**3GPP TSG-SA5 Meeting #157 *S5-245620***

Hyderabad, India, 14 - 18 October 2024

**Source: Nokia**

**Title: Rel-19 pCR TR 28.880 Add use case on AI/ML assisted energy saving**

**Document for: Approval**

**Agenda Item: 6.19.20**

# 1 Decision/action requested

***The group is requested to discuss and approve the pCR below.***

# 2 References

[1] 3GPP TR 28.880: " Study on energy efficiency and energy saving aspects of 5G networks and services"

# 3 Rationale

This contribution proposes to add a new use case for AI/ML assisted energy saving.

The inference function has been introduced in TS28.105 and it is agreed that Energy Saving is one use case for which for AI/ML inference functions may be instantiated. This pCR adds the configurable features and requirements for AI/ML-based Energy Saving Functions.

This is key issue related to the following objective that is described in FS\_Energy\_OAM\_Ph3.

* WT-1.3 Study new use cases, requirements and solutions for energy efficiency and energy saving, applying to NG-RAN and/or 5GC and/or network slicing, (including but not limited to intent based, analytics based and AI/ML assisted energy saving)

# 4 Detailed proposal

The following changes are proposed for TR 28.880[1].

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| **1st Change** |

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

CE Carbon Emission

CEE Carbon Emission Efficiency

CEF Carbon Emission Factor

CPC Cell Proximity Coupling

REF Renewable Energy Factor

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| **Next Change** |

## 5.A Use case #<A>: AI/ML-assisted Network Energy Saving: Cell-Proximity-based Energy Saving

### 5.A.1 Description

TS 28.310 defines a capacity booster cell which can be deactivated when the load is low. For a capacity booster cell to be deactivated, a coverage cell should have adequate overlap with the booster cell to make sure that deactivation of the booster cell does not lead to a overage hole. A coverage cell may have several capacity booster cells that can be deactivated. The energy saving function needs to select the best among the capacity booster cells.

To activate or deactivate cells, an energy saving function (be it the Domain-centralized ES or the distributed ES function, see TS 28.310 [12]) computes the degree of overlap among the cells to ensure that the coverage of a deactivated cell (the capacity booster cell) is compensated by another cell (called the coverage cell). The energy saving MnS producer can inform the MnS consumer of the computed degree of neighborliness among any coverage cell and its neighbor target cell (i.e. the candidate capacity booster cell). The degree of neighborliness can be termed as the Cell Proximity Coupling (CPC). The CPC thus measures the degree to which a capacity booster cell overlaps with the coverage cell.To optimize the selection of cells to be switched off or on, the energy saving function needs to group cells according to two categories - the coverage cells which are not switched off and provide primary coverage and capacity booster cells which only enhance capacity and can thus be switched off when the load is low. Given the degree of neighborliness among cells, the energy saving function informs the MnS consumer of the computed cell categories, e.g. incase the MnS consumer does not agree with certain capacity booster cells being switched off. Moreover, the energy saving function can inform the MnS consumer about the group of cells that need to be treated together (say called the Energy Saving Cell Group), which applies if cells need to be deactivated in a particular order as the load in the group reduces.

When selecting cells to deactivate, the energy saving function considers the load in a set of cells to then decides the most optimal cell(s) to be deactivated and the order in which they can be deactivated. Where the energy saving function does not have the capability to compute the Energy Saving Cell Group, the MnS consumer is enabled to configure the Energy Saving Cell Group to the energy saving function. Moreover, the energy saving function needs to inform the MnS consumer of the cell switch-off order which is the capacity booster cell’s rank in the switch off/on process indicating the order in which the cells in a given area shall be switched off. The MnS consumer can be enabled to request for such a switch-off order.

Given the cell switch-off order, the energy saving function routinely compares the load in the set of cells (the Cell Group load) to the low and high load thresholds to decide if activation or deactivation can be executed. Where the energy saving function does not have the capability to compute the cell switch-off order, the MnS consumer can be enabled to configure the cell switch-off order. Moreover, the MnS consumer can be enabled to configure the activation or deactivation load thresholds.

One or more AIML models utilizing configuration and coverage information of the cells as input may be used to learn the Cell Proximity Coupling among the cells; the grouping of cells; the assinmnet of cells as either coverage or capacity booster cells and the recommendation of a switch off/switch on order among the cells.

~~Editor’s note: Details on AI/ML handling and impacts is FFS.~~

### 5.A.2 Potential requirements

**REQ-AIML\_NES-01:** The 3GPP management system should have a capability allowing an authorized MnS consumer to configure and receive information on the Cell Proximity Coupling (CPC), which is the degree of neighborliness among any candidate neighbor cells.

**REQ-AIML\_NES-02:** The 3GPP management system should have a capability allowing an authorized MnS consumer to configure to and receive information on the group of cells that need to be treated together (called the Energy Saving Cell Group) when selecting cell to be activated or deactivated.

NOTE 1: Configuration is needed only if the energy saving function does not compute the Energy Saving Cell Groups.

**REQ-AIML\_NES-03:** The 3GPP management system should have a capability allowing an authorized MnS consumer to configure and receive information on the cell categories indicating coverage cells and capacity booster cells.

NOTE 2: coverage cells are those that provide primary coverage and are not switched off while capacity booster cells are those which only enhance capacity and can thus be switched off when the load is low.

**REQ-AIML\_NES-04:** The 3GPP management system should have a capability allowing an authorized MnS consumer to configure and receive information on the cell switch-off order which is the capacity booster cell’s rank in the switch off/on process indicating the order in which the cells in a given area should be switched off.

NOTE 3: Configuration is needed only if the energy saving function does not compute the cell switch-off order.

**REQ-AIML\_NES-05:** The 3GPP management system should have a capability allowing an authorized MnS consumer to configure the switch-on and switch-off load thresholds.

### 5.A.3 Potential solutions

#### 5.A.3.1 Potential solution #A: AI/ML-assisted Network Energy Saving

##### 5.A.3.1.1 Introduction

In this potential solution an authorized consumer derives the CPC or triggers the computation of the CPCs for a set of cells which they then configure on to the set of cells. The MnS consumer can then compute or trigger computation of membership of an energy saving group. Based on these the MnS consumer can then compute, or trigger computation of the cell switch off order which can then be configured to the individual cells or can be executed by an energy saving function.

##### 5.A.3.1.2 Description

This potential solution proposes the following:

Introduce an IOC for an AI/ML inference function for energy saving optimization

- Introduce in AI/ML inference function IOC an attribute representing the Cell Proximity Coupling (CPC) for each gNB,

- the Cell Proximity Coupling among the cells can be learned by an AI/ML function utilizing configuration and coverage information of the cells. For example, it can be the output of an AI/ML based MDA capability

- Introduce an IOC representing a group of cells that should be managed together for energy saving purposes. It can be a generic grouping IOC (e.g., GenericCollection) or a specific IOC for an energy saving purpose called EnergySavingCellGroup (derived from GenericCollection IOC).

- The group can be configured by the operator

- Alternatively the group can be learned by an AI/ML function utilizing the Cell Proximity Coupling among the cells

- Introduce attributes on the EnergySavingCellGroup IOC representing the set of coverage and capacity booster cells. They can respectively be called coverageCells and capacityBoosterCells.

- Introduce an attribute on the EnergySavingCellGroup representing the recommended cell switch off order.

 - The cells belonging to each of the two sets can be learned by an AI/ML function utilizing the Cell Proximity Coupling among the cells and the configuration and coverage information of the cells.

Note: this may also be achieved by using the property ‘IsOrdered = T’ for the list of candidate cells. A note may be added indicating that the first one in the list shall be switched on/off firstly (or vice versa).

### 5.A.4 Evaluation of potential solutions

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| **End of change** |