**3GPP TSG-2 Meeting #164 *S2-240xxxx***

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

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **23.502** | **CR** | **X** | **rev** | **-** | **Current version:** | **19.0.0** |  |
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| *For* [***HE******LP***](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 |  | Core Network |  |

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|  |
| ***Title:***  | Support for MPQUIC-IP and MPQUIC-E steering functionalities |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | MASSS |  |  |  |
|  |  |  |  |  |
| ***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 canbe 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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | The FS\_MASSS study has agreed to enhance ATSSS to support MPQUIC using CONNECT-IP and CONNECT-Ethernet, by defining two new Steering Functionalities. This has not yet been captured in TS 23.501. |
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| ***Summary of change:*** | Add support for two new Steering Funcitonalities for IP and Ethernet proxying using MPQUIC. |
|  |  |
| ***Consequences if not approved:*** | Missing functionality |
|  |  |
| ***Clauses affected:*** | TBD… |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\*\* First Change \*\*\*\*

### 4.17.6 SMF Provisioning of available UPFs using the NRF

#### 4.17.6.1 General

This clause describes the provisioning of available UPFs in SMF using the NRF as documented in clause 6.3.3 of TS 23.501 [2].

This optional node-level step takes place prior to selecting the UPF for PDU Sessions and may be followed by N4 Node Level procedures defined in clause 4.4.3 where the UPF and the SMF exchange information such as the support of optional functionalities and capabilities.

As an option, UPF(s) may register in the NRF. This registration phase uses the Nnrf\_NFManagement\_NFRegister operation and hence does not use N4.

For the purpose of SMF provisioning of available UPFs, the SMF uses the Nnrf\_NFManagement\_NFStatusSubscribe, Nnrf\_NFManagement\_NFStatusNotify and Nnrf\_NFDiscovery services to learn about available UPFs.

NOTE 1: The protocol used by UPF to interact with NRF is described in TS 29.510 [37]

UPFs may be associated with UPF Provisioning Information in the NRF. The UPF Provisioning Information consists of:

- a list of (S-NSSAI, DNN);

- UE IPv4 Address Ranges and/or IPv6 Prefix Range(s) per (S-NSSAI, DNN); and

NOTE 2: The above information can be used by the SMF for UPF selection when static IP address/prefix allocation is required for a UE.

- a SMF Area Identity the UPF can serve. The SMF Area Identity allows limiting the SMF provisioning of UPF(s) using NRF to those UPF(s) associated with a certain SMF Area Identity. This can e.g. be used if an SMF is only allowed to control UPF(s) configured in NRF as belonging to a certain SMF Area Identity.

- the supported ATSSS steering functionality, i.e. whether MPTCP functionality or ATSSS-LL functionality or MPQUIC-UDP functionality or MPQUIC-IP functionality or MPQUIC-E functionality, or any combination of them is supported.

- the supported UPF event exposure service and supported Event IDs, e.g. local notification of QoS Monitoring to AF or e.g. events for data collection to NWDAF by Nupf\_EventExposure\_Notify.

- the supported functionality associated with high data rate low latency services, eXtended Reality (XR) and interactive media services, specified in clause 5.37 (for example, ECN marking for L4S, specified in clause 5.37.3, PDU Set Marking, specified in clause 5.37.5, UE power saving management, specified in clause 5.37.8).

The SMF Area Identity and UE IPv4 Address Ranges and/or IPv6 Prefix Range(s) are optional in the UPF Provisioning Information.

\*\*\*\* Next Change \*\*\*\*

#### 4.22.2.1 Non-roaming and Roaming with Local Breakout

The signalling flow for a MA PDU Session establishment when the UE is not roaming, or when the UE is roaming and the PDU Session Anchor (PSA) is located in the VPLMN, is based on the signalling flow in Figure 4.3.2.2.1-1 with the following differences and clarifications:

- The PDU Session Establishment Request message may be sent over the 3GPP access or over the non-3GPP access. In the steps below, it is assumed that it is sent over the 3GPP access, unless otherwise specified.

- In step 1, the UE provides Request Type as "MA PDU Request" in UL NAS Transport message and its ATSSS Capabilities as defined in clause 5.32.2 of TS 23.501 [2] in PDU Session Establishment Request message.

 The "MA PDU Request" Request Type in the UL NAS Transport message indicates to the network that this PDU Session Establishment Request is to establish a new MA PDU Session and to apply one or more steering functionalities (defined in TS 23.501 [2], clause 5.32.6) for steering the traffic of this MA PDU session over multiple accesses.

 If the UE requests an S-NSSAI and the UE is registered over both accesses, it shall request an S-NSSAI that is allowed on both accesses.

 The UE indicates to AMF whether it supports non-3GPP access path switching, i.e. whether the UE can transfer the non-3GPP access path of the MA PDU Session from a source non-3GPP access (N3IWF/TNGF) to a target non-3GPP access (a different N3IWF/TNGF).

- In step 2, if the AMF supports MA PDU sessions, then the AMF selects an SMF, which supports MA PDU sessions. If the AMF supports non-3GPP access path switching and the UE indicated in step 1 that the UE supports non-3GPP access path switching, the AMF selects a SMF that supports non-3GPP access path switching, if such an SMF is available.

- In step 3, the AMF informs the SMF that the request is for a MA PDU Session by including "MA PDU Request" indication and in addition, it indicates to SMF whether the UE is registered over both accesses. If the AMF determines that the UE is registered via both accesses, but the requested S-NSSAI is not allowed on both accesses, then the AMF shall reject the MA PDU session establishment. If the AMF supports non-3GPP access path switching while maintaining two N2 connections for non-3GPP access, the selected SMF supports non-3GPP path switching and UE indicated in step 1 that the UE supports non-3GPP access path switching, the AMF indicates whether the UE supports non-3GPP path switching to the SMF.

 The AMF shall reject the PDU Session Establishment request if the request is for a LADN.

- In step 4, the SMF retrieves, via Session Management subscription data, the information whether the MA PDU session is allowed or not.

- In step 7, if dynamic PCC is to be used for the MA PDU Session, the SMF sends an "MA PDU Request" indication to the PCF in the SM Policy Control Create message and the ATSSS Capabilities of the MA PDU session. The SMF provides the currently used Access Type(s) and RAT Type(s) to the PCF. The PCF decides whether the MA PDU session is allowed or not based on operator policy and subscription data.

 The PCF provides PCC rules that include MA PDU session control information, as specified in TS 23.503 [20]. From the received PCC rules, the SMF derives (a) ATSSS rules, which will be sent to UE for controlling the traffic steering, switching and splitting in the uplink direction and (b) N4 rules, which will be sent to UPF for controlling the traffic steering, switching and splitting in the downlink direction. If the UE indicates the support of "ATSSS-LL Capability", the SMF may derive the Measurement Assistance Information.

 If the SMF receives a UP Security Policy for the PDU Session with Integrity Protection set to "Required" and the MA PDU session is being established over non-3GPP access, the SMF does not verify whether the access can satisfy the UP Security Policy.

- In the remaining steps of Figure 4.3.2.2.1-1, the SMF establishes the user-plane resources over the 3GPP access, i.e. over the access where the PDU Session Establishment Request was sent on:

- In step 10, the N4 rules derived by SMF for the MA PDU session are sent to UPF and two N3 UL CN tunnels info are allocated by the UPF. If the ATSSS LL functionality is supported for MA PDU Session, the SMF may instruct the UPF to initiate performance measurement for this MA PDU Session. If the MPTCP functionality and/or any of the MPQUIC based functionalities is supported for the MA PDU Session, the SMF may instruct the UPF to activate the corresponding MPTCP functionality and/or the MPQUIC based functionality for this MA PDU Session. In step 10a, the UPF allocates addressing information for the Performance Measurement Function (PMF) in the UPF. If the UPF receives from the SMF a list of QoS flows over which access performance measurements may be performed, the UPF allocates different UDP ports or different MAC addresses per QoS flow per access. In step 10b, the UPF sends the addressing information for the PMF in the UPF to the SMF. If UDP ports or MAC addresses are allocated per QoS flow and per access, the UPF sends the PMF IP address information and UDP ports with the related QFI to the SMF in the case of IP PDU sessions and sends the MAC addresses with the related QFI to the SMF in the case of Ethernet PDU sessions.

 In step 10a, if the message from the SMF instructs the UPF to activate MPTCP functionality, the UPF allocates the UE "MPTCP link-specific multipath" addresses/prefixes. In step 10b, the UPF sends the "MPTCP link-specific multipath" addresses/prefixes and MPTCP proxy information to the SMF. If the message from the SMF instructs the UPF to activate at least one of MPQUIC-UDP, MPQUIC-IP or MPQUIC-E functionalities, the UPF allocates the UE "MPQUIC link-specific multipath" addresses/prefixes. In step 10b, the UPF sends the "MPQUIC link-specific multipath" addresses/prefixes and MPQUIC proxy information to the SMF. The "MPTCP link-specific multipath" addresses/prefixes and the "MPQUIC link-specific multipath" addresses/prefixes may be the same.

- In step 11, for the MA PDU session, the SMF includes an "MA PDU session Accepted" indication in the Namf\_Communication\_N1N2MessageTransfer message to the AMF and indicates to AMF that the N2 SM Information included in this message should be sent over 3GPP access. The AMF marks this PDU session as MA PDU session based on the received "MA PDU session Accepted" indication. If the AMF indicated in step 3 that non-3GPP path switching while maintaining two N2 connections for non-3GPP access is supported, the SMF indicates support of non-3GPP path switching in the PDU Session Establishment Accept message.

- In step 13, the UE receives a PDU Session Establishment Accept message, which indicates to UE that the requested MA PDU session was successfully established. This message includes the ATSSS rules for the MA PDU session, which were derived by SMF. If the ATSSS -LL functionality is supported for the PDU Session, the SMF may include the addressing information of PMF in the UPF into the Measurement Assistance Information. If the MPTCP functionality is supported for the MA PDU Session, the SMF shall include the "MPTCP link-specific multipath" addresses/prefixes of the UE and the MPTCP proxy information. If the MPQUIC-UDP and/or MPQUIC-IP or MPQUIC-E functionality is supported for the MA PDU Session, the SMF shall include the "MPQUIC link-specific multipath" addresses/prefixes of the UE and the MPQUIC proxy information.

- After step 18 in Figure 4.3.2.2.1-1, if the SMF was informed in step 2 that the UE is registered over both accesses, then the SMF initiates the establishment of user-plane resources over non-3GPP access too. The SMF sends an Namf\_Communication\_N1N2MessageTransfer to the AMF including N2 SM Information and indicates to AMF that the N2 SM Information should be sent over non-3GPP access. Namf\_Communication\_N1N2MessageTransfer does not include an N1 SM Container for the UE because this was sent to UE in step 13. After this step, the two N3 tunnels between the PSA and RAN/AN are established.

The last step above is not executed when the UE is registered over one access only, in which case the MA PDU Session is established with user-plane resources over one access only. How user-plane resources can be added over an access of the MA PDU Session is specified in clause 4.22.7.

\*\*\*\* Next Change \*\*\*\*

##### 4.22.2.3.2 PDN Connections and Multi Access PDU Sessions

When the UE wants to request a new PDN Connection in EPC and wants to use this PDN Connection as user-plane resource associated with a MA PDU Session:

- The UE requests establishment of a new PDN Connection when the UE is registered via 3GPP access in EPS using PDN Connection Establishment procedure. The UE provides via PCO to PGW-C+SMF the following information:

- An indication that the PDN Connection is requested to be associated with a MA PDU Session

- The UE's ATSSS capabilities as described in clause 5.32.2 of TS 23.501 [2] (i.e. whether the UE is capable of supporting the ATSSS-LL functionality, the MPTCP functionality, the MPQUIC-UDP functionality, the MPQUIC-IP functionality, the MPQUIC-E functionality, or any combination of them).

- The MME may select a PGW-C+SMF as described in TS 23.401 [13] and clause 4.11.0a.4.

NOTE 1: The selection of PGW-C+SMF in the correct 5GC slice requires the same mapping between EPC and 5GC slices as required for single-access PDU sessions. In order to select an ATSSS capable PGW-C+SMF it is assumed that the operator deployment ensures that all PGW-C+SMF(s) configured to support the specific APN in this network slice are also capable to support ATSSS. There is however no assumption that all PGW-U+UPFs need to support ATSSS, since PGW-C+SMF can make a selection of PGW-U+UPF taking the multi-access properties into account.

- The PGW-C+SMF determines based its capabilities whether the request can be accepted. The PCF decides whether the multi-access connectivity is allowed or not based on operator policy and subscription data, as described in clause 4.22.2. The PGW-C+SMF provides the following information in the PCO to the UE:

- An indication whether the request for using the PDN Connection for MA-PDU Session is accepted or not.

- If the UE has indicated that it is capable of supporting the MPTCP functionality and/or any of the MPQUIC based functionalities and the PGW-C+SMF accepts to activate the MPTCP functionality and/or the corresponding MPQUIC based functionality(ies), then the network provides MPTCP proxy information and/or MPQUIC proxy information to the UE, as described in clause 5.32.2 of TS 23.501 [2].

- UE Measurement Assistance Information (as described in clause 5.32.2 of TS 23.501 [2]).

After the PDN Connection establishment:

- If the UE registers to 5GC and wants to add non-3GPP user-plane resources, then the UE shall send a PDU Session Establishment Request over this access containing a "MA PDU Request" indication as described in clause 5.32.2 of TS 23.501 [2].

NOTE 2: Adding the PDU Session connectivity and user plane resources over non-3GPP access in 5GS allows the PGW-C+SMF to provide ATSSS rules to the UE.

- If the UE registers via non-3GPP access in EPC, the UE shall not trigger PDN Connection establishment to add non-3GPP/EPC access to the MA PDU Session.

When the UE wants to request a new MA PDU Session in 5GC/non-3GPP access, the description in clause 5.32.2 of TS 23.501 [2], applies. After the MA PDU Session establishment in 5GS/non-3GPP access, the description in clause 5.32.2 of TS 23.501 [2], applies with the following additions:

- If the UE is registered to EPC and wants to add user-plane resources on 3GPP access over EPC, then the UE shall send a PDN Connection Establishment Request over this access containing a "handover" indication and include a "MA PDU Request" indication in the PCO as well as the PDU Session ID of the existing MA PDU Session on non-3GPP access over 5GC.

- When the UE deregisters from the EPC access (but remains registered on the 5GC access), the MME will notify the PGW-C+SMF that the PDN Connection is released, as described in TS 23.401 [13]. The SMF can then notify the UPF that the access type has become unavailable.

In order to support EPS interworking when Ethernet type PDN Connection is not supported in EPS, the UE may use non-IP type PDN Connection when the UE establishes a PDN Connection in EPS as an added 3GPP access leg of an Ethernet type MA PDU Session. In this case, the UE and SMF shall locally associate the PDN Connection as an Ethernet type PDU Session as described in TS 23.501 [2]. When Ethernet type PDN Connection is not supported in EPS, the UE does not request to establish a PDN Connection with "MA PDU Request" indication before the UE registers to 5GS and establishes MA PDU Session over non-3GPP access.

A UE that has an established MA-PDU session over non-3GPP access in 5GC and 3GPP access in EPS, may be able to use EN-DC for the 3GPP access leg.

Depending on the RAT types supported by the UE, the PDN connection may also be handed over to 3GPP access in 5GC. For a UE supporting both E-UTRAN/EPC access and NG-RAN/5GC access, the user plane resources for 3GPP access may be moved between E-UTRAN/EPC access and NG-RAN/5GC access as described in clause 5.17.2 of TS 23.501 [2]. The PDU Session and User Plane resources active over non-3GPP/5GC access are not affected by such inter 3GPP access RAT change.

\*\*\*\* Next Change \*\*\*\*

##### 4.22.2.4.2 PDN Connections and Multi Access PDU Sessions

When the UE wants to request a new PDN Connection in EPC and wants to use this PDN Connection as user-plane resource associated with a MA PDU Session:

- The UE requests establishment of a new PDN Connection when the UE is registered via non-3GPP access in EPS using PDN Connection Establishment procedure. The UE provides the following ATSSS information to ePDG via IKE signalling:

- An indication that the PDN Connection is requested to be associated with a MA PDU Session

- The UE's ATSSS capabilities as described in clause 5.32.2 of TS 23.501 [2] (i.e. whether the UE is capable of supporting any combination of the ATSSS-LL functionality, the MPTCP functionality, the MPQUIC-UDP functionality, the MPQUIC-IP functionality and the MPQUIC-E functionality).

- The ePDG may select a PGW-C+SMF as described in TS 23.402 [26]. The ePDG forwards the ATSSS information to the selected PGW-C+SMF via APCO in Create Session Request message.

NOTE: The selection of PGW-C+SMF in the correct 5GC slice requires the same mapping between EPC and 5GC slices as required for single-access PDU sessions. In order to select an ATSSS capable PGW-C+SMF it is assumed that the operator deployment ensures that all PGW-C+SMF(s) configured to support the specific APN in this network slice are also capable to support ATSSS. There is however no assumption that all PGW-U+UPFs need to support ATSSS, since PGW-C+SMF can make a selection of PGW-U+UPF taking the multi-access properties into account.

- The PGW-C+SMF determines based its capabilities whether the request can be accepted. The PCF decides whether the multi-access connectivity is allowed or not based on operator policy and subscription data, as described in clause 4.22.2. The PGW-C+SMF provides the following information via the APCO in the Create Session Response message to the ePDG:

- An indication whether the request for using the PDN Connection for MA-PDU Session is accepted or not.

- If the UE has indicated that it is capable of supporting the MPTCP functionality and the PGW-C+SMF accepts to activate the MPTCP functionality, then the network provides MPTCP proxy information to the UE, as described in clause 5.32.2 of TS 23.501 [2].

- If the UE has indicated that it is capable of supporting any of the MPQUIC based functionalities and the PGW-C+SMF accepts to activate the corresponding MPQUIC based functionality(ies), then the network provides MPQUIC proxy information to the UE, as described in clause 5.32.2 of TS 23.501 [2].

- UE Measurement Assistance Information (as described in clause 5.32.2 of TS 23.501 [2]).

- ATSSS rules

- The ePDG forwards the received above information to the UE via IKE signalling.

After the PDN Connection establishment:

- If the UE registers to 5GC and wants to add 3GPP user-plane resources, then the UE shall send a PDU Session Establishment Request over this access containing a "MA PDU Request" indication as described in clause 5.32.2 of TS 23.501 [2]. The AMF shall select the SMF according to the UE context in SMF data from UDM for the corresponding PDU Session ID.

- If the UE attaches in E-UTRAN/EPC, the UE shall not trigger PDN Connection establishment to add E-UTRAN/EPC access to the MA PDU Session.

When the UE wants to request a new MA PDU Session in 5GC/3GPP access, the description in clause 5.32.2 of TS 23.501 [2], applies. After the MA PDU Session establishment in 5GC/3GPP access, the description in clause 5.32.2 of TS 23.501 [2], applies with the following additions:

- If the UE is registered to EPC and wants to add user-plane resources on non-3GPP access over EPC, then the UE shall send a PDN Connection Establishment Request over this access containing the IP address of the MA PDU Session in CFG\_REQUEST Configuration Payload and include a "MA PDU Request" indication and UE's ATSSS capabilities and the PDU Session ID of the existing MA PDU Session on 3GPP access over 5GC. The ePDG shall select the PGW-C/SMF corresponding to the PGW identity provided by the 3GPP AAA server as described in TS 23.402 [26]. The ePDG forwards the ATSSS information via the APCO in the Create Session Request message to the PGW-C/SMF.

- When the UE deregisters from the EPC/non-3GPP access (but remains registered on the 5GC/3GPP access), the ePDG will notify the PGW-C+SMF that the PDN Connection is released, as described in TS 23.402 [26]. The SMF can then notify the UPF that the access type has become unavailable.

A UE that has an established MA-PDU session over 3GPP access in 5GC and non-3GPP access in EPS, may be able to use Dual Connectivity for the 3GPP access leg.

Depending on the RAT types supported by the UE, the PDU Session may also be handed over to 3GPP access in EPC. For a UE supporting both E-UTRAN/EPC access and NG-RAN/5GC access, the user plane resources for 3GPP access may be moved between E-UTRAN/EPC access and NG-RAN/5GC access as described in clause 5.17.2 of TS 23.501 [2]. For the MA PDU session over 3GPP access in 5GC and non-3GPP access in EPS, when a UE moves from NG-RAN/5GC to E-UTRAN/EPC, the SMF+PGW-C may release the user plane resources either over 3GPP access or non-3GPP access based on operator policy. In this case, while the UE remains in EPC in both 3GPP access and non-3GPP access, the UE shall not trigger PDN Connection establishment to add an additional EPC access leg to the MA PDU Session. If the SMF+PGW-C does not release the user plane resources over one of accesses, the UE sends traffic over both accesses based on ATSSS rules.

\*\*\*\* End of Changes \*\*\*\*