MME - KPI ANALYSIS REPORT
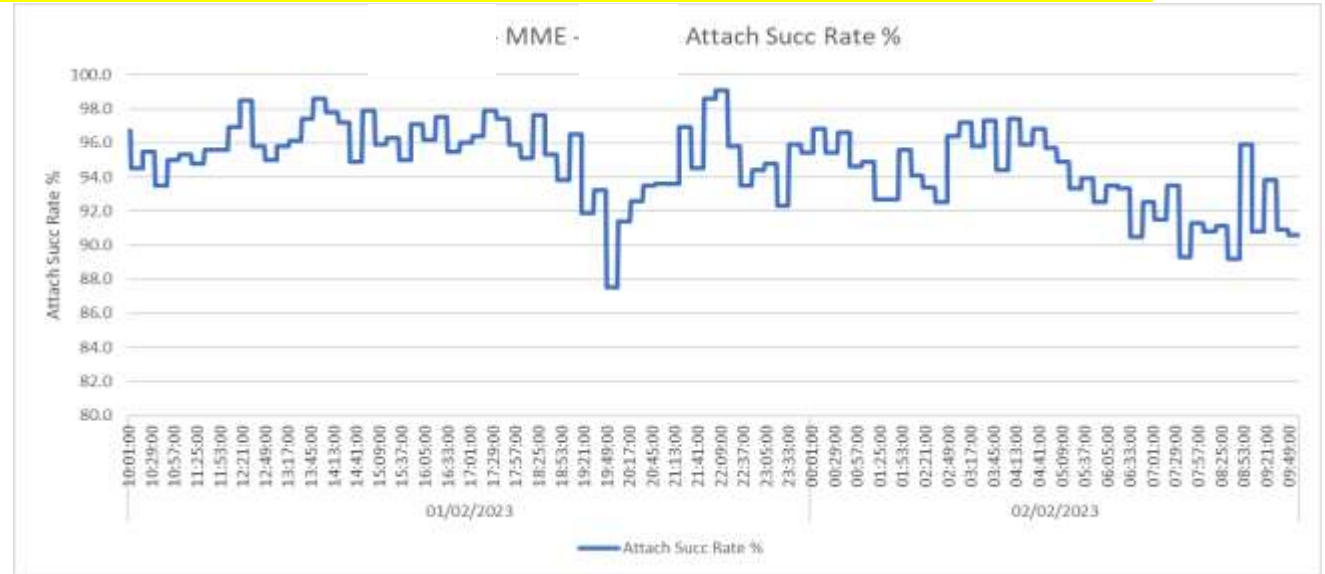
Attach Success Rate %

Feb 2nd , 2023

Current Trend Attach Success Rate, average 94 %

Collecting from Grafana, 10 AM Feb 1st ~ 10 AM 2nd , 2023

KPI Formula for Attach SR % :

NUMERATOR:

(LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_FAIL_EMM_CAUSE_11_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_FAIL_EMM_CAUSE_15_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_FAIL_EMM_CAUSE_19_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_FAIL_EMM_CAUSE_8_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERGENCY_ATTACH_FAIL_EMM_CAUSE_8_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERGENCY_ATTACH_FAIL_EMM_CAUSE_19_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERGENCY_ATTACH_FAIL_EMM_CAUSE_15_E +LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERGENCY_ATTACH_FAIL_EMM_CAUSE_11_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_FAIL_EMM_CAUSE_8_E +LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_FAIL_EMM_CAUSE_19_E + LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_FAIL_EMM_CAUSE_15_E +LTE_MM_ATTACH_FAIL_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_FAIL_EMM_CAUSE_11_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_SUCC_E +LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_SUCC_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERG_ATTACH_SUCC_E)

/

DENOMINATOR:

((LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EPS_ATTACH_ATT_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_COMB_ATTACH_ATT_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_EMERG_ATTACH_ATT_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_ATTACH_NAS_REDIRECTED_ATT_E)

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(LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_INIT_ATTACH_NAS_REDIRECT_IMSI_E + LTE_MM_ATTACH_IMSI_PLMN_ID_IMSI_PLMN_ID_MM_INIT_ATTACH_NAS_REDIRECT_UE_USAGE_TYPE_E))

MME – KPI ANALYSIS REPORT - ATTACH SUCCESS RATE %

Troubleshooting 1:

- We running trace using TCP dump and log in Jan 27th, 2023,
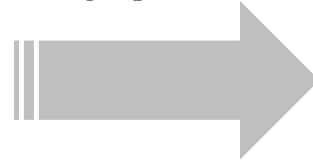- for 10 Minute, 00:08 AM ~ 0:15 AM JST Time

Message Type	Val Attempt
Attach Request	215
Attach Accept	53
Attach complete	42
Attach Reject	168

Analysis

summary_pcap_attach_response

pcap_attach_requ_accept_reject_com

Reject Cause	Count of Cause
EPS services and non-EPS services not allowed (8)	165
ESM failure (19)	3
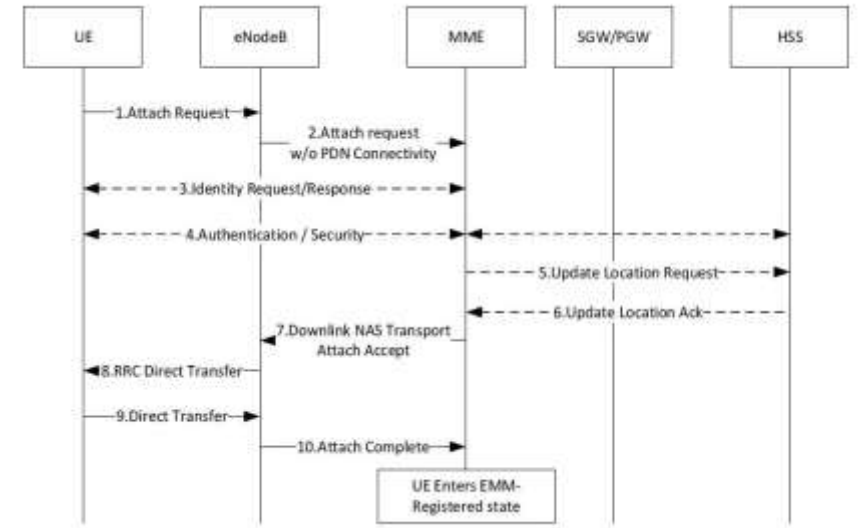
First concern we are checking cause code that was found during testing whether any cause triggering low attach success rate.
We found from attach request 215 , response attach reject total 168, and total 42.
From Reject 168 we found 165 Attach reject Cause 8 EMM_CAUSE_8_E, and 3 reject cause EMM_CAUSE_19_E.

From Attach Request 215 count, we got attach complete response 42, And Attach Reject 168, and if we sum total (reject + complete) is 210 count.
So if we subtract from attach request 215 – 210 than it missing 5 count without no info / response
From Here we are checking where are these 5 count, since the all attach reject is already include in numerator

MME – KPI ANALYSIS REPORT - ATTACH SUCCESS RATE %

PCAP Trace

Source	Destination	Protocol	Length	Info
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	204	InitialUEMessage, Attach request, PDN connectivity request
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	132	SACK (Ack=2450371214, Arwnd=106496) , DownlinkNASTransport, Identity request
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	152	UplinkNASTransport, Identity response
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	164	SACK (Ack=2450371215, Arwnd=106496) , DownlinkNASTransport, Authentication request
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	152	UplinkNASTransport, Authentication response
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	144	SACK (Ack=2450371216, Arwnd=106496) , DownlinkNASTransport, Security mode command
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	128	DownlinkNASTransport, Security mode command
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	152	UplinkNASTransport, Security mode complete
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	136	SACK (Ack=2450371217, Arwnd=106496) , DownlinkNASTransport, ESM information request
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	120	DownlinkNASTransport, ESM information request
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	152	UplinkNASTransport, Security mode complete
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	180	UplinkNASTransport, ESM information response
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	280	SACK (Ack=2450371219, Arwnd=106496) , DownlinkNASTransport, Attach accept, Activate default EPS bearer
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP/NAS-EPS	196	SACK (Ack=1318636686, Arwnd=524108) , UplinkNASTransport, ESM information response
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	264	DownlinkNASTransport, Attach accept, Activate default EPS bearer context request
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP/NAS-EPS	264	DownlinkNASTransport, Attach accept, Activate default EPS bearer context request
40b:c010:104:27d1:8f28:2:26:3c04	240b:c042:22a1:1021:0:311:0:1	S1AP	108	UEContextReleaseCommand [NAS-cause=detach]
40b:c042:22a1:1021:0:311:0:1	240b:c010:104:27d1:8f28:2:26:3c04	S1AP	140	SACK (Ack=1318636689, Arwnd=524288) , UEContextReleaseComplete

s1ap.ENB_UE_S1AP_ID == 62944||s1ap.MME_UE_S1AP_ID == 527527

pcap_no_attach_c complete

Analysis

Based on our checking, we found in those 5-missing response, is due to UE/eNB doesn't send attach complete after attach accept was send by MME.

One sample for missing eNB (ip: 240b:c042:22a1:1021:0:311:0:1) response we can see as above (filter PCAP s1ap.ENB_UE_S1AP_ID == 62944||s1ap.MME_UE_S1AP_ID == 527527), we see above after attach accept has been send by MME to eNB, there is no response from eNB for information that attach complete or not. Below we can see comparison message between with or without attach complete from eNB

MME – KPI ANALYSIS REPORT - ATTACH SUCCESS RATE %
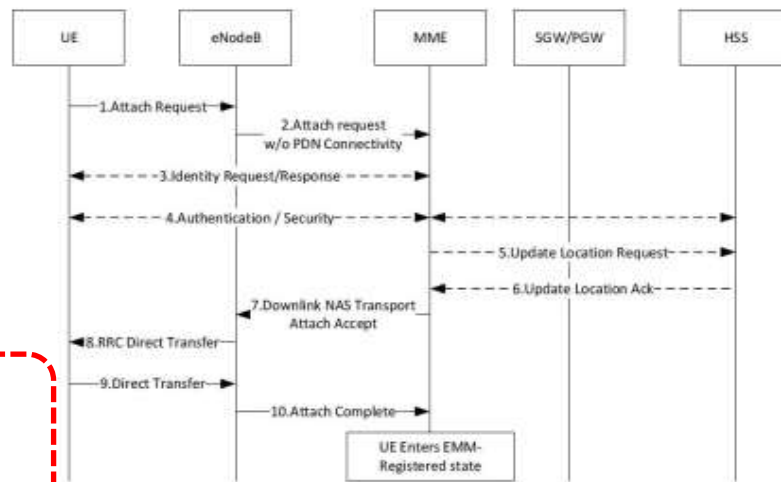
PCAP Trace

Analysis

At left is comparison between message "with vs without attach complete" from eNB to MME.
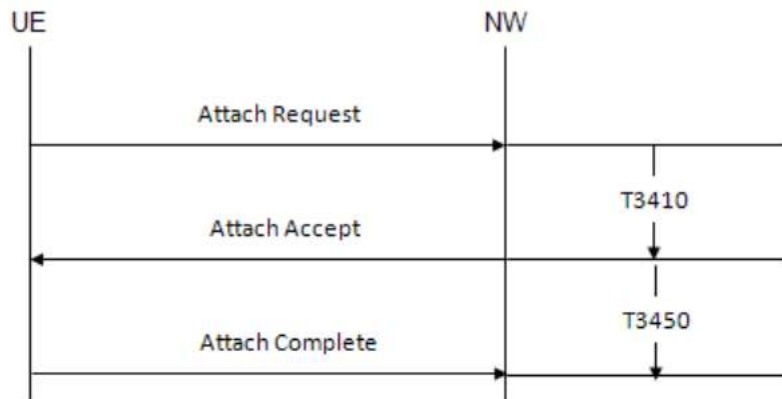
pcap_with_attach_complete

Troubleshooting 2:

- At Jan 31st 2023, We collect log WRN from system for 15minute interval 20:30~20:45 PM JST, and take curl command output before and after.

  Base on wrn log we found **MSGTYPE_MME_T3450_EXPIRY in state EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE.** This error coming when Attach Accept send by network and waiting for Attach Complete from eNB but than expiry

```
IMS.log_20230131203158.log.gz:<2023-01-31 20:31:34.657 *WRN* LOG_MMEMGR 62653:63321 0:0><epCMme>[OnMessage(EpCMmeEmmSession.cpp:903:0-634-2-116)] MSGTYPE_MME_T3450_EXPIRY in state
 EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE user:[440112000077398]
IMS.log_20230131203158.log.gz:<2023-01-31 20:31:54.660 *WRN* LOG_MMEMGR 62653:63321 0:0><epCMme>[OnMessage(EpCMmeEmmSession.cpp:903:0-634-2-116)] MSGTYPE_MME_T3450_EXPIRY in state
 EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE user:[440112000077398]
IMS.log_20230131203252.log.gz:<2023-01-31 20:32:00.130 *WRN* LOG_MMEMGR 62653:63393 0:0><epCMme>[OnMessage(EpCMmeEmmSession.cpp:903:0-634-7-175)] MSGTYPE_MME_T3450_EXPIRY in state
 EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE user:[440112000001970]
IMS.log_20230131203252.log.gz:<2023-01-31 20:32:03.839 *WRN* LOG_MMEMGR 62653:63360 0:0><epCMme>[OnMessage(EpCMmeEmmSession.cpp:903:0-634-4-97)] MSGTYPE_MME_T3450_EXPIRY in state
EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE user:[440112000054796]
IMS.log_20230131203252.log.gz:<2023-01-31 20:32:14.658 *WRN* LOG_MMEMGR 62653:63321 0:0><epCMme>[OnMessage(EpCMmeEmmSession.cpp:903:0-634-2-116)] MSGTYPE_MME_T3450_EXPIRY in state
 EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE user:[440112000077398]
```

ue_attach_comple
te_no_process

Troubleshooting 3

As per KPI we found S6a Diam Auth error answer 5XXX and base on PCAP it is found DIAMETER_ERROR_USER_UNKNOWN (5001).

This error is making MME response reject with Cause: EPS services and non-EPS services not allowed (8), and it already include in Attach Succ Rate Calculation formula as Numerator, so it is not suspecting as the contributor in direct for attach Succ rate decrease.

But it can lead UE to do re-try attach and in which can make attach request attempt high and possibility T3450 expired happen

Below attach are the list of IMSI that get issue with 5001, this taken from log 31jan2023 2030PM (string search Negative Response received(Cause Val: 0xbc9))

List of IMSI   ue_negative_resp
nse_31012023_203

curl_kpi_30jan2023_2030pm

LTE_DIAM_S6a_DIAM_SND_AUTH_INFO_REQUEST	481
LTE_DIAM_S6a_DIAM_RCV_AUTH_INFO_ANSWER	481
LTE_DIAM_S6a_DIAM_RCV_AUTH_INFO_ANSWER_RC_2001	120
LTE_DIAM_S6a_DIAM_RCV_AUTH_INFO_ANSWER_ERC_5XXX	361
LTE_DIAM_S6a_DIAM_SND_UPDATE_LOCATION_REQUEST	80
LTE_DIAM_S6a_DIAM_RCV_UPDATE_LOCATION_ANSWER	80
LTE_DIAM_S6a_DIAM_RCV_UPDATE_LOCATION_ANSWER_RC_2001	80
LTE_DIAM_S6a_DIAM_SND_PURGE_UE_REQUEST	77
LTE_DIAM_S6a_DIAM_RCV_PURGE_UE_ANSWER	77

RCA SUMMARY

Issue Descriptin:

Attach Succ Rate MME was seeing below than target KPI 98.5%

Impact:

In User Experience Device not able / difficult attaching to network

Analysis

1. eNodeB giving no response Attach complete after attach accept has been send from MME to eNB
2. From log we can see incident point 1, was printed in WRN as MSGTYPE_MME_T3450_EXPIRY in state EPC_MME_EMM_FSM_ST_WAIT_FOR_ATTACH_COMPLETE
3. Found Diameter S6a Receive from HSS with error code 5001

Improvement

1. Need to check to eNB/UE (sample ip eNB 240b:c042:22a1:1021:0:311:0:1), why it is not sending attach complete after receive attach accept from MME
2. There will be fix to peg attach fail KPI for T3450 expiry, means if attach complete is not came from UE than it need to peg attach fail KPI with reason T3450 expiry to the counter, and we can add into numerator after that
3. Need to check with HSS team regarding DIAMETER_ERROR_USER_UNKNOWN (5001), whether this Error normal behaviour or is there some issue in HSS side, list of sample problem IMSI is in slide 8