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METHOD TO SOLVE MT CALL FAILURES IN 5G NETWORK DUE TO USER PLANE STATE MISMATCH

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ABSTRACT

Presented herein is a solution that solves the mobile terminal call failure due to user plane state mismatch in a framework provided by N4 and N2 3GPP protocols.

DETAILED DESCRIPTION

One of the observations from a 5G network is that the user equipment (UE) and G-Node B (gNB)/Core network is going out of sync with respect to user plane state.

Consider a case where UE has IMS PDN session and the user plane is activated. If the UE goes out of sync with the network and if it thinks that user plane is not established, whereas the gNB /UPF has the N3 tunnel established, data traffic would be impacted.

The chances of the UE going out of sync are greater when the UE has both data and IMS sessions and when the UE is doing idle mode inter radio access technology (RAT) handovers.

IMS sessions typically are always-on sessions and during idle mode handover, the UE initiates handover with PDU session to be activated as true for IMS sessions. While this handover is going on, if the data network (DN) also needs to be activated, then there is a possibility of user plane state in the UE going out of sync with the network. There are other scenarios also where the UE can go out of sync with the network.

If the UE is out of sync with the network with respect to user plane state and if it wants to initiate uplink traffic, it initiates a service request with uplink data status indicating pending uplink data. The Access and Mobility Management Function (AMF) then initiates a sm-context-update message to the Session Management Function (SMF) indicating upCnxState as ACTIVATING. As per the 3GPP spec, if SMF gets this indication while the upState is already in ACTIVE state, the SMF has to delete the AN tunnel and re-establish N3. The standard does not discuss sending an N2 release with upCnxState=Deactivated on getting upCnxState as ACTIVATING. The Smf cleans the tunnel on the UPF and also

locally. After that, the SMF initiates N2 PDU Session Resource Setup again with UPF tunneld endpoint identifier (TEID).

Upon getting resource setup message from the SMF, the gNB finds that it already has a N3 tunnel active and it sends a PDU Session Resource Setup Response with cause radioNetwork: multiple-PDU-session-ID-instances.

Then, the SMF would update the UPF to mark the tunnel as deactivated and also enable buffering. After this there is a deadlock. The UPF, upon getting downlink packets sends DLDR. The SMF sends a N2 PDU Session Resource Setup, but the gNB rejects it with same cause and this goes in a loop.

Once the issue happens, there is no way get out of it unless the user reboots the UE or does airplane mode entry/exit. When the user wishes to make a call, he would realise there is something wrong and he would either restart the phone or toggle the airplane mode. But a MT call to the UE will not work until the UE reattaches to the network.

Presented herein is a solution that solves this problem within the existing framework provided by N4 and N2 3GPP protocols.

Upon getting upCnxState=ACTIVATING when the user plane is already in ACTIVATED state,

1. SMF sends N4 modification request to UPF with update-far with buff=1 NOCP=1 to enable buffering of downlink packets and also disabling DLDR.
2. SMF sends N2 PDU Session Resource Setup with same UPF TEID in sm-context-update response to AMF.
3. If GNB already has N3 in active state, it sends PDU Session Resource Setup Response with cause, radioNetwork: multiple-PDU-session-ID-instances.
4. SMF sends N4 modification with update-far with forward =1 and mark upstate as activated.

3a) If gNB has N3 in inactive state, it sends PDU Session Resource Setup Response with gNB N3 TEID.

4a) SMF sends N4 modification to UPF with update-far with forward =1 and new gNB TEID.

Figure 1 below illustrates a call flow when there is an MT call failure in the 5G network due to a user plane mismatch.

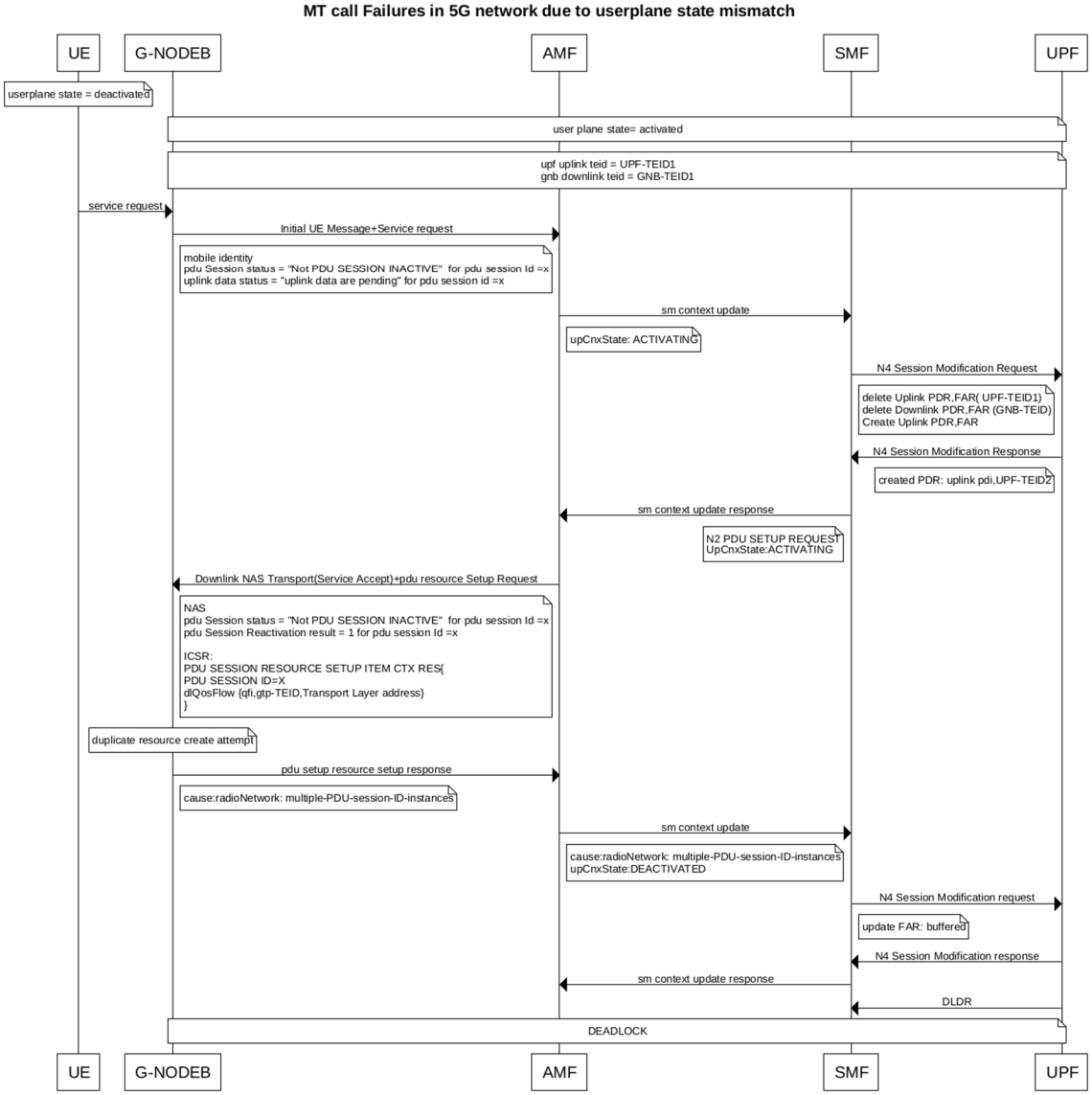

Figure 1

Figure 2 below illustrates a call flow for MT call failures employing the solution presented herein.

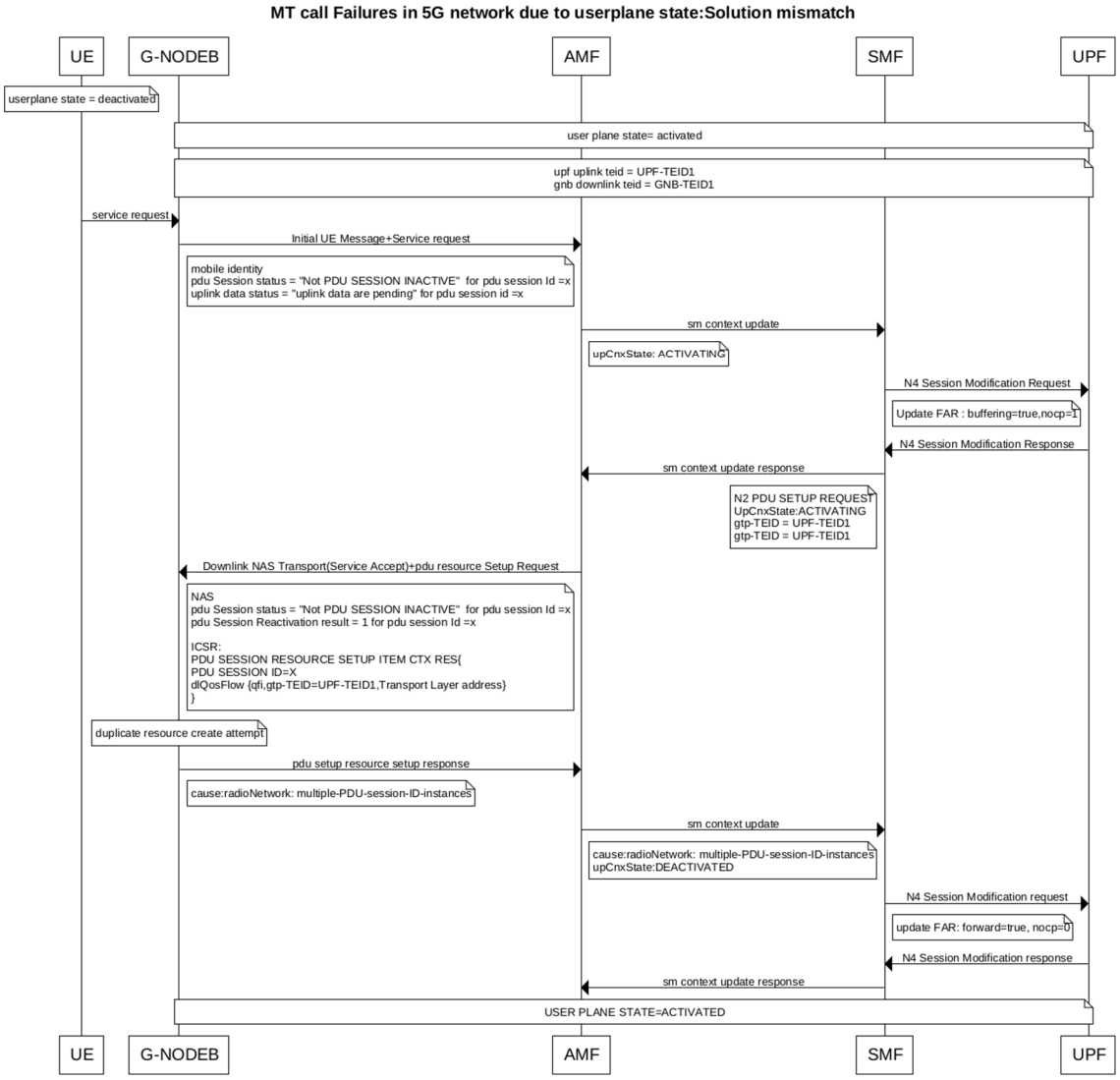
MT call Failures in 5G network due to userplane state:Solution mismatch
UE
G-NODEB
AMF
SMF
UPF
userplane state = deactivated
user plane state= activated
upf uplink teid = UPF-TEID1
gnb downlink teid = GNB-TEID1
service request
Initial UE Message+Service request
mobile identity
pdu Session status = "Not PDU SESSION INACTIVE" for pdu session Id =x
uplink data status = "uplink data are pending" for pdu session id =x
sm context update
upCnxState: ACTIVATING
N4 Session Modification Request
Update FAR : buffering=true,nocp=1
N4 Session Modification Response
sm context update response
N2 PDU SETUP REQUEST
UpCnxState:ACTIVATING
gtp-TEID = UPF-TEID1
gtp-TEID = UPF-TEID1
Downlink NAS Transport(Service Accept)+pdu resource Setup Request
NAS
pdu Session status = "Not PDU SESSION INACTIVE" for pdu session Id =x
pdu Session Reactivation result = 1 for pdu session Id =x
ICSR:
PDU SESSION RESOURCE SETUP ITEM CTX RES{
PDU SESSION ID=X
dlQosFlow {qfi,gtp-TEID=UPF-TEID1,Transport Layer address}
}
duplicate resource create attempt
pdu setup resource setup response
cause:radioNetwork: multiple-PDU-session-ID-instances
sm context update
cause:radioNetwork: multiple-PDU-session-ID-instances
upCnxState:DEACTIVATED
N4 Session Modification request
update FAR: forward=true, nocp=0
N4 Session Modification response
sm context update response
USER PLANE STATE=ACTIVATED

Figure 2