**3GPP SA WG2 Meeting #S2-161 draft S2-2403163**

**26 Feb. – 01 March, 2024 Athens, Greece**

Title: draft LS on per UE energy consumption in RAN

Response to:

Release: Rel-19

Work Item: FS\_EnergySys

Source: Vodafone [SA2]

To: RAN1, RAN2, RAN3, RAN4

Cc: SA5

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Attachments:

**1. Overall Description:**

Based on Rel-19 service requirements from SA1 *[has anyone got some references?* ], SA2 are studying how to expose information about the amount of network energy consumed by UEs.

In general, operators can already (pre-Rel-19) generate an approximate “energy consumption per UE” by taking the complete energy consumption for the network; the complete data traffic for the network; and the amount of data used by the UE.

However, it is clear from the difference between cell edge data rates (e.g. 99 percentile) and peak data rates, that UEs in different locations can experience vastly different (perhaps 1000 fold different) data rates with the same base station (with the base station transmitting at constant power). The amount of network energy a UE consumes also depends on the interference levels from adjacent cells.

The useful part of the Rel 19 work is to enable the identification of the users using a disproportionate amount of network energy for the data they receive. What the operator does with this information is FFS (and/or listed in the SA1 requirements), but at the moment, no one (operator, subscriber, chipset maker, base station vendor, CN vendor) knows this information and hence, e.g. network optimisation cannot be done to reduce energy consumption, nor enterprises encouraged to mount IoT devices in less energy-consuming locations, nor consumers nudged to modify their habits, etc.

Hence SA2 are interested in whether the RAN WGs can report on this disproportionate energy consumption for connected mode mobiles. While some of the energy consumption (e.g. in the base band unit) is probably proportional to the data volume, the majority is consumed by the remote radio heads and is likely to require more sophisticated estimation.

One company has suggested that the remote radio head part of the UE’s network energy consumption could be related to, for example:

*No. of DL resource blocks \* Transmit Time interval \* transmit power / No. of users sharing the resource block*

and SA2 invites RAN working groups (e.g., RAN1, 2, 4) to identify an appropriate measurement for the network energy consumption that is not linearly related to the data volume.

With regard to the granularity of reporting, the SA1 requirements request the ability to report energy consumption on a per-UE, per-UE-per-PDN connection, and per-UE-per-QoS flow basis [can someone check?]. SA2 invites RAN working groups (e.g., RAN2) to indicate whether anything more granular than per-UE reporting is possible for the network energy consumption that is not linearly related to the data volume.

With regard to how the information about the UE’s RAN energy consumption is reported to the CN, SA2 are studying various mechanisms (e.g. similar to EN-DC’s “secondary RAT data volume reporting”, or GTP-U header extensions, etc). SA2 invites RAN3 to highlight any issues that they foresee, e.g., related to CU-DU split.

**2. Actions:**

**To RAN1, RAN2 and RAN4**

SA2 requests RAN1, RAN2 and RAN4 to suggest an appropriate formula to estimate the RRC Connected mode base station energy consumption that is not linearly related to the UE’s data volume.

**To RAN2**

SA2 requests RAN2 to indicate whether the network energy consumption (that is not linearly related to the data volume) can be reported on a per-UE-per-PDN connection and per-UE-per-QoS flow basis.

**To RAN3**

SA2 asks RAN3 to indicate whether there are additional aspects (e.g. CU-DU split) that SA2 should take into account at this stage of their work.

**3. Date of Next SA2 Meetings:**

SA2#162 April 15 – 19, 2024 Changsha, CN

SA2#163 May 27 – 31, 2024 Jeju Island, KR