2G 3G 4G Registration Process

Application Note

80000NT11696A Rev 4
2023-09-26
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Contents

1 Applicability Table

Table 1: Applicability Table

Products	Platform Version ID
GE866-QUAD	16
GL865 Series	
GE910 Series	13 - 16
GL865-QUAD V4	34
GE310-GNSS	35
UL865 Series	12
UE910 Series	
UE866 Series	
HE910 Series	
LE910 Series	20 – 25 – 39 -44
ME910 Series	30 -37
ML865 Series	
ME310 Series	
NE310H2	26
NL865H2	
NE310L2	43

Note: Platform Version ID is a reference used in the document. It identifies the different SW versions, e.g. 13 for SW version 13.xx.xxx, 16 for SW version 16.xx.xxx, etc.

2 Introduction

2.1 Scope

Scope of this document is to give an overview and basic flow for Telit module registration. It is an indication that need to be adapted to the customer needs.

2.2 Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit modules family.

2.3 Contact Information, Support

For technical support and general questions, e-mail:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com
- TS-ONEEDGE@telit.com

Alternatively, use: https://www.telit.com/contact-us/

Product information and technical documents are accessible 24/7 on our website: https://www.telit.com

2.4 Conventions

Note: Provide advice and suggestions that may be useful when integrating the module.

Danger: This information MUST be followed, or catastrophic equipment failure or personal injury may occur.

ESD Risk: Notifies the user to take proper grounding precautions before handling the product.

Warning: Alerts the user on important steps about the module integration.

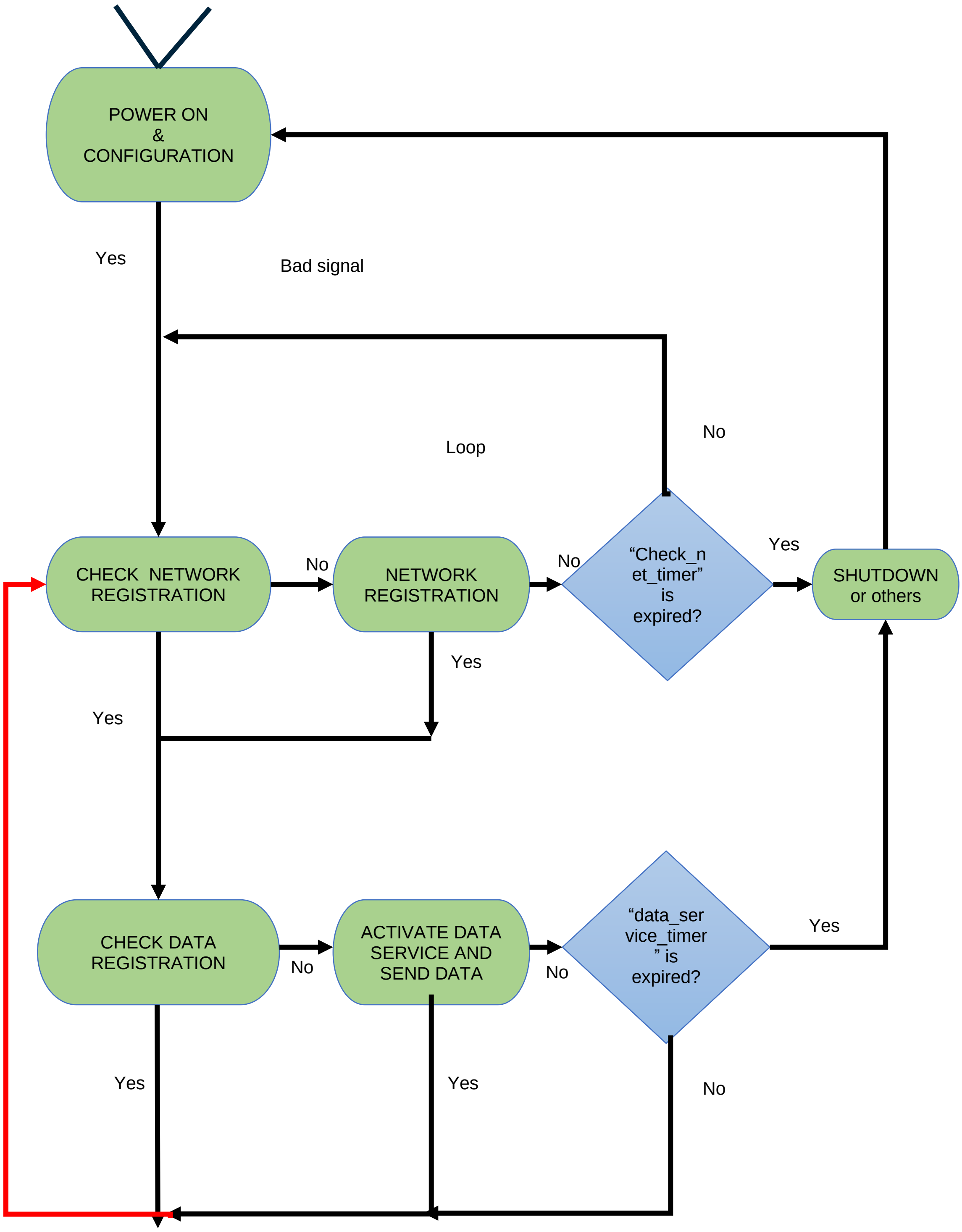
All dates are in ISO 8601 format, that is YYYY-MM-DD.

2.5 Terms and conditions

Refer to https://www.telit.com/hardware-terms-conditions/.

2.6 Disclaimer

3 Main Registration Flow



4 2G & 3G modules Registration Flow

(PLATFORM ID 10 – 12 – 13 – 16 – 34 - 35)

Pre-configuration:

> #AUTOATT=

0 - auto attach disabled

1 - auto attach enabled (default)

> +COPS - operator selecion

0 - Auto (default)

1 - Manual

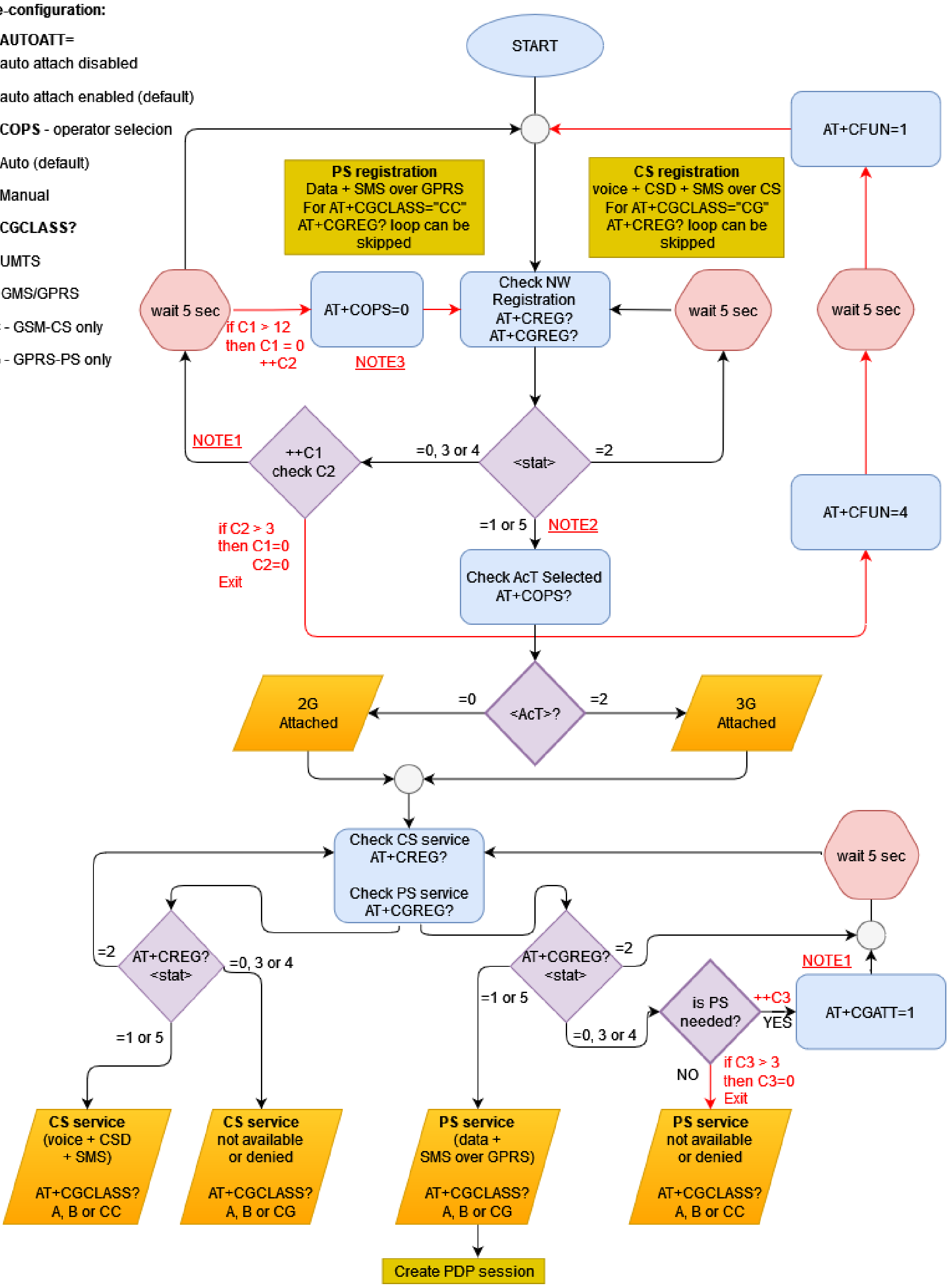
> +CGCLASS?

A - UMTS

B - GMS/GPRS

CC - GSM-CS only

CG - GPRS-PS only

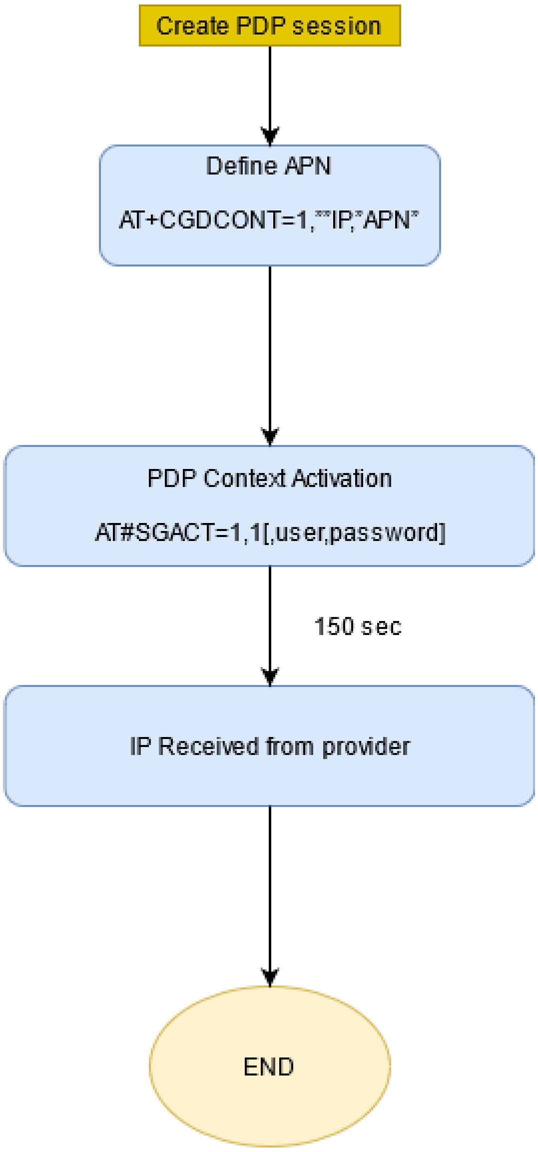


NOTE1: *In case of CGREG: 3 or CREG: 3 verify AT#CEERNET error cause and if needed delete the forbidden PLMN list with AT#FPLMN. Increment C1, C2 and C3 counters according to the flow diagram. Depending on the NW reject cause the module could start searching for a new PLMN, so the <stat> could move to 2 automatically. In this case AT+COPS=0 is not required. Keep monitoring <stat> value.*

NOTE2: *for at least one of the reg commands AT+CREG?, AT+CGREG?*

NOTE3: *AT+COPS=0 triggers full scan with automatic search as per procedure described in 3GPP 23.122. par. 4.4.3.1.1*

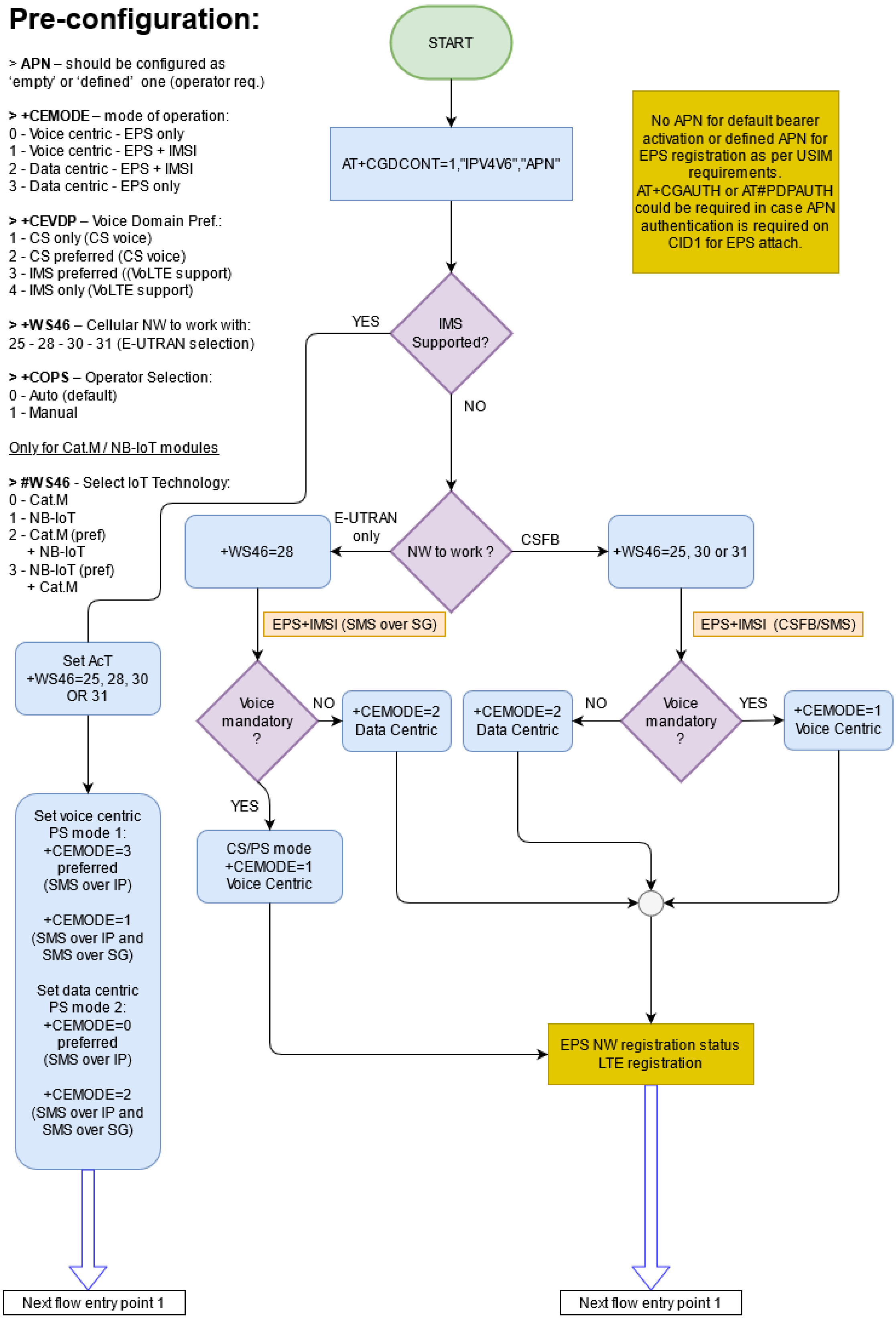
4.1 2G & 3G PDP context

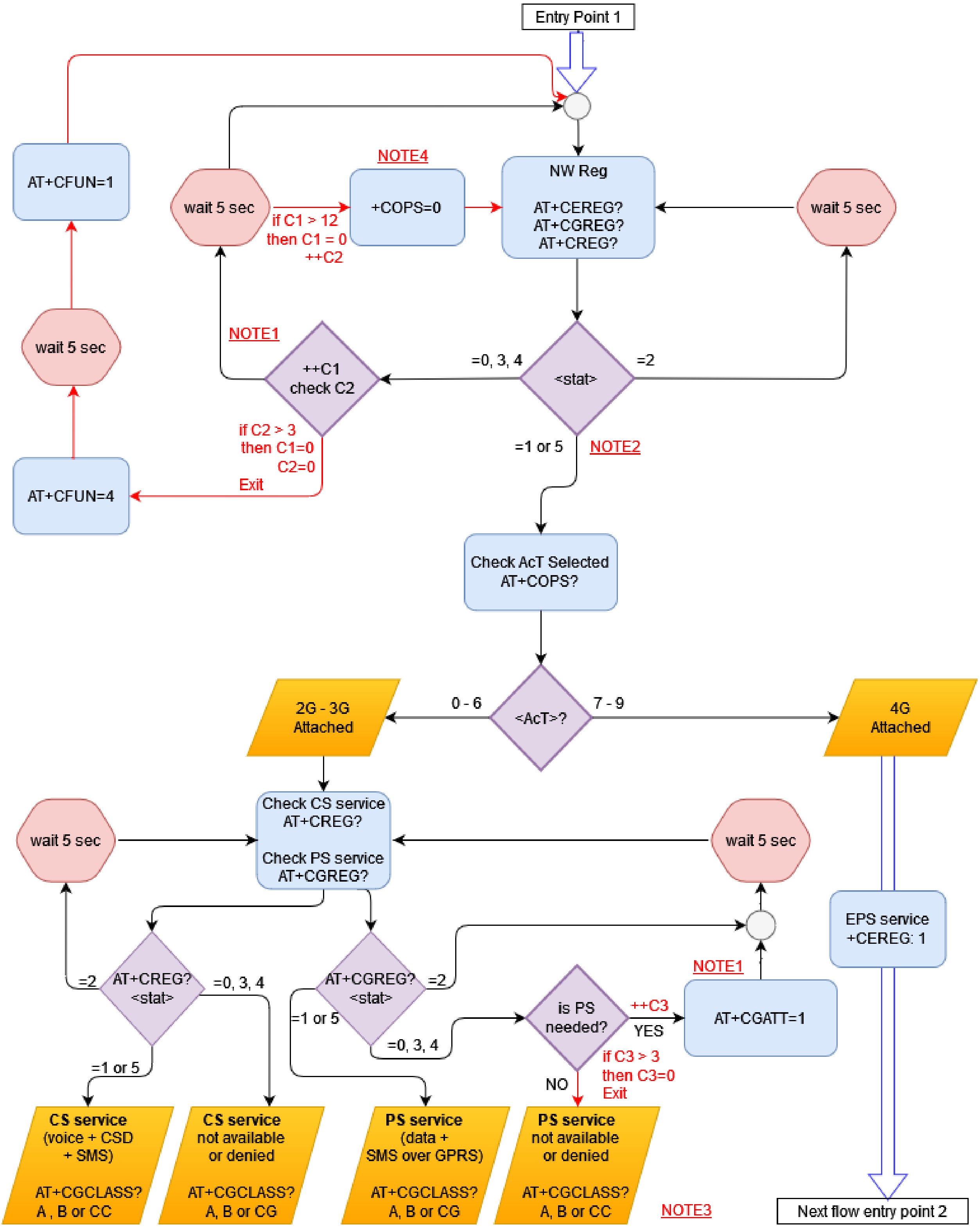


In case of PDP activation failure, verify AT#CEER error cause as defined by 3GPP TS 24.008.

5 4G modules Registration Flow

(PLATFORM ID 20 -25 – 26 - 30 – 37 – 39 – 43 – 44)



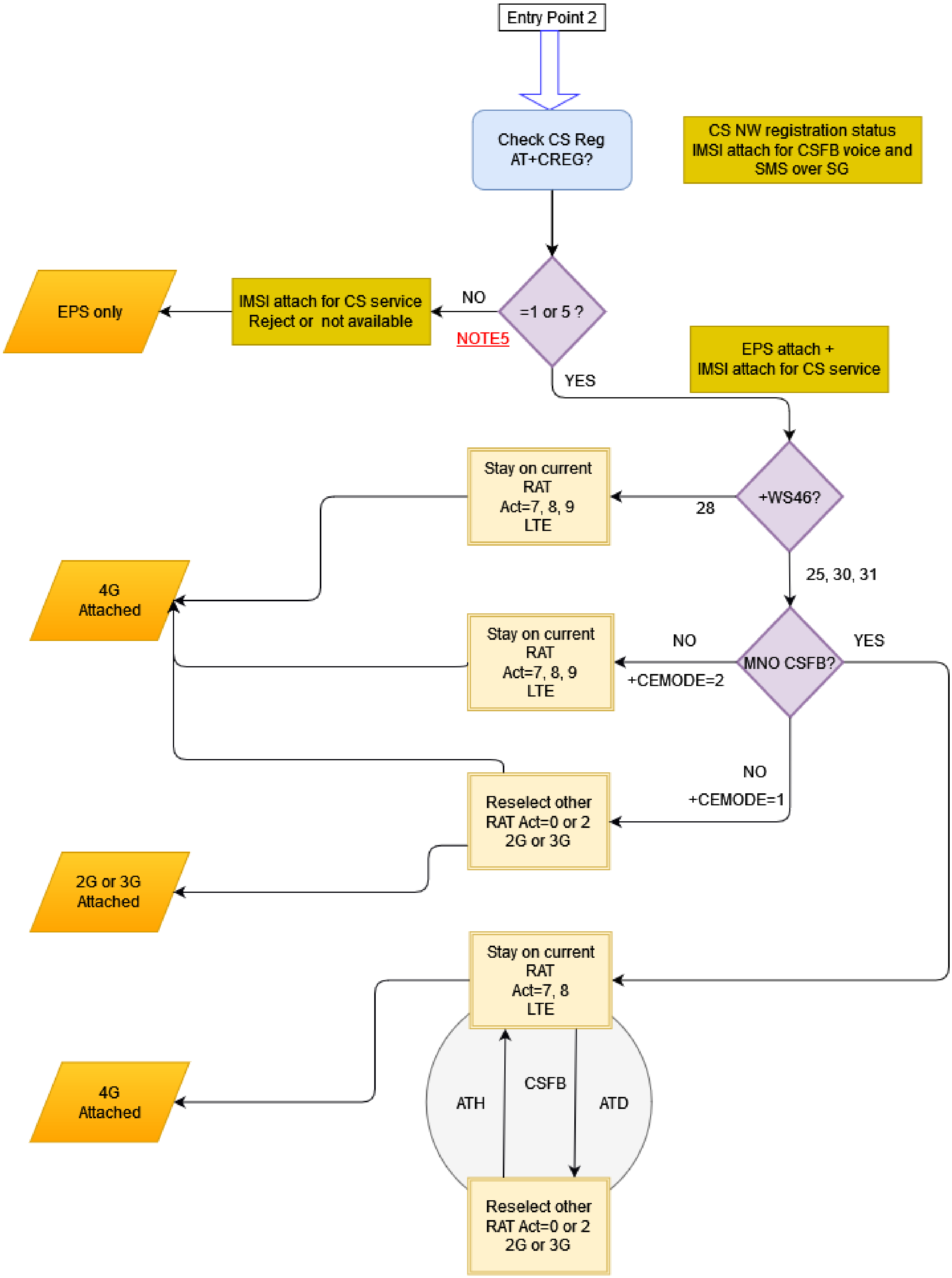


NOTE1: *In case of CEREG: 3, CGREG: 3 or CREG: 3 verify AT#CEERNET error cause and if needed delete the forbidden PLMN list with AT#FPLMN. Increment C1, C2 and C3 counters according to flow diagram. Depending on the NW reject cause the module could start searching for a new PLMN, so the <stat> could move to 2 automatically. In this case AT+COPS=0 is not required.*
Keep monitoring <stat> value.

NOTE2: *for at least one of the reg commands AT+CREG?, AT+CGREG?, AT+CEREG?*

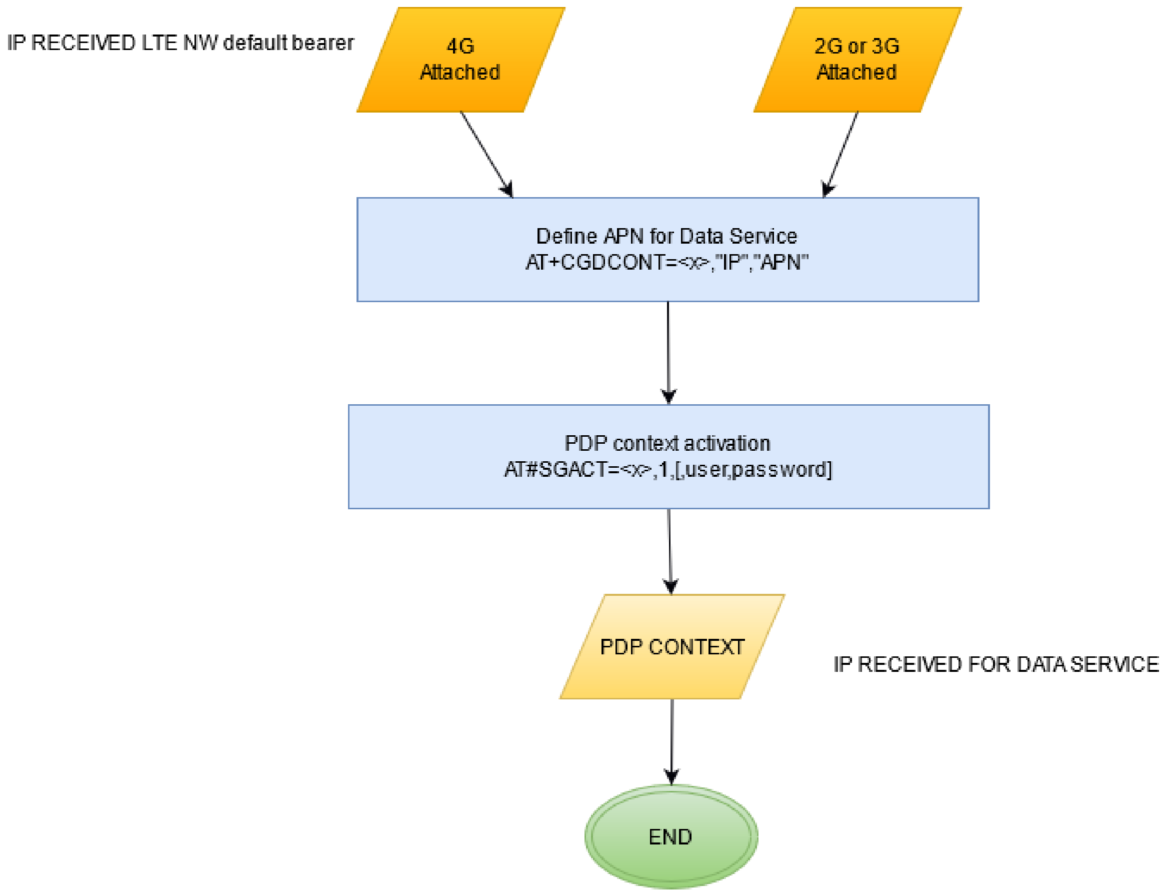
NOTE3: *AT+CGCLASS not supported on platform ID 30 - 37*

NOTE4: *AT+COPS=0 triggers a full scan with automatic search as per procedure described in 3GPP 23.122. par. 4.4.3.1.1*



NOTE5: *For CEMODE=0 and CEMODE=3 AT+CREG? is expected to be +CREG: 0 (EPS only with SMS over IP)*

5.1 4G PDP context



Legend:

- **CS** – Circuit Switch
- **PS** – Packet Switch
- **AcT** – Access Technology
- **NW** – Network / Carrier
- **RAT** – Radio Access Technology
- **CSFB** – Circuit Switched FallBack
- **PDN** – Packet Data Network
- **LTE** – Long Term Evolution
- **VoLTE** – Voice Over LTE
- **MNO** – Mobile Network Operator
- **PDP** – Packet Data Protocol
- **E-UTRAN** – Evolved UMTS Terrestrial Radio

In case of PDP activation failure, verify AT#CEER error cause as defined by 3GPP TS 24.008.

6 RAT/PLMN selection

6.1 Automatic selection

The search order during RAT/PLMN selection is determined by either the module setting (NV parameters) and files in the (U)SIM card, which have higher priority.

The module should select last registered PLMN (LRPLMN) or equivalent PLMN (if it is available) using all access technologies that the MS is capable of.

As reported in the 3GPP 23.122 [1], section 4.4.3.1, if there is no LRPLMN, or if registration is not possible due to the PLMN being unavailable or registration failure at switch on or recovery from lack of coverage, the module should selects and attempts registration on PLMNs if available and allowable using all access technologies that the module is capable in the following order:

I. either the HPLMN (if the EHPLMN list is not present or is empty) or the highest priority EHPLMN that is available (if the EHPLMN list is present);
II. each PLMN/access technology combination in the "User Controlled PLMN Selector with Access Technology" data file in the SIM (in priority order);
III. each PLMN/access technology combination in the "Operator Controlled PLMN Selector with Access Technology" data file in the SIM (in priority order); (Steering SIMs only)
IV. other PLMN/access technology combinations with received high quality signal in random order;
V. other PLMN/access technology combinations in order of decreasing signal quality.

High quality signal is defined by:

- 3GPP TS 43.022 [2] for the GSM radio access technology as a signal level (RSSI) stronger than -85 dBm;
- 3GPP TS 25.304 [6] for the UMTS radio access technology as a signal level (RSCP) stronger than -96 dBm;
- 3GPP TS 36.304 [9] for the LTE radio access technology as a signal level (RSRP) stronger than -110 dBm;

In ii and iii, the MS should limit its search for the PLMN to the access technology or access technologies associated with the PLMN in the appropriate PLMN Selector with Access Technology list (User Controlled or Operator Controlled selector list).

Roaming registration on VPLM

If the module is in a VPLMN (Visitor PLMN), it shall periodically search for its HPLMN or a higher priority PLMN/access technology combination listed in II and III as defined in the RAT/PLMN selection chapter. Specific timer may be stored in the USIM.

In steps I, II and III of subclause 4.4.3.1.1 the MS shall limit its attempts to access PLMN/access technology combinations of the same country as the current serving VPLMN.

More information can be found on 3GPP 23.122 [1] section “4.4.3.3 In VPLM”.

How to delete EFLOCI file in the USIM

In the particular scenario where the module is tested on country A and deployed on country B, in order to skip point (I.) the last registered PLMN (LRPLMN) can be deleted (for all the other cases, deleting the LRPLMN may result in longer registration times, since the module will have to perfom a full RF scan).

The last registered PLMN is stored in a USIM field (EFLOCI - Location Information - Identifier: '6F7E'). 3 methods are possible:

1) Using **AT+CSIM** and opening a USIM logical channel

AT+CSIM=14,"00A40804022F00" //SELECT FILE with FCP template [12]

+CSIM:
76,"62228205422100200183022F00A506C00140DE01008A01058B032F060380020020
8801F09000"

OK

AT+CSIM=10,"00B2010420" //READ RECORD

+CSIM:
68,"61124F10A0000000871002FFFFFFFF89060400FFFFFFFFFFFFFFFFFFFFFFFFFFFF9000"

OK

On FCP template returned by the previous select the 4F is the Application identifier-AID tag and it is followed by the length of AID; In the example it is 4F10 so length is 0x10 (16 Bytes) [13]

The string out from previous **+CSIM** in blue (AID) is 16 bytes after 4F10;

Now it is possible to open a logical channel with the USIM;

AT+CCHO="A0000000871002FFFFFFFF89060400FF"

+CCHO: 2 // could be 1 2 3

AT+CGLA=2,18,"02A4080C047FFF6F7E"

+CGLA: 4,"9000"

OK

First parameter (2) and first byte of APDU (02) is the number returned by +CCHO in red;

AT+CGLA=2,32,"02D600000BFFFFFFFFFFFFFFFFFFFFFF"

+CGLA: 4,"9000" // EFLOCI deleted

First parameter (2) and first byte of APDU (02) is the number returned by +CCHO. You can verify the EFLOCI content with:

AT+CGLA=2,10,"02B000000B"

+CGLA: 26," FFFFFFFFFFFFFFFFFFFFFF9000"

OK

Last bytes are status SW1 SW2: 9000 = SUCCESS;

To close the logical channel **(+CCHO: 2)**:

AT+CCHC=2

OK

> Note: It could happen that between first **+CSIM** and second one, module access the USIM and this is something that can't be blocked. To get the AID to be used with **+CCHO** the two **+CSIM** must be sent in a fast sequence and, if the AID is not returned (so an extra USIM access happened in between) they must be sent again.

Once the AID of a USIM is known the two **+CSIM** are no more required.

2) Using AT+**CRSM**. (not supported by HE910/UE910/UL865/UE866)

It is possible to read the field in 28542 ('6F7E' file in decimal format) on the USIM and then clear it out the LRPLMN).

AT+CRSM=176,28542,0,0,11 // Reads EFLOCI field (28542 is 6F7E in decimal format)

+CRSM: 144,0,A80B7CDB22F210D5BDFF00 //PLMN info

OK

AT+CRSM=214,28542,0,0,11,FFFFFFFFFFFFFFFFFFFFFF //Write EFLOCI field (in this case we're erasing the file)

+CRSM: 144,0

OK

AT+CRSM=176,28542,0,0,11 // Read the field again

+CRSM: 144,0,FFFFFFFFFFFFFFFFFFFFFF

OK

How to delete EFLOCI file with simWISE

Module with simWISE service enabled, and VSIM profile selected shall delete the EF_LOCI file with the dedicated command:

AT#VSIMEDITSIMDATA=0

Forbidden PLMN in USIM

The EF_FPLMN is a file contained in any SIM/USIM which includes up to four Forbidden PLMNs (FPLMN). It is read by the module as part of the USIM initialization procedure and indicates PLMNs which the module shall not automatically attempt to access.

A PLMN is written in the EF if a network rejects a Location Update with cause # 11 - "PLMN not allowed".

In case the FPLM list is full, the rejection of a further PLMN with cause # 11 will cause new FPLMN to be stored in 4th position, shifting the ones in the list, causing the previous content of the 1st position to be lost.

Since roaming agreements can change, it could be necessary to delete the FPLMN list from time to time, to avoid module not using PLMNs that are no more forbidden.

This can be done using the **AT#FPLMN** command. Refer to Telit AT Command Guides for more information and availability of this command.

> Note: Another option is to force a manual registration with **AT+COPS=1,2,"MCCMNC"** (e.g. **AT+COPS=1,2,"22201"**). In this case the module will try to register to the selected PLMN even if stored in the FPLMN list.

Forbidden PLMN with simWISE

Module with simWISE service enabled, and VSIM profile selected shall delete the EF_FPLMN file with the dedicated command:

AT#VSIMEDITSIMDATA=1,FFFFFFFFFFFFFFFFFFFFFFFF

6.2 GERAN Frequency scan and cell selection

The MS should search for a network at lack (or loss) of coverage - i.e. if the received signal strength or quality is no longer sufficient to camp on the registered network. The state Loss of coverage is achieved, if in the current cell the path loss criterion (C1, GSM) or the criterion for a downlink signalling failure (GSM) are fulfilled or the cell selection criterion S is NOT fulfilled (UMTS) and a cell reselection is not possible - i.e. there is no suitable cell available in the registered network.

The module scans all the RF channels for the specific technology:

For GSM:

- 3GPP TS 03.22. (Release 99) or TS 43.022 [2] (Release 4 and higher)
  Chapter 4.5 'Cell selection process'
- 3GPP TS 05.08. (Release 99) or TS 45.008 [3] (Release 4 and higher)
  Chapter 6.5 'Downlink signalling failure'
  Chapter 6.6.2 'Path loss criteria and timings for cell reselection'

According to 3GPP TS 43.022 [2], in normal cell-selection state MS has no prior knowledge of which RF channels are BCCH or CPBCCH carriers.

The module lists the channels from the strongest to the weakest to see which are BCCH or CPBCCH carriers (3GPP paragraph 3.2.1 require to list up to 30 GSM850/900 and 40 DCS1800/PCS1900 channels.

The first BCCH or CPBCCH carrier found which is from a suitable cell and on which there is a normal priority indication is taken and that cell is camped on.

If at least the number, given in subclause 3.2.1, of the strongest RF channels have been tried and the only suitable cells found have low priority indication the module shall camp on the strongest of these cells.

If, after searching the number of RF channels given for each frequency band, with the strongest received signal level, a BCCH or CPBCCH carrier has been found but no suitable cell of the selected PLMN has been found, the module can stop the attempt to find a suitable cell of the selected PLMN.

Telit 2G modules (Platform ID 13 - 16) is compliant with what specified in the 3GPP standard, since it scans all RF channels in the system (174 in E-GSM and 374 for DCS 1800) and lists the channels by power strength. Then the Telit algorithm starts decoding up to 60 GSM850/900 + 80 DCS1800/PCS1900 channels. The first BCCH or CPBCCH carrier found which is from a suitable cell and on which there is a normal priority indication is taken and that cell is camped on.

If at least the number, given in subclause 3.2.1, of the strongest RF channels have been tried and the only suitable cells found have low priority indication the module shall camp on the strongest of these cells.

If, after searching the number of RF channels (30 GSM900 and 40 DCS1800 by 3GPP, 60 and 80 in Telit module algorithm implementation), given for each frequency band, with the strongest received signal level, a BCCH or CPBCCH carrier has been found but no suitable cell of the selected PLMN has been found, the module can stop the attempt to find a suitable cell of the selected PLMN.

The modules support a special AT command to change the number of channels in low (850/900) and high (1800/1900) bands that will be decoded after frequency scan. It could be required to increase the number of channels decoded in specific network scenarios where GSM frequencies are refarmed to LTE or in any other case where LTE saturates the GSM bands.

AT#SERCHLIM =<GSMSearchLim>,<DCSPCSSearchLim>

Where:

- <**GSMSearchLim**>: setting the ARFCN number search limit for GSM 850 and GSM 900 bands. Default value is 60 and lower limit is 40. Upper limit is the maximum GSM ARFCN number available for the specific product.
- <**DCSPCSSearchLim**>: setting the ARFCN number search limit for DCS 1800 and PCS 1900 bands. Default value is 80 and lower limit is 60. Upper limit is the maximum DCS/PCS ARFCN number available for the specific product.

Note: On 3G and 4G modules (Platform ID 12 - 20 – 25 - 30 – 37) the command is not required even if they support 2G fallback. The channel list is decoded using the maximum number of ARFCN channels available.

6.3 UTRAN Frequency scan and cell selection

The UE shall scan all RF channels in the UTRA bands according to its capabilities to find available PLMNs. On each carrier, the UE shall search for the strongest cell and read its system information, in order to find out which PLMN the cell belongs to. If the UE can read one or several PLMN identities in the strongest cell, each found PLMN (see the PLMN reading in [5]) shall be reported to the NAS as a high quality PLMN (but without the RSCP value), provided that the following high quality criterion is fulfilled:

- For an FDD cell, the measured primary CPICH RSCP value shall be greater than or equal to -95 dBm
- For a TDD cell, the measured P-CCPCH RSCP shall be greater than or equal to -84 dBm.

Found PLMNs that do not satisfy the high quality criterion, but for which the UE has been able to read the PLMN identities are reported to the NAS together with the CPICH RSCP value for UTRA FDD cells and P-CCPCH RSCP for UTRA TDD cells.

The quality measure reported by the UE to NAS shall be the same for each PLMN found in one cell. The search for PLMNs on the rest of the carriers may be stopped on request of the NAS. The UE may optimise this search by using stored information of carrier frequencies and optionally also information on cell parameters, e.g. scrambling codes, from previously received measurement control information elements.

Once the UE has selected a PLMN, the cell selection procedure shall be performed in order to select a suitable cell of that PLMN to camp on.

Different types of measurements are used in different RATs and modes for the cell selection and reselection. The performance requirements for the measurements are specified in 3GPP TS 25.133 [4] and 3GPP TS 34.123.

For UTRAN:

- 3GPP TS 25.304 [6]
  Chapter 5.2 'Cell selection and reselection in idle mode'
- 3GPP TS 25.133 [4]
  Chapter 4.2 'Cell Re-selection'

6.4 EUTRAN Frequency scan and cell selection

The UE shall scan all RF channels in the E-UTRA bands according to its capabilities to find available PLMNs. On each carrier, the UE shall search for the strongest cell and read its system information, in order to find out which PLMN(s) the cell belongs to. If the UE can read one or several PLMN identities in the strongest cell, each found PLMN (see the PLMN reading in [8]) shall be reported to the NAS as a high quality PLMN (but without the RSRP value), provided that the following high quality criterion is fulfilled:

- For an E-UTRAN cell, the measured RSRP value shall be greater than or equal to -110 dBm.

Found PLMNs that do not satisfy the high quality criterion, but for which the UE has been able to read the PLMN identities are reported to the NAS together with the RSRP value. The quality measure reported by the UE to NAS shall be the same for each PLMN found in one cell. The search for PLMNs may be stopped on request of the NAS. The UE may optimise PLMN search by using stored information e.g. carrier frequencies and optionally also information on cell parameters from previously received measurement control information elements. Once the UE has selected a PLMN, the cell selection procedure shall be performed in order to select a suitable cell of that PLMN to camp on.

UE shall perform measurements for cell selection and reselection purposes as specified in 3GPP TS 36.133 [7]

For E-UTRAN (cat.M or higher, NB-IoT):

- 3GPP TS 36.304 [9]
  Chapter 5.2 Cell selection and reselection

The Radio Access Technology (RAT) to operate can be configured with **AT+WS46**.

6.5 EUTRAN Cat.M and NB-IoT selection (Platform ID 30 – 37 - 43)

The dual-mode Cat M1/NB1/NB2 modules offer the possibility to work on enhanced machine-type communication (eMTC) and Narrowband IoT (NB-IoT) technologies.

In order to optimize network registration time, related AT commands can be used to set the IoT searching sequence, RAT(s) to be searched, PLMN under LTE RAT, and preferred bands.

AT#WS46=<LTE_technology>,<2G_priority>

The device is configured as one of (0) M1 only, (1) NB1/NB2 only, (2) M1 preferred, or (3) NB1/NB2 preferred device.

<2G_priority> is available from FW version 30.01.xx0 & 37.00.xx4 and it allows to set 2G has preferred.

To limit the scan time specific bands can be enabled with AT#BND and AT#IOTBND commands.

> Note: Specially on WW variants, it could be required to limit the bands used on a specific region (NA, LATAM, EMEA, APAC) because of the high numbers of band supported by the module.

At power up, during very first registration (module/SIM system never registered before on a specific country) the device does a full scan over the applicable RF bands for the preferred system (**AT#WS46**) and, if unavailable, for the other systems.

Full scan can take several tens of minutes depending on number of RAT(s) and bands enabled (up to 210 seconds to scan a single NB-IoT band with AT#SNRSET=2).

To keep first registration time short it could be required to limit the number of RAT(s) and bands used by the device or choose a PLMN in manual selection.

If the device camps on HPLMN in the non-preferred system, it will perform periodic searches for the priority system in the foreground every 60 minutes (IRAT timer). Telit developed a dedicated command to customize the IRAT timer:

AT#IRATTIMER (available from 30.00.xx9 and 37.00.xx2).

The IRAT timer doesn't run if the device camps on VLPMN. In that case it will start a new scan, when the module goes in OOS (out-of-service) or when the HPLMN search timer present in the SIM expires.

When OOS in the camped RAT/system, the device will move to the next combination i.e. RPLMN with the next RAT, depending on the preferred RAT order. If the RPLMN is not found in any technology the module will perform a full scan searching for any available PLMN in the preferred RAT and different bands before switching to another RAT.

> Warning: After a network detach (e.g. shutdown) the last RAT and last PLMN (RPLMN) are saved in NV parameter in the module. At next power on, the module will search for last RAT/RPLMN used, even if not preferred. This implementation allows to keep the registration time as short as possible.

> Warning: There is no idle or connect state mobility across M1 and NB1 systems. (i.e. Inter-RAT mobility, not supported.)

> Warning: Only in Platform ID 37, when AT#WS46 <LTE technology> is changed before a power cycle, the RAT selection will not follow the last RAT order, but the preferred RAT order.

To change the SNR level used when scanning the NB-IoT network, the following command can be used:

AT#SNRSET (available from 30.00.xx9 and 37.00.xx2).

It sets a specifc NV item "snr_level_scan_scope" in the module:

- 1: UE tries SNR level 0 band scan (about 30s per active band - fastest scan time – lower coverage, SNR value > 0 dB);

- 2: UE tries SNR level 0 and level 1 band scan (up to seven times of the time under SNR level 0 per active band – default – medium coverage, SNR value ranges from 0 to -9 dB);
- 3: UE tries SNR level 0, level 1, and level 2 band scan (up to twenty times of the time under SNR level 0 per active band - slowest scan time – highest coverage, typical SNR value is about -12 dB).

6.6 CS/PS Mode of Operation for EPS (Platform ID 20 – 25 – 30 – 37 – 39 - 43 - 44)

The CS/PS mode of operation defined by AT+CEMODE sets the operation mode of the UE and the way it attach to a network. (refer to par.4).

CEMODE=0 : PS mode 2 of operation. The UE registers only to EPS services, and UE's usage setting is "data centric". A module set to "Data centric" does not disable the E-UTRAN capability if voice services cannot be obtained. Voice Domain Preference for E-UTRAN is "IMS PS voice only", UE is configured to prefer SMS over IP networks.

CEMODE=1 : CS/PS mode1 of operation. The UE registers to both EPS and non-EPS services, and the UE's usage setting is "voice centric". It means that it shall always try to ensure Voice service.

A CSFB and an IMS/CS-voice capable UE set to "Voice centric" unable to obtain voice service in E-UTRAN (e.g. CSFB and IMS voice are not supported or the configured preferences on how to handle voice services prevent usage of any available voice services), shall disable the E-UTRAN capability, which results in re-selecting GERAN or UTRAN. Without 2G/3G fallback, a module that is no VoLTE capable could be not able to attach to any network.

CEMODE=2 : CS/PS mode 2 of operation. The UE registers to both EPS and non-EPS services, and the UE's usage setting is "data centric". A module set to "Data centric" does not disable the E-UTRAN capability if voice services cannot be obtained. Upon receiving combined EPS/IMSI attach accept or combined TA/LA Update accept with "SMS-only" indication, a data centric UE stays in the current RAT and is not allowed to use CSFB. Upon receiving combined EPS/IMSI attach accept or combined TA/LA Update accept with "CSFB Not Preferred" indication , a data centric UE stays in the current RAT and is allowed to use CSFB for voice service.

CEMODE=3 : PS mode 1 of operations. The UE registers only to EPS services, and UE's usage setting is "voice centric". It means that it shall always try to ensure Voice service. Voice Domain Preference for E-UTRAN is "IMS PS voice only", UE is configured to prefer SMS over IP networks.

In general:

- A UE set to "Data centric" does not disable the E-UTRAN capability if voice services cannot be obtained. Upon receiving combined EPS/IMSI attach accept or combined TA/LA Update accept with "SMS-only" indication, a data centric UE stays in the current RAT and is not allowed to use CSFB. Upon receiving combined EPS/IMSI attach accept or combined TA/LA Update accept with "CSFB Not Preferred" indication, a data centric UE stays in the current RAT and is allowed to use CSFB.
- A UE set to "Voice centric" shall always try to ensure that Voice service is possible. A CSFB and an IMS/CS-voice capable UE set to "Voice centric" unable to obtain voice service in E-UTRAN (e.g. CSFB and IMS voice are not supported or the configured preferences on how to handle voice services prevent usage of any available voice services), shall disable the E-UTRAN capability, which results in re-selecting GERAN or UTRAN. The E-UTRAN capability is re-enabled by the UE under the conditions described in 3GPP TS24.301 [11]

Attach request: AT+CEMODE vs AT+CEVDP (not for NB-IoT)

	CEVDP: 1	CEVDP: 2	CEVDP: 3	CEVDP: 4
CEMODE: 0 PS mode 2	EPS attach. Data centric CS voice only	EPS attach. Data centric CS voice preferred. IMS PS Voice as secondary	EPS attach. Data centric IMS PS voice preferred CS Voice as secondary.	EPS attach. Data centric IMS PS Voice only
CEMODE: 1 CS/PS mode 1	combined EPS/IMSI attach Voice centric. CS voice only	combined EPS/IMSI attach. Voice centric. CS voice preferred, IMS PS Voice as secondary	combined EPS/IMSI attach. Voice centric. IMS PS voice preferred, CS Voice as secondary	combined EPS/IMSI attach. Voice centric. IMS PS Voice only
CEMODE: 2 CS/PS mode 2	combined EPS/IMSI attach. Data centric. CS voice only	combined EPS/IMSI attach. Data centric. CS voice preferred, IMS PS Voice as secondary	combined EPS/IMSI attach. Data centric. IMS PS voice preferred, CS Voice as secondary	combined EPS/IMSI attach. Data centric. IMS PS Voice only
CEMODE: 3 PS mode 1	EPS attach. Voice centric. CS voice only	EPS attach. Voice centric. CS voice preferred, IMS PS Voice as secondary	EPS attach. Voice centric. IMS PS voice preferred, CS Voice as secondary	EPS attach. Voice centric. IMS PS Voice only

6.7 Network Reject Causes

The network registration process (location update, attach) and PDP activation can fail for different reasons.

The registration response message may provide an indication of whether the roaming network accepted or rejected the registration request message from the UE. In some examples, the registration response message may provide one or more cause indications, which may signal reasons for the acceptance or rejection of the UE's registration request. A cause indication may be a permanent reject cause, which may have adverse effects for the UE, such as providing limited service for the UE or forcing a universal subscriber identity module (USIM) as invalid. In addition, the permanent reject cause may trigger the UE to operate in a lower RAT (e.g., operate in 3G versus 4G).

AT#CEER execution command causes the TA to return a numeric code which offers the user of the TA a report of the reason for:

- the last unsuccessful PS attach or unsuccessful PDP context activation;
- the last PS detach or PDP context deactivation.

Those reject causes are defined and described in the 3GPP TS 24.008 [10]

AT#CEERNET execution command causes the TA to return a numeric code which should offer the user of the TA a report for the last mobility management (MMGMM/EMM) or session management (SM/ESM) procedure not accepted by the network.

Additional info:

- The following error codes are valid for mobility management (MM/GMM) or session management (SM), i.e. for 2G and 3G networks.
- In 4G network the <code>s meanings are included in tables 9.9.4.4.1 (for ESM causes) and 9.9.3.9.1 (for EMM cause) of 3GPP TS 24.301 Release 9.

AT#CEERNETEXT enables/disables the URC presentation and gets the last reject error information from the network including the AcT and PLMN (MCC/MNC)

Telit recommends that the host controlling the modem defines the proper retry/reboot scheme for reject causes 2, 7, 11, 14, 30, 33, 34, 38.

7 PDP Context activation and deactivation

PDP activation and deactivation timeouts are defined by 3GPP 24.008 [10] and they involves 2 NW timers.

When an application tries to active a PDP context (e.g. **AT#SGACT=1,1**) module sends an "ACTIVATE PDP CONTEXT REQUEST" and network timer T3380 (30s) is started waiting for a PDP CONTEXT ACCEPT or REJECT.

In case of no network response this procedure is repeated 4 times, i.e. on the 5th expiry of timer T3380 the module will release all resources allocated and abort the procedure.

Total timeout is 5 x 30s = 150s

In case of PDP deactivation (e.g. **AT#SGACT=1,0**), module sends a "DEACTIVATE PDP CONTEXT REQUEST" and network timer T3390 (8s) is started waiting for a DEACTIVATE PDP CONTEXT ACCEPT.

This procedure is repeated 4 times, i.e. on the 5th expiry of timer T3390 the module will release all resources allocated and erase the PDP context data.

Total timeout is 5 x 8s = 40s

In 4G the initial default bearer is activated during the EPS attach procedure on cid1 (refer to AT+CGDCONT). In this case AT#SGACT=1,1 doesn't activate a new PDP, but it routes the data traffic to the default bearer.

Note: PDP deactivation is performed in backgroud after the OK. Check AT#SGACT? to verify the status, before a new activation of the same CID.

Note: In case PDP activation on CIDx is failing, while USB port is connected to an external device/PC running Windows or Linux O.S., verify that WWAN port is not enabled, taking control of that specific PDP context.

8 Acronyms and Abbreviations

Table 2: Acronyms and Abbreviations

Acronym	Definition
3GPP	Third Generation Partnership Project
AID	Application Identifier
APDU	Application Protocol Data Unit
BCCH	Broadcast Control Channel
C1	Path loss criterion parameter
CCPCH	Common Control Physical Channel
CID	Context Identifier
CPBCCH	Compact Packet Broadcast Control Channel
CPICH	Common Pilot Channel
DCS	Digital Cellular System
EF	Elementary File (SIM/USIM)
EHPLMN	Equivalent Home Public Land Mobile Network
EUTRAN	Evolved UMTS Terrestrial Radio Access Network
FDD	Frequency Division Duplex
FPLMN	Forbidden Public Land Mobile Network
GERAN	GSM EDGE Radio Access Network
GSM	Global System Mobile
HPLMN	Home Public Land Mobile Network
LOCI	LOCation Information
LRPLMN	Last Registered Public Land Mobile Network
LTE	Long Term Evolution
MCC	Mobile Country Code
MNC	Mobile Network Code
MS	Mobile Station
NAS	Non-Access Stratum
NB	Narrow Band
PCS	Personal Communications Service
PDP	Packet Data Protocol
PLMN	Public Land Mobile Network
RAT	Radio Access Technology
RF	Radio Frequency
RSCP	Received Signal Code Power
RSRP	Reference Signal Received Power
SNR	Signal to Noise Ratio
TDD	Time Division Duplex
UE	User Equipment
UMTS	Universal Mobile Telecommunication System
USB	Universal Serial Bus
(U)SIM	Universal Subscriber Identity Module
UTRA	UMTS Terrestrial Radio Access

Acronym	Definition
UTRAN	UMTS Terrestrial Radio Access Network
VPLMN	Visited Public Land Mobile Network
VSIM	Virtual Subscriber Identity Module
WWAN	Wireless Wide Area Network

9 Related Documents

Referenced documents in this Application Note

Table 3: Referenced Documents

Ref.	Code	Document Title
[1]	3GPP TS 23.122	Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode
[2]	3GPP TS 43.022	Functions related to Mobile Station (MS) in idle mode and group receive mode
[3]	3GPP TS 45.008	Radio subsystem link control
[4]	3GPP TS 25.133	Requirements for support of radio resource management (FDD)
[5]	3GPP TS 25.331	Radio Resource Control (RRC); protocol specification
[6]	3GPP TS 25.304	User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode
[7]	3GPP TS 36.133	Requirements for support of radio resource management
[8]	3GPP TS 36.331	E-UTRA; Radio Resource Control (RRC) - Protocol Specification
[9]	3GPP TS 36.304	Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode
[10]	3GPP TS 24.008	Mobile Radio Interface Layer 3 specification, Core Network Protocols - Stage 3
[11]	3GPP TS 24.301	Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3
[12]	ETSI TS 102 221	Smart Cards; UICC-Terminal interface; Physical and logical characteristics
[13]	ETSI TS 101 220	Smart Cards; ETSI numbering system for telecommunication application providers

Refer to https://dz.telit.com/ for current documentation and downloads.

Table 4: Telit Related Documents

Document Code	Document Title
80446ST10707A	LE910 V2 SERIES AT Commands Reference Guide
80378ST10091A	HE910/UE910/UL865/UE866 AT Commands Reference Guide
80529ST10815A	ME910C1/NE910C1/ML865C1 AT Commands Reference Guide
80000ST10025A	2G AT Commands Reference Guide
80502ST10950A	LE910C1 AT Commands Reference Guide
80617ST10991A	ME310G1/ME910G1/ML865G1 AT Commands Reference Guide
1VV0301611	NE310H2 NL865H2 AT Commands Reference Guide
80585ST10926A	GL865-QUAD V4 AT Commands Reference Guide
80598ST10945A	GE310-GNSS AT Commands Reference Guide
80000ST10028A	Telit IP Easy User Guide
1VV0300784	Modules Software User Guide 2G 3G 4G

10 Document History

Table 5: Document History

Revision	Date	Changes
4	2023-09-26	New document template Updated Applicability Table Added NOTES on paragraph 4 and 5 flow charts Updated paragraph 6.1: AT+CSIM example Updated paragraph 6.5: RAT and PLMN selection Added AT+CEMODE vs AT+CEVDP table on paragraph 6.6 Updated pagragraph 9 Related documents
3	2021-09-07	Modified paragraphs 3 and 4 flow charts and update notes Updated paragraph 5.5
2	2021-01-26	Modified paragraphs 3 and 4 flow charts Updated legend on paragraphs 4.1 Added new paragraphs 5.1.1, 5.2, 5.3, 5.4, 5.5, 6, 7, 8, 9 and 10
1	2018-0618	Added new method to delete EF_LOCI in 5.1.2 New paragraphs 5.1.2, 5.1.4, 5.1.5, 5.2
0	2018-06-03	First issue

From Mod.0818 Rev.11