TD-SCDMA LTE BPLMN Search Overview

80-NM424-1 B

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## Revision History

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<tr>
<td>A</td>
<td>May 2014</td>
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<td>Added note in High-Level End-to-End Call Flow and updated scope and LTE Requirements slides</td>
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Scope

- This document provides an introduction that the UE will reselect the LTE cell when UE is camped on the TDS network without the LTE cell.

- This document is applicable to:
  - Chipset – MSM8960/MSM9x15/MSM9x25/8974/8610/8926
  - Platform – NI.4.0/NI.6.0/DI.1.0/DI.2.0/DI.3.0/TR.1.0

- This document assumes the customer has knowledge of TDS and LTE protocol.
Background
Background

- In the LTE network deployment initial stage, LTE network configuration is not mature.
- The UE may not be able to reselect to LTE per network configuration.
- CMCC proposes this feature to address the above problem and enhance user experience.
CMCC Requirement
Summary

- The UE is required to report one suitable PLMN of a TD-LTE network and the cell with the most powerful signals under these conditions:
  - Multimode (LTE/TDS/GSM) SIM card
  - UE is in Idle mode in TD-SCDMA or GSM network
- After verifying PLMN and cell are suitable:
  - If yes, the UE will reselect to TD-LTE network and perform registration.
  - If no, the UE will still stay on the current network.
High-Level End-to-End Call Flow

1. Get NV/EFS item for Feature “CMCC LTE BPLMN Scan”

2. Auto PLMN Search Cmd (CMCC PLMN ID, CMCC LTE RF Band, LTE RAT Type)

3. Suspend TDS L1 for BPLMN Search

4. PLMN Search Cmd to LTE RRC (PLMN ID, LTE RF bands, time to return)

5. LTE PLMN search

6. PLMN Search Results to TDS RRC (Pass/Fail, Results)

7. Resume TDS L1 after BPLMN Search

8. Auto PLMN Search Results (Empty List OR (PLMN ID, LTE RSRP/RSRQ)

9. NAS sends command to deactivate TDS-RRC Stack

10. NAS sends command to activate LTE-RRC Stack

Note: There will be many suspend/resume TDS operations during TDS RRC guard timer to align with DRX cycle.
UE Requirement
TD-SCDMA Requirements

- RRC shall support receiving a command from NAS to perform an automatic BPLMN scan for only LTE RAT with a list of CMCC TD-LTE RF bands.
  - RRC shall reject such commands if it is not in RRC Idle or Cell/URA-PCH (DRX-mode).
  - RRC shall reject such commands if the current DRX cycle is less than 640 ms.
- Upon receipt from TDS L1 indicating it can go to SLEEP, RRC shall determine if the time left in the current DRX cycle is ≥ parameter value Minimum_TDLTE_BPLMN_ScanTime (180 ms) in order to start the BPLMN scan to TD-LTE.
- TDS RRC upon determining a BPLMN scan to TD-LTE can be initiated shall suspend TDS L1 operations prior to sending BPLMN command to LTE RRC.
- TDS RRC shall provide LTE RRC with the following information it received from NAS associated with this CMCC-specific automatic BPLMN scan:
  - CMCC PLMN ID list
  - CMCC-specific TD-LTE RF bands it received from NAS
  - Remaining time associated with this BPLMN scan
- TDS RRC shall command TDS L1 to resume DRX operations upon receipt of BPLMN scan results (Pass or Fail) from LTE RRC.
TD-SCDMA Requirements (cont.)

- TDS RRC shall:
  - Support the abort command for aborting the TD-LTE BPLMN scan
  - TDS RRC shall abort the TD-LTE BPLMN scan for the following high-priority events:
    - CS/PS connection setup
    - OoS
    - Inter-RAT reselections
    - Inter-RAT redirections
  - Support suspending TD-LTE BPLMN scans, due to the PS connection setup while the BPLMN scan guard timer has not expired
  - Abort CMCC TD-LTE BPLMN scans if the BPLMN guard timer expires after resuming LTE BPLMN search
  - Return an empty PLMN list if it receives a new CMCC-specific TD-LTE BPLMN scan request (automatic BPLMN scan request) while camped on a cell with valid SIB 19 containing LTE frequencies
  - Provide to LTE RRC a list of camped-on frequencies and corresponding bandwidth to LTE RRC when TDS RRC sends the automatic BPLMN scan command to LTE RRC
LTE Requirements

- LTE RRC shall support receiving LTE_RRC_SEARCH_REQ with PLMN list, one RAT of type LTE with network_selection_mode=automatic and service_search=IRAT_PLMN.
- LTE RRC shall support a request from TDS RRC for BPLMN scan specific to the CMCC network. This involves handling the following information provided by TDS RRC:
  - CMCC LTE PLMN ID list
  - CMCC-specific TD-LTE RF bands
  - Processing time allocated by TDS RRC associated with this BPLMN scan
- LTE RRC shall ensure that the BPLMN scan response is returned to TDS RRC within the allocated BPLMN scan time sent by TDS RRC.
- If one of the CMCC PLMNs is found in the list of provided PLMN IDs:
  - LTE cell is not barred
  - LTE cell meets S-criteria
Then, LTE RRC shall terminate the BPLMN search and report [PLMN, RAT, RSRP, RSRQ] back to TDS RRC.
LTE Requirements (cont.)

- LTE RRC shall provide a response for a successful BPLMN scan with the following results sent back to TDS RRC:
  - Acquired PLMN ID on LTE
  - Measured signal strength, RSRP
  - Measured signal quality, RSRQ

- LTE RRC shall provide an empty list as a response for an unsuccessful or incomplete BPLMN scan to TDS RRC.

- LTE RRC shall perform a cell barring check for every cell found during the BPLMN scans. LTE RRC shall ignore PLMNs of the cells that fail cell barring check and continue with the BPLMN scan.

- LTE RRC shall perform S criterion check for every cell found. LTE RRC shall ignore cells that fail S-criterion check and continue with the BPLMN scan.
NASDAQ Requirements

- NAS/REG shall periodically check the value of NV/EFS items associated with the feature CMCC-specific LTE BPLMN scan and selection.

- If an NV/EFS item is associated with the feature CMCC-specific LTE BPLMN scan and selection set to On, NAS/REG sends an automatic PLMN List-Search command to TDS RRC or GERAN with parameters (CMCC PLMN IDs, CMCC TD-LTE RF bands, LTE RAT-type), provided that the following conditions are met:
  - NAS/REG determines the UE is currently camped on CMCC EHPLMN IDs
  - NAS/REG determines the UE is currently camped on either TD-SCDMA or GSM RAT-type.

- If an NV/EFS item CMCC-specific LTE BPLMN scan and selection is set to Off, NAS/REG will not issue a command to scan for CMCC LTE in BPLMN.
NAS Requirements (cont.)

- If the NV/EFS item associated with the feature CMCC-specific LTE BPLMN scan and selection is set to On, NAS/REG sends an automatic PLMN List-Search command to TDS RRC with parameters (CMCC PLMN IDs, CMCC TD-LTE RF bands, LTE RAT-type) at every periodical timer expiry event where the timer value is defined in the NV/EFS item associated with this feature.

- Upon receipt of the BPLMN scan results from TDS RRC with the indication of the found PLMN belonging to the CMCC PLMN IDs and LTE signal strength report, NAS shall command the TDS RRC stack to stop operations and NAS shall command the LTE-RRC stack to start operations (similar to inter-RAT cell reselections operations).
Use Case
Search Complete – CMCC LTE PLMN Found

1. Get NV/EFS Item for Feature "CMCC LTE BPLMN Scan"

2. Auto PLMN Search Cmd CMCC PLMN ID, CMCC LTE RF Band, LTE RAT Type)

3. TDS BPLMN Guard Timer Started (150s)

4. tdsRRC_can_L1_gotosleep() with timer_val

5. TRUE, tdsRRC_can_L1_gotosleep()

6. TDS_Suspend_Mode_REQ

7. TDS_Suspend_Mode_CNF

8. TDS-RRC sets BPLMN DRX search timer to timer_val

9. TDS-RRC PLMN List Search Cmd (CMCC PLMN IDs, RF Bands, valid_time) AND TDS_Camped_Freq_List

10. LTE-RRC PLMN List Search Results [Completed/Success (PLMN ID, LTE RSRP/RSRQ)]

11. Auto PLMN Search Results PASS (PLMN ID, LTE RSRP/RSRQ)

12. TDS_Resumer_Mode_REQ

13. TDS_Resumer_Mode_CNF

14. CPHY_SETUP_REQ

15. CPHY_SETUP_CNF

16. NAS Procedure to De-Activate TDS-RRC

17. NAS Procedure to Activate LTE-RRC
Abort Procedures

1. Auto PLMN Search Cmd (CMCC PLMN ID, CMCC LTE RF Band, LTE RAT Type)

2. TDS BPLMN Guard Timer Started (150s)

3. tdsRRC_can_L1_gotosleep() with timer_val

4. TRUE, tdsRRC_can_L1_gotosleep()

5. TDS_Suspend_Mode_REQ

6. TDS_Suspend_Mode_CNF

7. TDS-RRC sets BPLMN DRX search timer to timer_val

8. TDS-RRC PLMN List Search Cmd (CMCC PLMN IDs, RF Bands, valid_time) AND TDS_Camped_Freq_List

9. RRC_SERVICE_REQ/RRC_PLMN_ABORT_REQ/RRC_STOPPED_IND/(High Priority Event)

10. TDS-RRC_BPLMN Search Suspend

11. TDS-RRC_BPLMN Search Abort

12. LTE-RRC BPLMN Abort Cnf [Parameters: Discuss]

13. RRC BPLMN Search Results [Pass/Fail : Discuss]
Suspend Procedures Due to PS Call

1. Auto PLMN Search Cmd (CMCC PLMN ID, CMCC LTE RF Band, LTE RAT Type)

3. tdsRRC_can_L1_gotosleep() with timer_val

4. TRUE, tdsRRC_can_L1_gotosleep()

2. TDS BPLMN Guard Timer Started (150s)

3. TDS_Suspend_Mode_REQ

5. TDS_Suspend_Mode_CNF

6. TDS_Suspend_Mode_CNF

7. TDS-RRC sets BPLMN DRX search timer to timer_val

8. TDS-RRC PLMN List Search Cmd (CMCC PLMN IDs, RF Bands, valid_time) AND TDS_Camped_Freq_List

9. RRC_SERVICE_REQ (PS Call)

10. TDS-RRC_BPLMN Search Suspend

11. LTE-RRC BPLMN Suspend Cnf

12. TDS BPLMN guard timer expired

13. TDS-RRC_BPLMN Search Abort

14. LTE-RRC BPLMN Abort Cnf

15. PLMN List Search Response (Fail, Empty List)

A) TDS BPLMN Guard Timer Is Maintained and running

B) TDS BPLMN Guard Timer Is Aborted
Suspend/Resume Procedures Due to PS Call

1. Auto PLMN Search Cmd (CMCC PLMN ID, CMCC LTE RF Band, LTE RAT Type)

2. TDS BPLMN Guard Timer Started (150s) and RRC suspend the procedure.

3. TDS RRC resumes the procedure.

4. TDS_Suspend_Mode_REQ

5. TDS_Suspend_Mode_CNF

6. TDS-RRC PLMN list search Cmd

7. LTE-RRC PLMN List search Result

8. PLMN List search Response (Success)

A) TDS BPLMN Guard Timer Is Maintained and running

B) TDS BPLMN Guard Timer Is stopped
Log Analysis
T2L BPLMN Log Analysis – Normal Case

//UE will do T2L BPLMN with USIM card
reg_sim.c 1281 H =REG= SIM card mode (USIM)

//IRAT priority list included LTE(9) and TDS(11)
reg_state.c 01012 =REG= Rat priority list num_items = 2
reg_state.c 01018 =REG= sys_mode = 9 bst_rat_acq_required = 1 bst_band_cap = 0x44 //LTE
reg_state.c 01018 =REG= sys_mode = 11 bst_rat_acq_required = 1 bst_band_cap = 0x21 //TDS

//Started BPLMN search timer(15 minutes). OEM can change this timer in EFS file /nv/item_files/modem/nas/irat_search_timer
reg_timers.c 00614 =REG= Started HPLMN IRAT Search Timer (15 minutes)

//Timer expired and then started to do BPLMN
reg_state.c 05181 =REG= HPLMN IRAT Search Timer expired
tdsrrccsp.c 02122 FR2164: do LTE BPLMN search
tdsrrccsputil.c 19702 Do TD2L search first

//Found LTE PLMN
tdsrrccsp.c 24821 TD2X: HPLMN found on IRAT. Send PLMN_LIST_CNF to NAS
tdsrrccsputil.c 09137 Adding LTE PLMN 460-0
T2L BPLMN Log Analysis

- Keyword
  - Inter-RAT Search Timer expired
  - SIM card mode
  - Started HPLMN IRAT Search Timer
  - Adding LTE PLMN
  - PLMN_LIST_CNF
# References

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<tr>
<td>Q1</td>
<td><em>Application Note: Software Glossary for Customers</em></td>
<td>CL93-V3077-1</td>
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<tr>
<td>Q2</td>
<td><em>Application Note: Forced HPLMN IRAT Search on CMCC</em></td>
<td>80-NJ071-1</td>
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Questions?
https://support.cdmatech.com