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**Source: Qualcomm Incorporated, Nokia**

**Title: ATSSS\_Ph4 Solution for KI 2.2: Architecture for ATSSS-Lite**

**Document for: Discussion/Approval**

**Agenda Item: 19.13**

**Work Item / Release: FS\_MASSS / Rel-19**

*Abstract of the contribution: Discusses a possible solution for KI 2.2 (Simplified ATSSS architecture over non-3GPP access).*

# 1. Discussion

This pseudo-CR proposes a solution for ATSSS\_Ph4 KI 2.2 (Simplified ATSSS architecture over non-3GPP access) based on the concept of Non-Integrated Non-3GPP Access (abbreviated in NIN3A, pronounced “Ninja” 🥷).

# 2. Text proposal

It is proposed to agree the following changes vs. TS 23.700-54:

>>>>BEGINNING OF CHANGES<<<<

# 3 Definitions of terms and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Non-Integrated Non-3GPP Access:** a type of non-3GPP access network that provides direct IP connectivity between the UE and the UPF without any intermediate NF such as Non-3GPP InterWorking Function (N3IWF) and Trusted Non-3GPP Gateway Function (TNGF). When a UE is connected using Non-Integrated Non-3GPP Access, the UE data flows can be routed via this access to operator and third party offered 5G services.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

NIN3A Non-Integrated Non-3GPP Access

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## 6.0 Mapping of Solutions to Key Issues

Table 6.0-2: Mapping of ATSSS\_Ph4 Solutions to Key Issues

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Key Issues for ATSSS\_Ph4 | | | |
| Solution# | <Key Issue #2.1> | <Key Issue #2.2> |  |  |
| X |  | X |  |  |
|  |  |  |  |  |
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## 6.2 Solutions for ATSSS\_Ph4

### 6.2.X Solution #X: Architecture for ATSSS-Lite

#### 6.2.X.1 Description

##### 6.2.X.1.1 Introduction

This solution addresses KI 2.2 (Simplified ATSSS architecture over non-3GPP access) and introduces the architecture for a lightweight version of ATSSS, name ATSSS-Lite. This new architecture is based on the principles described in the following subclauses. The solution does not apply to ATSSS-LL.

##### 6.2.X.1.2 Architecture without TNGF/N3IWF

This solution proposes an architecture in which there is no gateway for access to 5G CN via non-3GPP access, such as TNGF (for trusted non-3GPP access) or N3IWF (for untrusted non-3GPP access). In particular, the UE does not establish any IPSec connection to the 5G CN. Instead, the UE connects to the UPF via the public IP network (Internet) over a new interface named Nx. The existing UPF and ATSSS related traffic handling is extended in such way that a PDU session over the native non-3GPP access used in ATSSS is logically replaced by a secure connection that is used to transfer UP traffic between UE and UPF. The connection between the UE and the UPF over the Nx interface is secured using TLS. There are no explicit resources reserved in the native non-3GPP access, which just provides IP connectivity to the UE, allowing the UE to connect to the UPF in a secure manner. Traffic handling is done like in ATSSS, but with only difference that the non-3GPP access leg of the MA PDU Session is now replaced with the secure connection over native non-3GPP access.

The **ATSSS-Lite** architecture, in case of non-roaming and roaming scenario is described in Figures 6.2.X.1.2-1 and 6.2.X.1.2-2, respectively.



Figure 6.2.X.1.2-1: Baseline ATSSS-Lite architecture (non-roaming scenario).



Figure 6.2.X.1.2-2: Baseline ATSSS-Lite architecture (roaming scenario).

It is assumed that the UPF acting as anchor for the ATSSS-Lite connectivity supports the new Nx interface. The UPF processes the traffic according to the traffic handling rules (MAR/N4 rules) provided by the SMF (this aspect is inherited from ATSSS and is described more in detail in subclause 6.2.X.1.4).

Editor’s Note: security aspects related to exposing a new IP communication endpoint to be reachable directly by the UE over non-3GPP access may need further investigation by SA3.

##### 6.2.X.1.3 Non-Integrated Non-3GPP Access and re-use of the MA PDU Session concept

The ATSSS-Lite architecture leads to the notion of **Non-Integrated Non-3GPP Access (NIN3A)** (see clauses 3.1 and 3.2). The solution proposes to reuse the definition of **Multiple Access PDU Session** described in TS 23.501 [3] clause 3.1 **for NIN3A**, which reads as follows:

***MA PDU Session:*** *A PDU Session that provides a PDU connectivity service, which can use one access network at a time, or simultaneously one 3GPP access network and one non-3GPP access network.*

Figure 6.2.X.1.3-1 depicts a simplified diagram of a MA PDU Session applied to one 3GPP access and one Non-Integrated Non-3GPP Access.



Figure 6.2.X.1.3-1: MA PDU Session with Non-Integrated Non-3GPP Access

##### 6.2.X.1.4 Re-use of high layer steering functionality and traffic security

The assumption for ATSSS-Lite is that the steering functionalities in the UE and in the UPF are high layer steering functionalities. They are based on the existing MPTCP and MQUIC steering functionalities that are used in the legacy ATSSS (see TS 23.501 [3] clauses 5.32.6.2.1 and 5.32.6.2.2).

Editot's Note: Whether only the MPQUIC functionality or both the MPQUIC and the MPTCP steering functionalities are going to be supported, can be decided based on the conclusion of KI#2.1 (MPQUIC steering functionality to steer, switch and split non-UDP traffic).

The traffic exchanged between UE and UPF (in terms of confidentiality and integrity protection) can be protected using the Transport Layer Security protocol (TLS).

NOTE: Further security details can be discussed by SA3, if and when needed.

##### 6.2.X.1.5 Protocol stacks connectivity via Non-3GPP

The solution is based on the following assumptions:

* The NAS signaling between UE and CN is carried only over the 3GPP access. This implies that there is no need to have NAS signaling between UE and CN exchanged over NIN3A when the UE is connected via 3GPPA. Consequently, no CP protocol stack between UE and CN over Nx interface is needed.

NOTE: How the communication between UE and UPF via NIN3A is established and managed is discussed in other solutions which are based on the architecture of this solution.

Editor's Note: Whether and how there is a need to establish, manage and maintain communication between UE and UPF via NIN3A when the UE is not connected via 3GPPA is FFS.

* Since, as explained in 6.2.X.1.4, there is no need of establishing an IPSec tunnel between UE and network over NIN3A, the UE UP protocol stack for the non-3GPP access can be simplified. Figure 6.2.X.1.5-1 depicts the user plane protocol stack over Nx interface.



Figure 6.2.X.1.4-1: UP Protocol Stack for Nx interface

##### 6.2.X.1.6 Re-use of steering modes, MPTCP/MQUIC measurements and extension URSP/ATSSS/N4 rules

Since the steering functionality for ATSSS-Lite is based on MPTCP or MPQUIC, the MPTCP/MQUIC measurements mechanisms can be used instead of the 3GPP defined PMF (Performance Measurement Function) to measure Round Trip Time (RTT) and Packet Loss Rate (PLR). Because of that, at least in principle, the existing ATSSS steering modes (with thresholds, where applicable), namely, Load Balancing, Shortest Delay, Active-Standby, Priority Based and Redundant Steering Mode can be applied also to MA PDU Sessions with NIN3A.

Similarly, the URSP rules, currently used in the 5GS by the PCF to indicate to the UE which traffic is subject to ATSSS, can be extended to indicate which traffic is subject to ATSSS-Lite (i.e., which traffic can be transferred using NIN3A). The same principle can be applied to the ATSSS rules (for the UE) and the MAR/N4 rules (for the UPF), so that the SMF can indicate to the UE and UPF *how* the traffic subject to ATSSS-Lite is to be handled.

Editor’s Note: Details of how URSP rules, ATSSS and MAR/N4 rules can be extended are FFS.

The assumption

#### 6.2.X.2 Procedures

The procedures in this clause describe how the MA PDU Session can be established for ATSSS-Lite and how the appropriate SMF and UPF can be selected according to the indicated UE capability. Figures 6.2.X.2.1-1 and 6.2.X.2.1-2 describe two options of how a MA PDU Session over the Nx interface can be established. Such Figures are based on a simplified version of TS 23.502 [4] Figure 4.3.2.2.1-1 and on the procedure described in TS 23.502 [4] clause Clause 4.22.2.1, with the key enhancements highlighted.

In the procedures, SMF selects the UPF based on an ATSSS-Lite indication from the UE, and then the SMF requests the UPF for its Access Info data to be used with this MA PDU session. Access Info data includes communication parameters of how the UPF may be reached, such as IP addresses, port numbers or FQDNs, credentials, security keys and other relevant information depending on the used steering functionality, i.e., MP-QUIC. One Access Info data may be associated with one MA PDU session, and it is steering functionality specific. In addition, the Access Info data is dynamic in nature, and it may have lifetime during which the UPF is reachable for the UE to establish a secure connection via the native non-3GPP access. If the UE has not managed to establish a secure connection within the given timeframe, then the given Access Info data is expired, and the UE needs a new one by requesting PDU Session modification from the SMF (as shown in Figure 6.2.Y.3‑2). It is the UPF's responsibility to provision and monitor this lifetime.

##### 6.2.X.2.1 Option 1: ATSSS capable SMF does not support ATSSS-Lite

This option does not assume that an ATSSS capable SMF supports ATSSS-Lite.



Figure 6.2.X.2.1-1: Simplified ATSSS-Lite MA PDU Session Establishment – Option 1

The main steps of the MA PDU Session Establishment procedure for ATSSS-Lite can be summarized as follows:

1. When sending the PDU Session Establishment Request to the CN, the UE Includes a request to establish a MA PDU Session Request as well as its ATSSS-Lite capability indication.

2. Based on such indication and request, the AMF selects an ATSSS-Lite capable SMF (which may, but does not have to, support legacy ATSSS), or if no such SMF is available, rejects the request and notifies the UE.

3. The AMF forward the indications from the UE to the SMF.

4. The SMF, based on the ATSSS-Lite capability indication of the UE forwarded by the AMF and with the help of NRF, selects a UPF that is configured to receive/send traffic over the Nx interface. If no such UPF is available, the session cannot be established, and this is notified to the UE.

5. The SMF establishes SM policy association with the PCF and receives ATSSS rules. The SMF establishes the UP resources in the UPF and instructs it with the related N4 Rules. The SMF instructs the UPF to activate MPTCP or MPQUIC functionality, and requests Access Info data from the UPF and the UPF sets new timer for the Access Info data. The UPF allocates the UE "MPTCP link-specific multipath" or the UE "MPQUIC link-specific multipath" addresses/prefixes.

6. The SMF establishes the necessary UP resources over the 3GPP access network, indicates the ATSSS rules to the UE. The SMF provides to the UE the provides Access Info data , including the MPTCP or MPQUIC link-specific multipath addresses/prefixes of the UE and the MPTCP or MPQUIC proxy and the necessary information (e.g., TLS security material including any required certificates for MPTCP/MPQUIC Proxy) for the UE to establish the MPTCP/MQUIC session over NIN3A.

After step 6, the UE is able to establish the communication with the UPF via NIN3A/Nx interface. For MP-QUIC, once the PDU Session is established the UE first establishes an MP-QUIC connection with the UPF and adds the first path of the MP-QUIC connection via the 3GPP access. If the UE also has another IP connectivity via a native non-3GPP access, the UE then creates a second MP-QUIC path to the UPF over the native non-3GPP access using the Access Info data received from the SMF during PDU Session establishment. The QUIC layer takes care of using the existing secure context that was created when the MP-QUIC connection was established over 3GPP access.

As soon as the communication is established, the UE and the UPF can exchange UP data over both accesses according to the ATSSS rules and the MAR/N4 rules received from the SMF.

##### 6.2.X.2.2 Option 2: ATSSS capable SMF supports ATSSS-Lite

This option assumes that an ATSSS capable SMF supports ATSSS-Lite.



Figure 2: Figure 6.2.X.2.2-2: Simplified ATSSS-Lite MA PDU Session Establishment – Option 2

With the assumptions above, Option 2 is based on the same steps of Option 1, with the key difference that the (legacy) ATSSS capability indication is sent by the UE to enable the AMF to select the SMF, while the SMF selects an ATSSS-Lite capable UPF (i.e., a UPF capable to receive/transmit traffic over the Nx interface) based on the ATSSS-Lite capability indication included in the extended protocol configuration option IE (ePCO) of the PDU Session Establishment message.

##### 6.2.X.2.3 Enhancements to MA PDU Session Modification



Figure 6.2.X.2.3-1: MA PDU session modification for using native non 3GPP-access.

Step 1: The UE issues new PDU session modification request (for the MA PDU session supporting ATSSS between 3GPP and native non-3GPP access) to get a new Access Info data.

Step 2: The SMF requests Access Info data from the PSA UPF of MA PDU Session.

Step 3: The SMF provides Access Info data in Session Modification Accept to the UE.

Step 4: Using Access Info data, the UE adds a new path to the MP-QUIC connection (QUIC takes care of security etc.).

NOTE: While Access Info data is valid, the UE may try to repeat Step 4, via different native non-3GPP access.

#### 6.2.X.3 Impacts on services, entities and interfaces

UE

- Indicates UE ATSSS-Lite Capability

Editor’s Note: whether this is indicated only in SM signalling at PDU session establishment or also to AMF is FFS.

- Receives Access Info data from the SMF.

- Creates new MPTCP/MP-QUIC path to the existing MA PDU session using the received Access Info data.

- Ability to request new Access Info data from the SMF via PDU Session modification procedure.

AMF (in option 1 only)

- Uses UE ATSSS-Lite Capability to select ATSSS-Lite capable SMF

SMF

- Uses UE ATSSS-Lite Capability provided by the UE to select ATSSS-Lite capable UPF

- Provisioning of new MPTCP/MPQUIC information between UPF and UE.

- Support of MA PDU Sessions via non-3GPP access without a SM NAS connection via non-3GPP access. This includes handling of the MA PDU Session in case the UE is not reachable via 3GPP access.

- Indicates to UE whether ATSSS-Lite MA PDU Session is accepted or not.

- SMF:

- Receives in PDU Session establishment request, an indication for support of ATSSS-Lite and selects an UPF that supports this feature.

- Query Access Info data from the UPF and provide it to the UE.

- Receives request from UE, in PDU Session Modification, to fetch fresh Access Info data from UPF, Query Access Info data from the UPF and provide it to the UE.

- UPF

- Supports Nx interface by exposing new communication endpoint(s) (i.e., Access Info data) reachable via native non-3GPP access network for adding a new path for the MPTCP/MP-QUIC connection.

- Provides Access Info data when requested by SMF.

- Provisions and monitors of Access Info data lifetime.

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