efficiency issues and performance issues caused by energy saving actions) based on the specified RAN energy saving issue analysis control information.

**Level 3 for RAN energy saving:** The 3GPP management system has the following autonomy capabilities:

- Generate the recommended energy saving solution based on specified RAN energy saving adjustment control information.

- Evaluate the recommended RAN energy saving solution and determine the optimal energy saving solutions to be executed based on specified RAN energy saving adjustment decision control information.

- Predict the traffic load trend and network performance trend.

**Level 4 for RAN energy saving:** The 3GPP management system has the following autonomy capabilities:

- Determine or update RAN energy saving control information according to RAN energy saving intent based on specified intent translation control information.

- Evaluate RAN energy saving intent fulfilment result based on specified intent evaluation control information.

**Level 5 for RAN energy saving:** The 3GPP management system has the following autonomy capabilities:

- Generate the RAN energy saving intent translation and evaluation control information.

#### 6.1.1.Y Potential MnS requirements

**REQ-ANL-RANES-Level\_1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the RAN energy saving solutions and RAN energy saving related information collection control information.

**REQ-ANL-RANES-Level\_2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the control information of RAN energy saving issues identification, RAN energy saving issue demarcation, RAN energy saving issue root cause analysis and obtain the corresponding analysis result.

**REQ-ANL-RANES-Level\_3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the RAN energy saving solutions analysis control information and obtain the RAN energy saving solution to be executed.

**REQ-ANL-RANES-Level\_4** The 3GPP management system shall have the capability allowing its authorized consumer to specify the RAN energy saving intent and obtain the fulfilment information of the RAN energy saving intent.

### 6.1.X Potential solutions

Based on the solutions for MnS requirements of autonomous network level for RAN energy saving defined, following are the potential enhanced solutions description for generic MnS requirements of autonomous network level for RAN energy saving.

Note: the solutions below are not used to evaluate the autonomous network level, which are MnS solutions to support MnS requirements for 3gpp management system derived from autonomy capability of each level.

Regarding the **REQ-ANL-RANES-Level\_1,** the NR NRM (e.g. NRCellCU, beam, and NRCellRelation, CESManagementFunction IOC) defined in TS 28.541[8] are used to represent network adjustment solution. The RSRP measurements (e.g. SS-RSRP), RSRQ measurements (e.g. SS-RSRQ) , SINR measurements (e.g. SS-SINR) defined in TS 28.552 [6], RSRPs of the serving cell and neighbour cells, and UE location in MDT reports, power, energy and environmental (PEE) measurements (e.g. PNF Energy consumption) and data volume measurements defined in TS 28.552[10] and performance measurements for gNB (e.g. UE throughput) are used to represent the RAN energy saving related information.

Regarding the **REQ-ANL-RANES-Level\_2,** the MDA MnS defined in TS 28.104 [6] can be used. The Analytics output can represent RAN energy saving issue identification and RAN energy saving issue demarcation result. The "EnergyEfficiencyProblematicObject " and "EnergyEfficiencyProblemType " of analytics output for energy saving analysis in TS 28.104[6] can be used to obtain the RAN energy saving issue and corresponding demarcation result.

Regarding the **REQ-ANL-RANES-Level\_3,** the CESManagementFunction IOC defined in TS 28.310 [2] can be used to specify the RAN energy saving solutions analysis control information, RAN energy saving solutions evaluation and determination control information.

Regarding the **REQ-ANL-RANES-Level\_4,** The RadioNetworkExpectation defined in TS 28.312[5] can be used as the intent expectation for RAN energy saving. The attribute "targetCondition ", " targetValueRange ", " targetContexts " and "rATContext" in ObjectContext can be used as expected setting parameters. The attribute "weakRSRPRatioTarget", "lowSINRRatioTarget", "aveULRANUEThptTarget" and "aveDLRANUEthptTarget" in ExpectationTarget can be used as expected network capacity and performance targets. The “RanEnergyEfficiencyTarget " and “RanEnergyConsumptionTarget” in TS 28.912[X] The expected can be used as expected setting parameters for RAN energy saving.

The "targetfulfillmeInfo" of RadioNtworkExpectation defined in TS 28.312[5] can be used to deliver the RAN energy saving intent fulfilment information.

Editor’s Note: The difference of Level 3 and Level 4 for RAN energy saving use case needs to be further clarified.

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| **End of Changes** |