**3GPP TSG SA WG 1 Meeting #107 S1-242420**

**Maastricht, The Netherlands, 19 – 23 Aug 2024** *(revision of S1-242402, S1-242029)*

**Source: Nokia, China Telecom, Samsung**

**pCR Title: 22.883 pCR on New Use case on tolerance to QoS degradation due to network energy saving**

**Draft Spec: 3GPP TR 22.883**

**Agenda item: 7.2 (FS\_EnergyServ\_Ph2)**

**Document for: Approval**

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*Abstract:* *This pCR proposes requirements to better control service adjustments targeting network energy saving.*

**1. Introduction**

This pCR proposes a new use case related to UEs’ tolerance to service adjustments caused by network energy saving actions, which could vary based on subscription policies, the target service performance characteristics, or potential incentives.

**2. Reason for Change**

The main problem with known energy saving techniques is that it is unclear what tradeoff among power saving and QoS degradation is acceptable. Depending on load and network deployment, some changes to configuration due to energy saving cannot be adhered to without service/QoS degradation.

UEs may have different requirements with respect to QoS degradation when it comes to save network energy, especially when contractual SLAs are in place.

Yet users may be more tolerant if stimulated by some incentive, being it charging-related or service-related, thus allowing the network to perform actions targeting higher energy savings.

The present use case introduces different situations – and the associated requirements - for which the network willing to save energy checks for UE-acceptable “ES actions” before applying them.

Rev2402

- [Huawei, Futurewei] removed ES action formal definition

- [Huawei] removed UE energy trigger

- [Samsung] better distinguished charging and incentives aspects

- [Apple] reworded “identify” UEs to “detect” UEs

- [China Telecom] Merge of S1-242202 as follows: PR#1 into PR#3, PR#2 into PR#5

Rev2420

* Removed PR#2 and PR#4
* Reworded the concept of tolerance as related to QoS policy
* Updated use case description accordingly
* Removed details related to incentives in last NOTE
* Added Samsung as cosigner

**3. Conclusions**

None.

**4. Proposal**

It is proposed to agree the following use case and add it to TR 22.883.

FIRST CHANGE (NEW TEXT)

## 5.x Use case on tolerance to QoS degradation due to network energy saving

### 5.x.1 Description

By default, mobile networks seek least energy consumption. Network energy saving techniques try to optimize energy consumption without QoS degradation. Sometimes, they may identify further energy saving opportunities, but at the cost of QoS degradation. Actions from the network in order to save energy may target one or more UEs: in some cases, if a UE is generating very high energy consumption on a base station due to its location/radio conditions and heavy traffic, it may alone be identified by the network as potential candidate to propose an incentive in turn of service performance adjustments that could lower such energy consumption from a network perspective.

The main problem is that it is unclear what tradeoff is acceptable (e.g. tolerated by the application / end user) between energy saving and service adjustments, such as QoS degradation. Different kinds of behaviors are envisioned:

* not tolerant to any QoS degradation
* tolerant to some QoS degradation based on QoS policy

Tolerance to QoS degradation can vary case by case depending on the current UE/user activity, in particular based on the specific application/service. QoS degradation could take the form of a change in 5QI to accommodate more relaxed KPIs for example for conversational or streaming video services in particular when using GBR. However, there is a limit to a tolerable QoS degradation, which still needs to satisfy policy rules or operator policies in place for a service, even in degraded conditions. Note that this use case does not apply to best effort traffic, as the network would not be able to evaluate an alternative configuration of the QoS attributes.

Furthermore, users may be more tolerant if stimulated by some incentive, being it charging-related or service-related, thus favoring the network to perform network saving actions. In general, the network should trace energy saving evidence at the cost of QoS degradation, to avoid reducing the QoS performance to the minimum without any compensation from UE/user side.

 The 5G network can then perform actions to reduce service performance in order to save energy, taking into account:

* The service performance characteristics (e.g. reduced/augmented bitrate, latency, 5QI) that would result from the energy-saving action;
* The QoS policy associated with the impacted service;
* Incentives: Charging impacts (e.g. lower energy credit consumption rate, rewarded credits), or future dynamic adjustments of the provided communication service (e.g. temporary improved QoS or service performance);
* Applicability conditions, which can be (semi-) permanent, or limited in terms of e.g., applicable network slice, time or area, application/service. Such conditions can also refer to explicit actions from UEs and/or users (e.g. move to another location, stay at a given location for a minimal duration).

Before adjustments are applied to service performance, the 5G network can check the associated QoS policies.

### 5.x.2 Pre-conditions

Tom is a site manager at a construction company. His company has subscribed a QoS-based 5G service for their mobile rugged devices, which are used for various professional tasks.

Their fleet of professional devices is optimized to prioritize QoS performance operation mode. However, they can relax their QoS requirements for regular video calls under certain conditions (e.g. limited duration).

Tom’s mobile network operator cares about energy saving and runs optimization algorithms to this end. In some cases the algorithms allow for saving without any QoS degradation, but in other cases, their recommendations would potentially degrade the QoS of some UEs. This results in one or more candidate “ES actions” that could save more or less energy on the network side, whilst impacting differently the service performance of some session.

### 5.x.3 Service Flows

1. Tom goes for a site inspection with his professional rugged tablet. As the inspection goes on, he notices some cracks in the concrete of foundations and decides to use its RemoteExpertise app to interact with one of the few remote experts of his company on video to understand the potential risks. Based on Tom’s subscription, this application leverages a dedicated slice.
2. At some point during this video/AR session, the 5G network wants to save energy locally (e.g. based on energy price or supply mix change during some time period and some algorithm suggesting energy saving opportunities), which would degrade the QoS of UEs it is serving in that area. Based on internal logic, the network could for example take one of the following actions that could potentially impact UEs:
	* allow the network to switch off the capacity cell, i.e. move Tom under the coverage layer,
	* remove the video flow and only keep the audio flow
	* degrade the QoS (e.g. by adjusting PDB/PER) of the video flow, probably resulting in lower resolution/quality.

When checking the tolerance indication of the QoS policy associated with the ongoing session, the network identifies whether these example (or other) actions comply with the policy associated with the subscriber.

1. Tom is now having his weekly video call on his rugged tablet with his boss Alice. Part of it includes a tour of the construction site to let her see the progress. As the site building rises up, coverage quality varies across the site but still its QoS contract allows him to have good quality video call. However from a network operator perspective, such QoS is costly to maintain around the site.
2. After 10mn of high-quality video call, as Tom’s UE traffic is quite resource-consuming, the network tries again to identify opportunities to save energy. All actions to be taken by the network are checked against the tolerance indication of the QoS policy associated with this new ongoing video session before applying them. In this case, a particular action taken (e.g. remove the video flow and only keep the audio flow) is acceptable and thus can be applied. It is entirely possible that the network selects a different action, e.g. based on the potential to save more energy, as long as it complies with the policy and its conditions. This could also lead to no action complying with the policy.

### 5.x.4 Post-conditions

Tom continues to have a high-quality service despite some seldom notifications when his mobile network operator degrades QoS to save energy. In turn, his network operator manages to keep its energy consumption quite low over its serving area and attractive subscription plans despite providing good QoS.

### 5.x.5 Existing features partly or fully covering the use case functionality

The QoS Parameter Notification control method allows SMF to indicate whether notifications are requested from the NG-RAN when the "GFBR can no longer (or can again) be guaranteed" for a QoS flow during the lifetime of the QoS flow. This method also allows the NG-RAN to apply an Alternative QoS Profile for the QoS flow.

UE can already provide updated parameter list within the QoS flow descriptor, or even new 5QI for energy saving with relaxed QoS parameters values that most influence the energy consumption at the UE side. However, such mechanisms imply the UE to know and request specific QoS profiles, rather than enabling the network to maximize the trade-off between QoS and energy saving and adjust its service accordingly, whilst still meeting the UE requirements.

Editor’s Note: FFS to align with Rel-19 Stage-2 study conclusion on Energy Behaviour Assistance Information.

The 5G standard supports a change in subscribed QoS policy applied to communication is through AF and UE initiated session modification procedures. In this way, the needs and preferences for specific services can be reflected, as long as this is permitted by the network. In this use case, the conditions for tolerating performance degradation can also be introduced as part of the session performance policy.

### 5.x.6 Potential new requirements needed to support the use case

[PR.5.x.6-1] Subject to operator’s policy, regulatory requirements and subscription policies, the 5G system shall enable QoS policies to include tolerance to energy saving actions from the network, at least based on service performance adjustment variations, their applicability conditions (e.g. time, geographical area, slice) and incentives characteristics.

[PR.5.x.6-2] Subject to operator’s policy, regulatory requirements, subscription policies and user consent, the 5G network shall be able to perform energy saving actions resulting in service performance adjustments (e.g. QoS parameters, maximum bitrate) for UEs, based on the energy-related characteristics of the network (i.e. energy consumption, energy supply mix, carbon footprint, energy capacity and availability conditions) and on tolerance to service performance adjustment as expressed in the QoS policies associated with the target UEs.

NOTE 1: This requirement implies that tolerance to service performance adjustment expressed in the QoS policies associated with the target UEs could disallow service performance adjustments.

[PR.5.x.6-3] Subject to operator’s policy and regulatory requirements, the 5G network shall be able to trigger charging events related to each impacted UE when energy saving actions degrading service performance occur. Such charging events shall include the service performance characteristics of the related data flow before and after the energy saving action and the related charging information (e.g. timestamp).

NOTE 2: Such charging events can result in incentives to the subscriber.

END OF CHANGES