**3GPP TSG-WG SA2 Meeting #170 rev of T1202 *S2-250xx***

**Fukuoka City, Fukuoka, JP, 19th May – 23rd May, 2025 (revision of S2-250xxxx)**

**Source: Huawei, HiSilicon**

**Title: WT#1: Accuracy evaluation of estimation**

**Document for: Approval**

**Agenda Item: 20.4.1**

**Work Item / Release:** FS\_EnergySys\_Ph2 **/ Rel-20**

*Abstract: A summary of what this is about. Don’t start it with “This contribution…”*

# 1. Introduction/Discussion

This document proposes how to determine the accuracy of R19 estimation and generic for an estimation approach.

Based on the accuracy proposal the contribution make the accuracy analysis of the solution XX proposed for Network slice Energy Consumption.

# 2. Text Proposal

It is proposed to capture the following changes in TR 23.xxx

\* \* \* \* First change \* \* \* \*

# 6 Solutions

## 6.0 Mapping of Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues |
| Solutions | 1 | 2 | 3 |
| X | X |  |  |
| Y | X |  |  |

\* \* \* \* second change \* \* \* \*all new text

## 6.X Solution #X: Accuracy of EC estimation

This solution addresses the question on how to determine the accuracy of estimation based on R19 formula. The Rel-19 estimation is based on the Energy consumption at node level is provided by OAM based on the evaluation defined in TS 28.554 clause 6.7.3.1.1. The ECNF is obtained by summing up the energy consumption of Physical Network Function(s) (PNF) and/or Virtual Network Function (VN) which compose the NF.

### 6.x.1 Accuracy for Physical Node

In case of physical node the EC is obtained by OAM via measurement as defined in ETSI ES 202 336-12 [x] where the power and energy metering is mandatory and it is monitored via embedded sensor in type 1 monitoring equipment and with external sensor in type 2 and type 3 monitoring equipment. Which type of monitoring is implemented is left to implementation. For all cases the power is measured in Watt and the energy is the cumulated active energy metering in Wh or kWh at the input of the considered ICT Network Equipment.

 (1)

 (2)

 (3)

Where in record period Tr the physical expression of instant power P(t), power consumption E(Tr) and mean power P(Tr) over Tr are given by (6), (7) and (8). The u(t) and i(t) are instant values of voltage and current at the AC or DC power interface of the Network Element under measurement.

**The ETSI TS 202 336-12 defines that the measurement of active power and the energy metering shall have the following accuracy:**

- **Accuracy 1 ±3 % from 25 % to 100 % of maximum load of the equipment (load range 1)**

**- Accuracy 2 ±5 % between 5 % and 25 % of maximum load of equipment (load range 2)**

The accuracy is intended as the error range in measurement (i.e. the meter's readings will be within ±3% of the actual energy consumed) and the type of error is relative (a percentage of the measured value).

For both accuracy, the 100 % load is specified as the maximum power of each considered ICT network equipment. The accuracies of power measurement and energy metering shall be defined in normal indoor operating temperature range of class 3.2 according to ETSI EN 300 019-1-3 [y]. Furthermore, for equipment working in outdoor power measurement and energy metering accuracy can be extended to ±5 % in load range 1

Therefore, the best possible accuracy for the EC at node level satisfies the SA2 TS requirement if not exceed the above values, hence accuracy of estimation of EC at granularity different from Node level can not be better then the accuracy of the EC at node level.

It shall also be noted that the Energy Consumption is the accumulate value in the measurement interval, therefore different behaviour of variation in EC in the time may lead to the same accumulated resulting value.

### 6.x.2 Accuracy for Virtual Network function

The Energy consumption for a Virtual node ECVNF is defined in TS 28.554 clause 6.7.3.1.2 as the sum of the EC consumption estimated for the VNF ECVNF,Estimated which composes the virtual function

 (4)

The ECVNF,Estimated in TS 28.554 is defined taking into account different possible formulas which are based on the allocation of the EC of the hardware where the VNF is running proportional to the resource instance during the observation period, provided by ETSI NFV MANO. TS 28.554 provides the estimation based on the mean vCPU usage VCpuUsageMean, the mean memory usage VMemoryUsageMean, the mean disk usage VDiskUsageMean and the sum of the incoming and outgoing traffic volumes IOTrafficVolume, for example



 (5)

Where the ECNVFINode, Measured is the EC of physical node measured as described in clause 6.x.1.

The accuracy of EC for a Virtual NF is impacted by 3 measurement uncertainty:

* The accuracy of the measurement of the energy consumption of the Physical(s) node hosting the NF (depending by implementation may be hosted in several hardwares for example if storage is on different platform) which has the accuracy described in clause 6.x.1
* The accuracy of the estimation of resources used by the virtual function as estimated or measured by ETSI MANO (if applicable) or by vendor specific means at defined in TS 28.554. This number has not associated a minimum accuracy to be satisfied.
* The estimation of resource is the performed considering the mean value on the measurement interval.

NOTE 1: For example TS 28.554 clause 6.7.3.1.4 defines that VCpuUsageMean is the mean vCPU usage of the virtual compute resource instance during the observation period, provided by ETSI NFV MANO (see clause 7.1.2 of ETSI GS NFV-IFA 027),

Therefore the accuracy of EC per NF which is a virtual process provided by OAM is higher that those of the EC at physical layer.

NOTE 2: For example if we assume that the accuracy of EC at physical node is x% and the accuracy of measurement of CPU usage is y% and the measurement of total CPU usage is z% the accuracy of the EC based on equation 5 results

### 6.x.3 Accuracy due to data volume measurement

The accuracy of measurement of DV is due to 2 components: the first one is the accuracy of counting the bits at node level and at smaller granularity (e.g at PDU session); the second is due to the variation along the measurement interval due to time variation. In fact different changes over time of the traffic can produce the same result over the measurement period. However it shall be considered that also that EC changes over time in the measurement period roughly proportionally with the traffic for UPF and gNB (in both cases if different features and capabilities are used for different traffic the energy consumed for each elaborated bit can be significantly different). This second aspect if time variation is not represented by the accuracy described in clause 6.x.1 which is related to how the measurement is performed.

The effect of variation in time due to traffic variation, i.e. to the load, are not currently considered in both the measurement of the EC at node level, in the estimation of EC at virtual NF level and in the UE traffic described in clauses 6.x.1 and 6.x.2. For the Node level EC this is outside the SA2 scope, and it may be determined be based on statistic considerations.

### 6.x.4 Conclusions

Independently by the formula used to derive the EC per different granularity, the accuracy can not be better than the accuracy of EC at network Node level as defined in TS 28.554 that for physical node

- Accuracy 1 ±3 % from 25 % to 100 % of maximum load of the equipment (load range 1)

- Accuracy 2 ±5 % between 5 % and 25 % of maximum load of equipment (load range 2)

While for a virtual network function the EC is an estimation proportional to the average consumed resource provided by ETSI MANO of the EC of the hardware hosting the NF as defined by equation (6.x.3-19), which can not be lower than the accuracy of the measurement EC for physical node

The Energy Consumption is the accumulate value in the measurement interval, therefore different behaviour of variation in EC in the time may lead to the same accumulated resulting value.

Therefore accuracy of the measurement of Energy Consumption at node level it is outside the remit of SA2.

The accuracy of measurement of DV is due to:

- the accuracy of counting the bits at node level and at smaller granularity (e.g at PDU session), for example the packet lost and retransmission is be not considered properly

- the time variation along the measurement interval

The time variation in the measurement interval of EC at NF and DV depends by several factors which difficult to take into account properly, as thumb rules smaller is the measurement interval, e.g 5 minutes, less that variation can be more precisely detected, but the system needs to dedicate more resources increasing the load and energy consumed. Considering the measurement interval can be in range from 5 Minutes to several hours/days the operator and the AF may decide which is the suitable interval for the scope.

The above considerations shall be taken into account for the selection of solutions to be considered in normative phase.

\* \* \* \* second change \* \* \* \*

### 7.1.Y Agreed Principles for KI#1

The following principles are agreed and considered for selection of solutions: - For physical node independently by the formula used to derive the EC per different granularity, the accuracy can not be better than the accuracy of EC at network Node level as defined in TS 28.554 that

- Accuracy 1 ±3 % from 25 % to 100 % of maximum load of the equipment (load range 1)

- Accuracy 2 ±5 % between 5 % and 25 % of maximum load of equipment (load range 2)

- For Virtual Network Function the EC is an estimation proportional to the average consumed resource provided by ETSI MANO of the EC of the hardware hosting the NF as defined by equation (6.x.3-19), which can not be lower than the accuracy of the measurement EC for physical node.

- The Energy Consumption is the accumulate value in the measurement interval, therefore different behaviour of variation in EC in the time may lead to the same accumulated resulting value.

- To determine or to improve the accuracy of the measurement of Energy Consumption at node level it is outside the remit of SA2.

- The accuracy of measurement of DV is due to:

- the accuracy of counting the bits at node level and at smaller granularity (e.g at PDU session), for example the packet lost and retransmission is be not considered properly

- the time variation along the measurement interval

- The time variation in the measurement interval of EC at NF and DV depends by several factors which difficult to take into account properly, as thumb rules smaller is the measurement interval, e.g 5 minutes, less that variation can be more precisely detected, but the system needs to dedicate more resources increasing the load and energy consumed. Considering the measurement interval can be in range from 5 Minutes to several hours/days the operator and the AF may decide which is the suitable interval for the scope.

\* \* \* \* End of changes \* \* \* \*