**3GPP TSG-SA5 Meeting #156 *S5-243923***

**Maastricht, Netherlands, 19 – 23 August 2024**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **28.552** | **CR** | **0585** | **rev** | **-** | **Current version:** | **19.0.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network | **X** |

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| ***Title:*** | Rel-19 CR TS 28.552 New measurements to monitor Paging Load in Non-Terrestrial Network deployments | | | | | | | | | |
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| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | S5 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | PM\_KPI\_5G\_Ph4 | | | | |  | ***Date:*** | | | 2024-08-08 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | Paging Load is the number of UEs that receive a page. In NTN (Non-Terrestrial Network) deployments where cell sizes are large, the paging load could be very high leading to large resource usage of satellite beams. On the other hand, smaller cell sizes would mean more frequent TAU procedures. NTN deployments will need to monitor both these metrics (ie paging load and rate of TAU procedures) to dimension the cell size leading to optimal signalling and radio resource usage. The paging load can be measured either at different instants within a measurement. And the paging load could be defined for both core initial page (for Idle UEs) and RAN initiated page (for UEs in RRC-INACTIVE state). | | | | | | | | |
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| ***Summary of change:*** | | 2 new measurements are proposed  - Instantaneous Paging Load for Core Initiated Page  - Instantaneous Paging Load for RAN Initiated Page | | | | | | | | |
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| ***Consequences if not approved:*** | | NTN operators will not be able to measure the paging load in their deployements – this could lead inefficient radio resource usage and service degradation. | | | | | | | | |
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| ***Clauses affected:*** | | 2  Below new clauses are added  5.1.1.27.a, 5.1.1.27.b, A.x | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

***Start of First change***

#### **5.1.1.27.a Distribution of Instantaneous Paging Load for Core Initiated Page in NTN Deployments**

a) This measurement provides distribution of the instantaneous paging load applicable for core-initiated paging in NTN deployments. The measurement is provided per TAI and only for NTN.

b) CC

c) Each sample is obtained with an internal sampling period (e.g. one second) as the number of UEs in Idle state in the list of TAIs (comprising the Registration Area) in which a page is sent out by the Core Network as specified in TS 38.331 [20], TS 38.300 [49], TS 38.401 [66] and TS 23.501 [4]. The number of UEs in Idle is obtained using the running count of UEs which are incremented whenever a UE is moved from RRC Connected to RRC Idle in a given TAI and summing up the counts per TAI across all the TAIs in which the page is being sent.

d) Each measurement is an integer.

e) The measurement name has the form PAG.PagingLoadInstantCore.Bin, where Bin indicates a data volume range which is vendor specific.

f) NRCellCU

GNBCUCPFunction

g) Valid for packet switched traffic.

h) 5GS

NOTE: This measurement is applicable to Earth-fixed and quasi-Earth-fixed cell NTN deployments

#### **5.1.1.27.b Distribution of Instantaneous Paging Load for RAN Initiated Page in NTN Deployments**

a) This measurement provides distribution of the of instantaneous paging load applicable to RAN initiated paging in NTN deployments. The measurement is provided per RNA and only for NTN.

b) CC

c) Each sample is obtained with an internal sampling period (e.g. one second) as the number of UEs in RRC-INACTIVE state for each RAN based Notification Area (RNA) in the RAN as specified in TS 38.300 [49], TS 38.401 [66] and TS 23.501 [4]. The number of UEs in RRC-INACTIVE is obtained using the running count of UEs which is incremented whenever a UE is moved from RRC Connected to RRC INACTIVE in a given RNA.

d) Each measurement is an integer.

e) The measurement name has the form PAG.PagingLoadInstantRAN.Bin, where Bin indicates a data volume range which is vendor specific.

f) NRCellCU

GNBCUCPFunction

g) Valid for packet switched traffic.

h) 5GS

NOTE: This measurement is applicable to Earth-fixed and quasi-Earth-fixed cell NTN deployments

***Start of next change***

# A.x Monitoring of Paging Load for NTN Deployments

Non-Terrestrial Networks (NTN) typically need to cover large areas to provide their service. One of the challenges due to this large area of coverage is the dimensioning of NTN Cells.

Each NTN gNB covers a large geographical area (each cell could cover area with radius of hundreds of kms). The cell area dimensioning poses a problem due to this requirement. Very large area cells would mean large Registration Area where a 5GC initiated page should be broadcast. A Registration Area contains several Tracking Areas each of which in turn may have multiple cells. Since this geographical area is huge in NTN, the number of UEs covered will be very high and this leads to large paging load. On the other hand, small area cells would mean small Registration Areas. This would lead to a larger number of Registration Area updates for UEs that are moving in the overlapping areas.

This consideration leads to the need for NTN operators to monitor both paging load and Registration Area Update rates. The cell sizes should be dimensioned based on the monitoring such that both the paging load and Registration Updates are kept at manageable levels. Currently, RA updates are measured in clause 5.2.2 and paging related measurements are specified in clause 5.1.1.27, but there exists no measurement for paging load monitoring. Without this measurement, NTN deployments may not be able to know how many UEs are being paged in a given RA and hence, may end up over or under dimensioning cell area sizes.

In order to accurately characterize the paging load, two categories of paging load are defined – instantaneous load and average load. The former gives a picture of the paging load at sub intervals of a measurement interval whereas the latter provides the average paging load over the measurement interval. These two categories are defined for UEs in RRC idle state per TAI (for core initial pages) and UEs in RRC inactive state per RNA (for RAN initiated pages).

Once implemented, these paging load measurements could be used in tandem with the TAU related measurements (already defined in clause 5.2.2) to ensure that optimal usage of radio resources are done in NTN deployments.

***End of change***