**SA WG2 Meeting #139-e S2-2000xxxx**

**Online, 1-12 June, 2020 (revision of )**

**Source: Nokia, Nokia Shanghai Bell**

**Title: establishment of association on user plane for paging notification on user plane**

**Document for: Approval**

**Agenda Item: 8.4**

**Work Item / Release: FS\_MUSIM**

*Abstract of the contribution: xxx*

# Discussion

In clause 6.7 a solution is proposed allowing for push notifications to be sent to the UE on user plane, thus allowing a UE to be connected on one system and at the same time to receive paging or other USIMs by means of user plane notification.

This paper expands that solution by providing details on how to achieve the establishment of user plane security.

The solution can work by a separate push notification server in the HPLMN of the USIM that is registered to send push notification, or directly for AMF. if AMF and push notification server are separate 9e.g. to provide a gateway towards external networks) then an open interface between such server and the AMF needs to be provided to deliver notifications. This server may also implement NAT traversal schemes if the PDU session established in the other PLMN with the other PLMN subscription is associated to a private addressing scheme not reachable on the Internet for notifications. If so, the MUSIM UE camping on a PLMN must also keep the NAT traversal alive with the PLMN(s) of the other USIM(s).

# Proposal

It is proposed to add the following text to TR 23.761

**Proposed changes**

## 6.X Solution #X: establishment and maintenance of push notifications for paging.

### 6.X.1 Introduction

This solution addresses KI#2,3 . this is a variant of the solution in clause 6.7 where the establishment of security between the MUSIM UE and the (various) USIM(s) PLMN(s) providing push notifications is clarified.

### 6.X.2 Functional Description

In this description we refer to 5GS and to the case of 2 USIMs, but it can be generalised to EPS and to more than two USIMs.

1) The UE registers as UE-1 on PLMN-1 and as UE-2 on PLMN-2. Note that PLMN-1 and PLMN-2 need not be the HPLMN of the UE-1 for USIM-1 and UE-2 USIM-2. They are just the serving PLMNs the virtual UEs the MUSIM UE is comprised of select. The PLMNs provide indication about whether they support paging notification via user plane of the other network. This information could be provided either in broadcast channel or in registration response message (the latter is used in the message sequence).

2) The UE-1 establishes a PDU session on PLMN-1 which is suitable to obtain notifications (e.g. an Internet APN). This corresponds to address IP-1. If the UE is behind a NAT, IP-1 may also be the result of a NAT traversal binding as observed by a server in PLMN-2 (in which case also a port number for NAT traversal may be added part of this information also)

3) The UE-2 establishes a PDU session on PLMN-2 which is suitable to obtain notifications. This corresponds to address IP-2. If the UE is behind a NAT, IP-2 may also be the result of a NAT traversal binding as observed by a server in PLMN-2 (in which case also a port number for NAT traversal may be part of this information also)

4) If PLMN-1 indicated support, UE-1 further registers with PLMN-1 AMF-1 the IP-2 and provides the security key, SEC-2, which AMF-1 needs to use to encrypt and integrity protect the notifications towards IP-2. AMF-1 returns to the UE-1 a handle for PLMN-2 that UE-1 needs to use to specify that PLMN-2 is actively receiving paging notifications on user plane for PLMN-1 and UE-1 at IP-2, and it shall not start considering PLMN-2 active for such task till the UE indicates so by a subsequent registration with this handle (Handle-2). At any time, the UE-1 and PLMN-1 may refresh this Handle value and related security key SEC-2 when executing a registration procedure. IP-2, Handle-2, SEC2 are stored in the AMF-1 UE context.

5) If PLMN-2 indicated support, UE-2 further registers with PLMN-2 AMF-1 the IP-1 and provides a security key, SEC-1, which AMF-2 needs to use to encrypt and integrity protect the notifications towards IP-1. AMF-2 returns to the UE-2 a Handle (handle-2) for PLMN-1 that UE-2 needs to use to specify that PLMN1 is actively receiving paging notifications on user plane for PLMN2 and UE2 at IP-1, and it shall not start considering PLMN-1 active for such task till the UE indicates so by a subsequent registration with this handle. [As an alternative, the AMF may provide the security key SEC1 alongside handle 1 (Handle 1) At any time the UE2 and PLMN2 may refresh this Handle-1 value and related security key SEC-1 when executing a registration procedure. IP-1, Handle-1, SEC-1 are stored in the AMF-2 UE context

6) The UE decides internally which PLMN should be the master and receive paging notifications from other PLMNs to the UE.

7) This decision could be a UE-specific implementation. One example would be the UE utilizes the very first PLMN it registered to as master. Or, the MUSIM UE selects the one where it is currently connected, if in all other PLMNs the UE is idle mode.

8) When (for example) the UE selects PLMN-1 to act as the PLMN where the user plane paging notification need to be delivered for UE-2 (i.e. PLMN1 is master), it causes UE-2 to indicate to PLMN-2 in a registration message that the PLMN identified by Handle-1 is ready to take paging notifications on the user plane for UE-2 at IP-1.

- These stops PLMN-2 delivering paging on the control plane for UE-2.

- UE-2 stops monitoring paging channel on PLMN-2.

Note: It can be observed that If PLMN-1 and PLMN-2 are the same PLMN, there is no difference in behaviour as the handle per se identifies a UE+PLMN pair and not just a PLMN.

9) When (for example) UE-2 receives on PLMN-1 a notification at IP-1, this notification message is encrypted, and integrity protected by using the Key that UE-2 had provided and it includes that it needs to respond to a page for PLMN-2 and the Handle-1 to identify the UE-2 in PLMN-2 and the security association. The details of the paging notification format are FFS but it may include a correlation ID to identify the paging transaction.

a) If the UE-2 decides to accept the paging notification, it shall indicate by registration message to AMF-1 that PLMN identified by Handle-2 is becoming the one receiving paging notifications on user plane at IP-2 for UE-1, and then UE-2 proceed to execute a service request in PLMN-2. PLMN-1 stops paging the UE on C-plane in PLMN-1.

b) If the UE-2 decides NOT to respond to paging, it provides a response on the user plane by replying to the incoming paging message, indicating to AMF-2 to stop paging the ongoing paging on user plane towards IP-1 for UE-2 as it is busy. The AMF-2 includes in the paging notification a correlation value so it can understand what paging notification a response about. This message uses the Handle-1 provided to AMF-2 by UE-2 to identify IP-1 on PLMN-1 for the AMF-2 to understand the security association and decrypt the message using the secret key UE-2 has provided for IP-1.

### 6.X.3 Procedures



Figure 6.x.3-1: outline of the message flows involved in this solution.

In the diagram above we only show interaction with AMFs. Similar concepts apply with MMEs. Also, a Push notification server is not indicated however the deployment may also comprise the AMFs interacting with a push notification server by an open interface used to relay the messages to and from it. Messages from the UE to the Push notification server shall include the GUAMI for routing purposes. Note that PLMN-1 and PLMN-2 need not be the HPLMN of the UE-1 for USIM-1 and UE-2 USIM-2. They are just the serving PLMNs the UEs select.

1. The UE-1 for USIM-1 registers in PLMN-1 and PLMN2. It indicates support of UP paging notification in MUSIM assistance info). For sake of argument we suppose both the two PLMNs support UP notification.
2. The UE-2 for USIM-2 obtains a suitable IP address in PLMN1. It may here execute a NAT traversal protocol to find out the outside IP@ and port number. This is recorded as IP-1 in the UE.
3. The UE obtains a suitable IP address in PLMN 2. It may here execute a NAT traversal protocol to find out the outside IP@ and port number. This is recorded as IP-2 in the UE.
4. The UE-1 for USIM 1 may register with PLMN 1 AMF-1 the IP-2 and provide a Security Key for the encryption and Integrity protection of Push notifications SEC-2. The AMF-1 stores IP-2 and SEC-2 alongside a Handle it assigns to identify this security association (Handle 2). Handle-2 is provided to the UE-1 in registration accept.
5. The UE-2 for USIM 2 may register with PLMN 2 AMF-2 the IP-1 and provide a Security Key for the encryption and Integrity protection of Push notifications SEC-1. The AMF-2 Stores IP-1 and SEC-1 alongside a Handle it assigns to identify this security association (Handle 1). Handle-1 is provided to the UE-2 in registration accept.
6. The MUSIM UE determines that PLMN-1 is the master PLMN
7. UE-2 by means of registration indicates that the paging messages need to be delivered to the endpoint identified by Handle-1
8. The AMF-2 needs to page UE-2. Since UE-2 is registered for push notification, AMF-2 initiates paging on the user plane towards IP-2 securing the notification with SEC-1 and prepending handle -1 for identification of security association.

Editor's Note: the format of the handle must ensure it is globally unique, it is FFS. It may also allow using it to rout to the right AMF that has assigned it.

1. UE-1 received the paging notification on the user plane. It detects the handle is associated to USIM2. So it delives the notification to UE-2. The two cases 10a or 10b may occur.

10a. The MUSIM UE decides to respond to paging for UE-2 on PLMN-2. UE-1 registers with AMF-1 PLMN2 as the one to send notifications to by providing Handle-2. Then it abandons PLMN-1 and performs a service request in PLMN-2. This cause the PLMN2 to become the master PLMN.

10b The MUSIM UE decides to not respond to paging. So it responds on the user plane to AMF-2 to stop paging indicating Handle 1. The format of this message is FFS, but it includes handle 1 so this can be routed to AMF-2.

### 6.X.4 Impacts on existing entities and interfaces

UE: support UP notifications as outlined above

AMF, MME: support of support UP notifications as outlined above

Push notification server: may be required as new entity.

**End of Proposed changes**