**3GPP TSG-WG SA2 Meeting #140E e-meeting *S2-2005487r014***

**Elbonia, August 19 – September 1, 2020 (revision of S2-200xxxx)**

**Source: Huawei, HiSilicon**

**Title: KI#1 Interim Evaluations**

**Document for: Approval**

**Agenda Item: 8.10**

**Work Item / Release: FS\_MUSIM / Rel-17**

*Abstract: This contribution provides initial evaluations for the solutions which address KI#1.*

# 1. Introduction/Discussion

As FS\_MUSIM starts to draw to a close it is time to start initial evaluations for the solutions for the different key issues. This contribution provides initial evaluations for KI#1.

KI#1 studies:

- How to handle the MT service for a Multi-USIM device with the aim of avoiding any unnecessary interruptions of the service in the current system and saving system resources.

- How to prevent the other system, which triggered the paging message, from performing undesirable operations (e.g. wasting resources, reaching misleading assumption of reachability, etc.).

- Solutions shall be studied for both EPS and 5GS. For 5GS, the solutions shall consider the cases where the Multi-USIM device in the current system is in either IDLE state or RRC Inactive state.

An evaluation is provides that includes a brief description of the solution and whether it addresses the studied areas of the KI.

In addition this pCR includes evaluations of solutions that address both KI#1 and KI#2 which studies:

- How the system can enable operation when the paging associated with the 3GPP RATs and systems in which the Multi-USIM device is in Idle state or RRC\_Inactive state (for 5GS) overlap in time?

- Whether and how the network needs to be aware of specific UE communication constraints (e.g. Single Rx) in order to enable the Multi-USIM device to receive paging for each of the registered USIMs?

# 2. Text Proposal

It is proposed to capture the following changes vs. TR 23.761.

\* \* \* \* First change (all new) \* \* \* \*

# 7 Evaluations

## 7.x Evaluation of Solutions for Key Issue 1: Handling of Mobile Terminated service with Multi-USIM device

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| Solution #1 | This solution introduces additional information into the paging message to indicate why the UE was paged. Based on the indication and potential ongoing service on the other USIM, the UE determines whether to respond to the page or not. The UE does not need to respond to paging. The solution avoids responding to paging to identify why the UE was paged, thus minimizing any impact on the ongoing service on the other USIM. In the case the UE does not respond to the page, the paging request will be escalated and waste radio resources within the whole registration area. Furthermore, the AMF may think the UE suffers from RLF or lost power.  The granularity of the indication is under discussion. A complete evaluation will be made once this is finalized.  The solution can be applied to both RRC\_Inactive and RRC\_Idle.  The solution has UE, RAN and core network impacts.  Privacy considerations are under evaluation by SA3. |
| Solution #2 | The solution introduces a mechanism for the UE paged in network B to negotiate a one-off period of absence with network A to allow responding to paging in network B. Other activity may also be performed by the UE during the negotiated period of absence. However no user control of the solution is described. While performing the other operations some service interruption may occur in the other USIM (depending upon service).  The solution can prevent unnecessary interruptions of the current service (depending on the impact of the negotiated period of absence on the current service) by determining full necessary details of the incoming service (i.e. voice call form who, what data etc.), as if the incoming service is not desired the current service is not disconnected.  The solution requires the UE to respond to paging, thus preventing paging escalation (under normal conditions).  The solution has UE and RAN impacts.  Whether solution #2 is similar to RRC procedure for graceful leaving in clause 6.5.3.3 of solution #5 where the pause time can also serve the same purpose and therefore whether solution #2 can be merged with solution #5 is subject to feedback from RAN groups.  The duration of the period of absence is subject to RAN confirmation. |
| Solution #3 | This solution adds a response to paging to inform the paging network that the UE has received the page but does not want to / cannot fully engage in the MT triggered service at this time, and is intended to be used in addition to other solutions for KI#1. While performing the response some service interruption may occur in the other USIM (depending upon service).    The solution requires the UE to respond to paging, thus preventing paging escalation (under normal conditions). The solution may have RAN impact to support RRC-Inactive.  The solution has UE, RAN and core network impacts. |
| Solution #7 | Solution #7 additionally addresses “Key Issue 2: Enabling Paging Reception for Multi-USIM Device”.  The solution is based on the deployment of an internet facing IP based service protocol that the UE accesses via the current serving network to receive push notifications of paging. The protocol used for the push notifications is to be defined.  The UE must maintain a connection to the paging server via the serving network while it is in CONNECTED. The protocol used for paging via the paging server is not defined. The details of the authentication are to be defined. The NAS layer in the UE has to support IP communications and be triggered to respond to paging based on traffic via IP.  The solution requires paging the UE in network A and after some delay via network B. If the UE monitors paging in both networks, there is a possibility that the UE does not receive either paging. If the UE only monitors paging in network B, the UE can receive the paging. The solution introduces some delay for paging and paging resource wastes. The MNO has to maintain a new internet facing service for the UEs to register with. The AMF/MME in the network also has to connect to the external facing server. It is not defined what protocol is used for the AMF/Paging Server.  When actively communicating with one network the UE does not need to listen to paging in the other network.  The solution prevents unnecessary interruptions of the current service to receive paging.  The user, depending upon service plan from serving network, may be charged by the serving network for the data required for the paging server i.e. control plane signaling in one network (typically not charged to the end user) may end up being charged to the user in the other network.  The solution has UE and core network impacts. It requires deployment of a paging server as well as necessary secure interactions between this server, the UE and the network. |
| Solution #8 | This solution uses N3GPP access to register with an N3IWF on the non-serving network and a new paging indication is sent via the N3GPP service to inform the UE about paging. The AMF can determine whether the UE is reachable via the 3GPP access based on the N3GPP registration. Additional information to enable paging filtering by the network for each PDU Session may be provided.  The solution requires the UE to support N3GPP access and register and maintain a connection to the N3IWF while the UE is in CONNECTED on the serving network.  The solution may prevent unnecessary interruptions of the current service and the level of service differentiation is at the PDU Session level. Depending upon how services map onto PDU Sessions broad categories for how the user/UE determines what is unnecessary may only be possible.  The solution prevents unnecessary interruptions of the current service to receive paging.  The user, depending upon service plan from serving network, may be charged by the serving network for the data required for the N3GPP access.  The solution has UE and core network impacts. It requires deployment of N3IWF as well as necessary (secure) interactions with the UE and the network. |
| Solution #9 | This solution is intended to be used in addition to solution #1 to filter paging into different groups based on the incoming callers identity. The identities are provided to the non-serving network to enable the grouping and each of the groups provide a different paging cause to the UE.  There may be privacy issues providing the grouping of preferred and non-preferred for each incoming caller to the network. The additional benefit of grouping by preferred and non-preferred is not clear. The total number of groups is unclear as some identities may not be included is either of the groups and the behaviour in this case is not clear..  The solution has UE and core network and IMS services impacts.  The solution requires user interaction to determine the callers identities and whether preferred/not preferred and to update the settings in the network. Additional MMI impacts are expected. |
| Solution #10 | The solution uses PPI to enable the network to filter paging for the UE. The UE provides the rules for filtering in the Registration procedure.  When the network pages the UE, the network determines whether to page based on the PPI and filtering rules provided by the UE. The filtering rules are expected to be coarse (voice, data, SMS etc.).  How and when the filtering rules are updated is not defined. The rules apply at all times including when the UE is in IDLE or CONNECTED on the serving network, therefore incoming services maybe filtered whether needed or not. A more dynamic update from the UE will introduce significant additional signaling and it is not clear how that signaling interacts with the state of the serving network. While performing the establishment of new filtering rules, some service interruption may occur in the other USIM (depending upon service).If the filtering is only updated when the UE leaves the network some overhead ay be reduced.  The solution may prevent unnecessary interruptions of the current service but only for very broad categories for how the user/UE determines what is unnecessary (i.e. voice call but not who from, data arrival but not what etc.).  The solution requires the UE to respond to paging and avoids the network to page services that are filtered out, thus preventing paging escalation (under normal conditions).  The solution makes the UE unreachable for services that are filtered out.  The solution has UE RAN and core network impacts. The solution may require user interaction and related MMI impacts are expected. |
| Solution #11 | This solution adds an upper time bound for when the UE must respond to (NAS) paging and provides a response to paging to inform the paging network that the UE/user has received the page but does not want to / cannot fully respond at this time. No additional information is proposed in paging.  The solution does not prevent unnecessary interruptions of the current service (service dependent), as it requires the UE to respond, however the response may be delayed for a period of time. The solution prevents paging escalation (under normal conditions). The solution is expected to only need a short duration gap.  The solution has UE and core network impacts. |
| Solution #12 | Solution #12 additionally addresses “Key Issue 2: Enabling Paging Reception for Multi-USIM Device”.  When the UE is paged, if there is no response an SMS is sent to the UE using MSISDN of the serving network. The UE has to provide the non-serving network with the MSISDN the UE uses on the serving network.  There may be privacy issues with providing the non-serving network the MSISDN from the serving network.  SMS is not a time critical service therefore the SMS based paging notification maybe delayed without warning.  The solution requires paging the UE in network A and after some delay via network B. If the UE monitors paging in both networks, there is a possibility that the UE does not receive either paging. If the UE only monitors paging in network B, the UE can receive the paging. The solution introduces some delay for paging and paging resource wastes.  The NAS layer in the UE has to support being triggered to respond to paging based on receiving SMS messages from another network. The solution does not introduce any mechanisms for the UE to perform any activity with the other network that is not actively communicating with (e.g. listen to paging, respond to paging, perform mobility update etc.), however the UE does not need to listen to paging.  The solution may prevent unnecessary interruptions of the current service but only for very broad categories for how the user/UE determines what is unnecessary (i.e. voice call but not who from, data arrival but not what etc.). The service categories and how they are determined is not defined.  The solution may not prevent paging escalation, as the SMS may be delayed.  The user, depending upon service plan from serving network, may be charged by the serving network for paging notification SMS. The solution has UE and core network impacts. |
| Solution #13 | The solution targets asymmetric scenarios where a “serving” network provides data services and a “non-serving” network provides IMS voice and SMS-over-IMS. It does not intend to support data services on the non-serving network.  The UE registers with the non-serving network via its ePDG/N3IWF using an IP connection through the serving network. Prior to registering the UE detaches/enters MICO mode on the non-serving network. When a MT IMS voice call or SMS is received, SIP signaling is initiated towards the UE via the ePDG/N3IWF.  The solution relies on existing mechanisms (e.g., paging) when in IDLE mode in the serving network to inform the UE of MT services on the non-serving network.  The solution prevents unnecessary interruptions of the current service to receive paging and to respond for non-serving network’s IMS voice and SMS services.  When the user accepts the voice call from the “non-serving” network, the media plane can be established over the top of the “serving” network or directly over 3GPP access in the “non-serving” network. In the case of the media plane being established directly over the 3GPP access (step 10A in Figure 6.13.3-1) the “non-serving” network temporarily becomes the “serving” network for the duration of the voice call and the solution does not explain how MT services on the previous “serving” network are handled.  Charging records may be generated by the serving network for the data required.  The solution has UE and core network impacts. |

\* \* \* \* End of changes \* \* \* \*