**3GPP TSG-SA3 Meeting #118 S3-244326**

Hyderabad, India 14 - 18 October 2024

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|  |  | **CR** | **DRAFT** | **rev** | **1** | **Current version:** | **19.0.0** |  |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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| ***Title:***  | Living document of the Non3GPPMobEnh study |
|  |  |
| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | S3 |
|  |  |
| ***Work item code:*** | Non3GPPMob\_Sec |  | ***Date:*** | 2024-10-6 |
|  |  |  |  |  |
| ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Previous meeting agreed Living CR of the Non3GPPMobEnh for normative work. So resubmitting it again to add further content |
|  |  |
| ***Summary of change:*** | Draft Living CR is proposed.TNGF mobility solution addedNSWO note is updated |
|  |  |
| ***Consequences if not approved:*** | Living CR is not available |
|  |  |
| ***Clauses affected:*** | 2, 7A, 7A.1, 7A.2.1,, S.3.2 |
|  |  |
|  | **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:*** | NOTE: Coversheet detail will need revising to align with final CR |
|  |  |
| ***This CR's revision history:*** | S3-243933, S3‑244507, S3-244325 |

 **\* \* \* \* Start of Change \* \* \* \***

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System Architecture for the 5G System".

[3] 3GPP TS 33.210: "3G security; Network Domain Security (NDS); IP network layer security".

[4] IETF RFC 4303: "IP Encapsulating Security Payload (ESP)".

[5] 3GPP TS 33.310: "Network Domain Security (NDS); Authentication Framework (AF)".

[6] IETF RFC 4301: "Security Architecture for the Internet Protocol".

[7] 3GPP TS 22.261: "Service requirements for next generation new services and markets".

[8] 3GPP TS 23.502: "Procedures for the 5G System".

[9] 3GPP TS 33.102: "3G security; Security architecture".

[10] 3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security architecture".

[11] 3GPP TS 33.402: "3GPP System Architecture Evolution (SAE); Security aspects of non-3GPP accesses".

[12] IETF RFC 5448: " Improved Extensible Authentication Protocol Method for 3rd Generation Authentication and Key Agreement (EAP-AKA')".

[13] 3GPP TS 24.301: " Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[14] 3GPP TS 35.215: " Specification of the 3GPP Confidentiality and Integrity Algorithms UEA2 & UIA2; Document 1: UEA2 and UIA2 specifications".

[15] NIST: "Advanced Encryption Standard (AES) (FIPS PUB 197)".

[16] NIST Special Publication 800-38A (2001): "Recommendation for Block Cipher Modes of Operation".

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[29] SECG SEC 1: Recommended Elliptic Curve Cryptography, Version 2.0, 2009. Available <http://www.secg.org/sec1-v2.pdf>

[30] SECG SEC 2: Recommended Elliptic Curve Domain Parameters, Version 2.0, 2010. Available at <http://www.secg.org/sec2-v2.pdf>

[31] 3GPP TS 38.470: "NG-RAN; F1 General aspects and principles".

[32] 3GPP TS 38.472: "NG-RAN; F1 signalling transport".

[33] 3GPP TS 38.474: "NG-RAN; F1 data transport".

[34] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)"

[35] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[36] 3GPP TS 35.217: "Specification of the 3GPP Confidentiality and Integrity Algorithms UEA2 & UIA2; Document 3: Implementors' test data".

[37] 3GPP TS 35.223: "Specification of the 3GPP Confidentiality and Integrity Algorithms EEA3 & EIA3; Document 3: Implementors' test data".

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[41] 3GPP TS 38.460: "NG-RAN; E1 general aspects and principles".

[42] Void.

[43] IETF RFC 6749: "OAuth2.0 Authorization Framework".

[44] IETF RFC 7519: "JSON Web Token (JWT)".

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[69] 3GPP TS 36.331: "Radio Resource Control (RRC); Protocol specification".

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[86] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

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[89] IANA: "Transport Layer Security (TLS) Parameters".

[90] Void

[91] 3GPP TS 33.535: "Authentication and key management for applications based on 3GPP credentials in the 5G System (5GS)".

[92] 3GP TS 29.573: "5G System; Public Land Mobile Network (PLMN) Interconnection".

[93] 3GPP TS 29.503: "5G System; Unified Data Management Services".

[94] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition".

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[103] 3GPP TS 23.247: "Architectural enhancements for 5G multicast-broadcast services".

[104] 3GPP TS 33.535: "Authentication and Key Management for Applications (AKMA) based on 3GPP credentials in the 5G System (5GS)".

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[106] 3GPP TS 23.554 Application architecture for MSGin5G Service; Stage 2.

[107] 3GPP TS 22.262 Message service with the 5G System (5GS); Stage 1.

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[114] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

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**\*\*\*\* NEXT CHANGES \*\*\*\***

# 7A Security for trusted non-3GPP access to the 5G core network

## 7A.1 General

Security for trusted non-3GPP access to the 5G Core network is achieved when the UE registers to the 5GC via the TNAN. The UE registers to 5GC and, at the same time, it authenticates with the TNAN by using the EAP-5G procedure, similar to the one used with the registration procedure for untrusted non-3GPP access.

The link between the UE and the TNAN can be any data link (L2) that supports EAP encapsulation. The requirement on the Ta interface between the TNAP and TNGF can be found in clause 4.2.8.3.2 of TS 23.501[2]. The TNGF terminates the EAP-5G signalling andfowards the NAS message to the 5GC when the UE attempts to register to 5GC via the TNAN. The security relies on Layer-2 security between UE and TNAP, which is a trusted entity so that no IPSec encryption would be necessary between UE and TNGF, i.e. NULL encryption is sufficient for the user plane and signalling. However, integrity protection would be provided.

NOTE: The encryption protection over Layer-2 between UE and TNAP is assumed to be enabled.

During IPSec IKE negotiations the UE and TNGF may negotiate MOBIKE support as specified in RFC 4555[111], this would facilitate quick re-establishment IPSec connection and any associated SAs later if needed. Separate IPSec SAs may be used for NAS transport and PDU Sessions. At the end of the UE’s registration to 5GC, an IPSec SA (NWt) is established between the UE and TNGF. This is used to protect NAS messages between the UE and TNGF. Later when the UE initiates a PDU session establishment, the TNGF initiates establishment of one or more IPSec child SAs per PDU session. This results in additional IPSec SA’s (NWt) to be setup between the UE and TNGF-UP which are then for user plane transport between the two.

Clause 7A.2.1.2 describes when UE reconnects from one TNAP to another TNAP connecting to the same TNGF, authentication of UE from the previous context without performing the full primary authentication.

Clause 7A.2.4 describes how WLAN UEs that do not support 5GC NAS (N5CW) register via trusted non-3GPP access. Those N5CW devices are able to authenticate to the network with 3GPP credentials and register with the help of an interworking function (TWIF) that provides the 5GC NAS protocol stack towards the AMF.

As defined in clause 7.1, it is the home operator policy decision if a non-3GPP access network is treated as trusted non-3GPP access network. When all of the security domains in clause 4.1 of the present specification related to the non-3GPP access network are considered sufficiently secure by the home operator, the non-3GPP access may be identified as a trusted non-3GPP access for that operator. However, this policy decision may additionally be based on reasons not related to security feature groups.

NOTE: It is specified in clause 7.1a of the current document how the UE gets the operator policy and how it will behave accordingly.

**\*\*\*\* NEXT CHANGES \*\*\*\***

7A.2.1 Authentication for trusted non-3GPP access

7A.2.1.1 General

This clause specifies how a UE is authenticated to 5G network via a trusted non-3GPP access network.

This is based on the specified procedure in TS 23.502 [8] clause 4.12a.2.2 "Registration procedure for trusted non-3GPP access". The authentication procedure is similar to the authentication procedure for Untrusted non-3GPP access defined in clause 7.2.1 with few differences, which are mentioned below:

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**Figure 7A.2.1-1: Registration \ Authentication and PDU Session establishment for trusted non-3GPP access**

0. The UE selects a PLMN and a TNAN for connecting to this PLMN by using the Trusted Non-3GPP Access Network selection procedure specified in TS 23.501 [2] clause 6.3.12. During this procedure, the UE discovers the PLMNs with which the TNAN supports trusted connectivity (e.g. "5G connectivity").

1. A layer-2 connection is established between the UE and the TNAP. In case of IEEE 802.11 [80], this step corresponds to an 802.11 [80] Association. In case of PPP, this step corresponds to a PPP LCP negotiation. In other types of non-3GPP access (e.g. Ethernet), this step may not be required.

2-3. An EAP authentication procedure is initiated. EAP messages shall be encapsulated into layer-2 packets, e.g. into IEEE 802.3/802.1x packets, into IEEE 802.11/802.1x packets, into PPP packets, etc. The UE provides a NAI that triggers the TNAP to send a AAA request to a TNGF. Between the TNAP and TNGF the EAP packets are encapsulated into AAA messages.

4-10. An EAP-5G procedure is executed as specified in clause 7.2.1with the following modifications:

- The EAP-5G packets shall not be encapsulated into IKEv2 packets. The UE shall also include a UE Identity Id in the AN parameter i.e., . a 5G-GUTI or a SUCI. The value in the UE identity shall be stored at TNGF to as key identifier as described in step 13.

- A KTNGF as specified in clause Annex A.9 (equivalent to KN3IWF) is created in the UE and in the AMF after the successful authentication. The KTNGF is transferred from the AMF to TNGF in step 10a (within the N2 Initial Context Setup Request).

- The TNAP is a trusted entity. The TNGF shall generate the KTNAP as specified in Annex A.22 and transfers it from TNGF to TNAP in step 10b (within a AAA message).

- After receiving the TNGF key from AMF in step 10a, the TNGF shall send to UE an EAP-Request/5G-Notification packet containing the "TNGF Contact Info", which includes the IP address of TNGF. After receiving an EAP-Response/5G-Notification packet from the UE, the TNGF shall send message 10d containing the EAP-Success packet.

11. The common TNAP key is used by the UE and TNAP to derive security keys according to the applied non-3GPP technology and to establish a security association to protect all subsequent traffic. In case of IEEE 802.11 [80], the KTNAP is the Pairwise Master Key (PMK) and a 4-way handshake is executed (see IEEE 802.11 [80]) which establishes a security context between the WLAN AP and the UE that is used to protect unicast and multicast traffic over the air. All messages between UE and TNAP are encrypted and integrity protected from this step onwards.

NOTE 1: whether step 11 is performed out of the scope of this document. The current procedure assumes the encryption protection over Layer-2 between UE and TNAP is to be enabled.

12. The UE receives IP configuration from the TNAN, e.g. with DHCP.

13. The UE shall initiate an IKE\_INIT exchange with the TNGF. The UE has received the IP address of TNGF during the EAP-5G signalling in step 9b, subsequently, the UE shall initiate an IKE\_AUTH exchange and shall include the same UE Id (i.e. SUCI or 5G-GUTI) as in the UE Id provided in step 5. The common KTIPSe is used for mutual authentication. The key KTIPSec is derived as specified in Annex A.22.NULL encryption is negotiated as specified in RFC 2410 [81]. After step 13c, an IPsec SA is established between the UE and TNGF (i.e. a NWt connection) and it is used to transfer all subsequent NAS messages. This IPsec SA does not apply encryption but only apply integrity protection.

14. After the NWtp connection is successfully established, the TNGF responds to AMF with an N2 Initial Context Setup Response message.

14a. The AMF may determine whether the TNGF is appropriate for the slice selected as defined in clause 4.12.2.2 of TS 23.502[8]. If it is compatible with the selected TNGF, then proceed with steps 15 to step 19. Otherwise, the AMF shall proceed with step 20 to step 22, and step 15 to step 19 are skipped.

Case a):

15. Finally, the NAS Registration Accept message is sent by the AMF and is forwarded to UE via the established NWt connection.

16-18. The UE initiates a PDU session establishment. This is carried out exactly as specified in TS 23.502 [8] clause 4.12a.5. The TNGF may establish one or more IPSec child SA’s per PDU session.

19. User plane data for the established PDU session is transported between the UE and TNGF inside the established IPSec child SA

Case b:)

20. The AMF may trigger the UE policy update procedure and update the UE policy as defined in step 17 and step 18 in clause 4.12a.2.2 of TS 23.502[8].

21. The AMF shall send a Registration Reject message via TNGF to the UE as defined in step 19 to step21 in clause 4.12a.2.2 of TS 23.502[8]. The Registration Reject message is ciphered and integrity protected.

22. The UE shall decipher and verify the integrity of the Registration Reject message. If verification is successful, then the UE proceeds with step 21 in clause 4.12.2.2 of TS 23.502[8], and sends a Registration request message to the AMF via a new selected TNGF.

**\*\*\*\* NEXT CHANGES \*\*\*\***

7A.2.1.2 Re-authentication for UE moving from one TNAP to another TNAP connecting to the same TNGF

When UE moves from one TNAP to another TNAP connecting to the same TNGF, if TNAP and TNGF in TNAN support FT, the TNAP in the TNAN advertises the FT capability as in IEEE 802.11 [80]. During the IKE process, the UE also indicates MOBIKE indication if it supports MOBIKE and TNGF acknowledges it if supported.

NOTE 1: It is assumed that TNGF is aware of the FT capabilities of the TNAP in the TNAN. Whether this is done by configuration or signalling internal to the TNAN is left to operator implementations.

The UE and TNGF perform the following in addition to the procedures specified in clause 7A.2.1.1 of the present document. If the TNAP supports FT, the TNGF shall derive a fresh key to enable re-authentication based on FT procedure, i.e. KFT, from KTNGF as specified in A.22 of the present document and either keep KFT if the TNGF acts as the R0KH or send the KFT to the R0KH otherwise. If the UE supports FT and connects to the TNAN supporting the FT, the UE shall determine to enable re-authentication based on FT procedure and derive a FT key, KFT, from KTNGF as specified in A.22 of the present document.

NOTE 2: Where the entity R0 key holder (R0KH) is located in the TNAN is outside the scope of 3GPP.

The UE and R0KH use KFT as Master PMK (MPMK) to construct the FT key hierarchy as specified in IEEE 802.11 [80] to perform re-authentication and security (re-)establishment while the UE switches between different TNAPs within the same mobility domain (i.e., identified by the MDID specified by IEEE 802.11 [80]) connected to the same TNGF. To perform such a switch the UE performs the FT procedure as specified in IEEE 802.11 [80]. The R0KH derives a key PMK-R1 from PMK-R0 and provides the key PMK-R1 to the new TNAP in TNAN during the FT procedure.

After the UE switch between TNAPs is complete, if MOBIKE is supported, the UE may send the request to restore the IPSec connectivity and all IPSec SAs as defined in RFC 4555[111].

NOTE 3: How to configure the MDID used for FT within the TNGF domain is left to Operator’s implementation and deployment. How the 3GPP defined TNGF domain and IEEE defined MDID co-exists/works is outside the scope of this document.

**\*\*\*\* NEXT CHANGES \*\*\*\***

### 7A.2.3 Key hierarchy for trusted non-3GPP access

The key hierarchy described in clause 6.2.1 applies, with the following changes:

The key derived for non-3GPP access is called KTNGF in the context of trusted access.

The key KTNGF received from AMF is used for three different purposes; to setup IPSec SAs between the UE and the TNGF and to create WLAN keys between the UE and the TNAP and to create the root key for IEEE 802.11 Fast BSS Transition (FT).

To separate the keys for these purposes, the key hierarchy in Figure 7A.2.3-1 shall be used. The KTIPSec key is used to setup IPSec SAs, the KTNAP key is used to setup access security and the KFT key is used as the root key for FT.

The keys KTIPSec, KTNAP and KFT are derived as described in Clause A.22.



Figure 7A.2.3-1 Key hierarchy for trusted non-3GPP access

**\*\*\*\* NEXT CHANGES \*\*\*\***

# A.22 KTIPSec, KTNAP and KFT derivation function

When deriving a KTIPSec from KTNGF and when deriving a KTNAP or KFT from KTWIF or KTNGF the following parameters shall be used to form the input S to the KDF.

- FC = 0x84

- P0 = Usage type distinguisher

- L0 = length of Usage type distinguisher (i.e. 0x00 0x01)

The values for the Usage type distinguisher are defined in table A.22-1. The values 0x00 and 0x03 to 0xf0 are reserved for future use, and the values 0xf1 to 0xff are reserved for private use.

The Usage type distinguisher shall be set to the value for IPSec (0x01) when deriving KTIPSec. The Usage type distinguisher shall be set to the value for TNAP (0x02) when deriving KTNAP. The Usage type distinguisher shall bet set to the value for TNAP Key-refresh using FT (0x03) when deriving KFT.

The input key KEY shall be the 256-bit KTNGF or KTWIF.

Table A.22-1: Usage type distinguishers

|  |  |
| --- | --- |
| Usage type distinguisher | Value |
| IPSec | 0x01 |
| TNAP | 0x02 |
| TNAP Key-refresh based on FT | 0x03 |

**\*\*\*\* END OF CHANGES \*\*\*\***

S.3.2 5G NSWO procedures

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**Figure: S.3-1: Authentication procedure for NSWO in 5GS**

1. The UE establishes a WLAN connection between the UE and the WLAN Access Network (AN), using procedures specified in IEEE 802.11[80].

2. The WLAN AN sends an EAP Identity/Request to the UE.

3. The UE sends an EAP Response/Identity message. If the UE determines to use the NSWO service, the UE shall use the SUCI in NAI format (as specified in TS 23.003 [19], clause 28.7.12 and clause 28.7.9.2) as its identity irrespective of whether SUPI Type configured on the USIM is IMSI or NAI. If the SUPI Type configured on the USIM is IMSI, the UE shall construct the SUCI in NAI format with username containing the encrypted MSIN and the realm part containing the MCC/MNC.

4. The EAP Response/Identity message shall be routed over the SWa interface towards the NSWOF based on the realm part of the SUCI.

NOTE 1: NSWOF acts as SBI/AAA proxy between the AUSF and the WLAN Access Network.

5. The NSWOF shall send the message Nausf\_UEAuthentication\_Authenticate Request with SUCI, Access Network Identity and NSWO indicator towards the AUSF. NSWO\_indicator is used to indicate to the AUSF that the authentication request is for Non-seamless WLAN offload purposes. The NSWOF shall set the Access Network Identity to "5G:NSWO".

6. Based on the NSWO\_indicator, the AUSF (acting as the EAP authentication server) shall send a Nudm\_UEAuthentication\_Get Request to the UDM, including SUCI and the Access Network Identity and NSWO indicator.

7. Upon reception of the Nudm\_UEAuthentication\_Get Request, the UDM shall invoke SIDF. SIDF shall de-conceal SUCI to gain SUPI before UDM can process the request. Based on the NSWO indicator and if NSWO is allowed based on the UE subscription data, the UDM/ARPF shall select the EAP-AKA´ authentication method and generate an authentication vector using the Access Network Identity as the KDF input parameter. The UDM shall include the EAP-AKA’ authentication vector (RAND, AUTN, XRES, CK´ and IK´) and may include SUPI to AUSF in a Nudm\_UEAuthentication\_Get Response message.

8. The AUSF shall store XRES for future verification. The AUSF shall send the EAP-Request/AKA'-Challenge message to the NSWOF in a Nausf\_UEAuthentication\_Authenticate Response message.

NOTE 2: The Access Network Identity is carried in the AT\_KDF\_INPUT attribute in EAP-AKA' as defined in RFC 5448 [12].

9. The NSWOF shall send the EAP-Request/AKA'-Challenge message to the WLAN AN over the SWa interface.

10. The WLAN AN forwards the EAP-Request/AKA'-Challenge message to the UE.

11. At receipt of the RAND and AUTN in the EAP-Request/AKA'-Challenge message, the ME shall obtain the Access Network Identity from the EAP signalling and the USIM in the UE shall verify the freshness of the AV' by checking whether AUTN can be accepted as described in TS 33.102 [9]. If so, the USIM computes a response RES. The USIM shall return RES, CK, IK to the ME. The ME shall derive CK' and IK' using the Access Network Identity as the KDF input parameter. If the verification of the AUTN fails on the USIM, then the USIM and ME shall proceed as described in sub-clause 6.1.3.3. The UE may derive MSK from CK’ and IK’ as per Annex F and as described in RFC 5448[12]. When the UE is performing NSWO authentication, the KAUSF shall not be generated by the UE.

12. The UE shall send the EAP-Response/AKA'-Challenge message to the WLAN AN.

13. The WLAN AN forwards the EAP-Response/AKA'-Challenge message over the SWa interface to the NSWOF.

14. The NSWOF shall send the Nausf\_UEAuthentication\_Authenticate Request with EAP-Response/AKA'-Challenge message to AUSF.

15. The AUSF shall verify if the received response RES matches the stored and expected response XRES. If the AUSF has successfully verified, it continues as follows to step 16, otherwise it returns an error to the NSWOF. The AUSF shall derive the required MSK key from CK’ and IK’ as per Annex F and as described in RFC 5448[12], based on the NSWO indicator received in step 5. The AUSF shall not generate the KAUSF.

16. The AUSF shall send Nausf\_UEAuthentication\_Authenticate Response message with EAP-Success and MSK key to NSWOF. The AUSF may optionally provide the SUPI to NSWOF. The AUSF/UDM shall not perform the linking increased home control to subsequent procedures (as stated in present document clause 6.1.4).

17. The NSWOF shall send the EAP-success and MSK to WLAN AN over the SWa interface. The EAP-Success message is forwarded from WLAN AN to the UE.

18. Upon receiving the EAP-Success message, the UE derives the MSK as specified in step 11, if it has not derived the MSK earlier. The UE uses the first 256-bit of MSK as PMK to perform 4-way handshake to establish a secure connection with the WLAN AN.

NOTE 3: An alternative deployment when UE moves to a new WLAN AP and when both the UE and WLAN AN support FT procedure as specified in IEEE 802.11 [I] is to use FT relying on MSK (available to the WLAN AN and UE) to generate the keys necessary.

 **\* \* \* \* End of Change \* \* \* \***