Cloud-RAN-Simulation-Electronic-Fence-Based-on-NFV

Architecture

Related Information

SRB(Signaling Radio Bearer)

RRC defines three SRBs: SRB0, SRB1, SRB2

SRB0

Use the CCCH logical channel for RRC connection establishment/re-establishment process. There has always been.

SRB0 is not encrypted and integrity protected.
The signaling carried on SRB0 is:

1. RRCConnectionRequest
2. RRCConnectionReject
3. RRCConnectionSetup
4. RRCConnectionReestablishmentRequest
5. RRCConnectionReestablishment
6. RRCConnectionReestablishmentReject

SRB1

Use the DCCH channel, which is established when the RRC connection is established.

After the initial security activation, SRB1 has encryption and integrity protection.
SRB1 carries all RRC signaling and some NAS signaling (before SRB2 is established)

SRB2

Use the DCCH channel, established by RRC reconfiguration, after initial security activation.

SRB2 carries NAS signaling.

SRB3

Used to initiate connection establishment

Downlink piggybacked NAS messages are only used during attach procedures (eg connection success/failure): bearer establishment/modification/release,
The uplink piggybacked NAS message initiates the NAS message during connection establishment.
The RRC message in UE dual connectivity (EN-DC) is carried on the DCCH channel.

Comparison

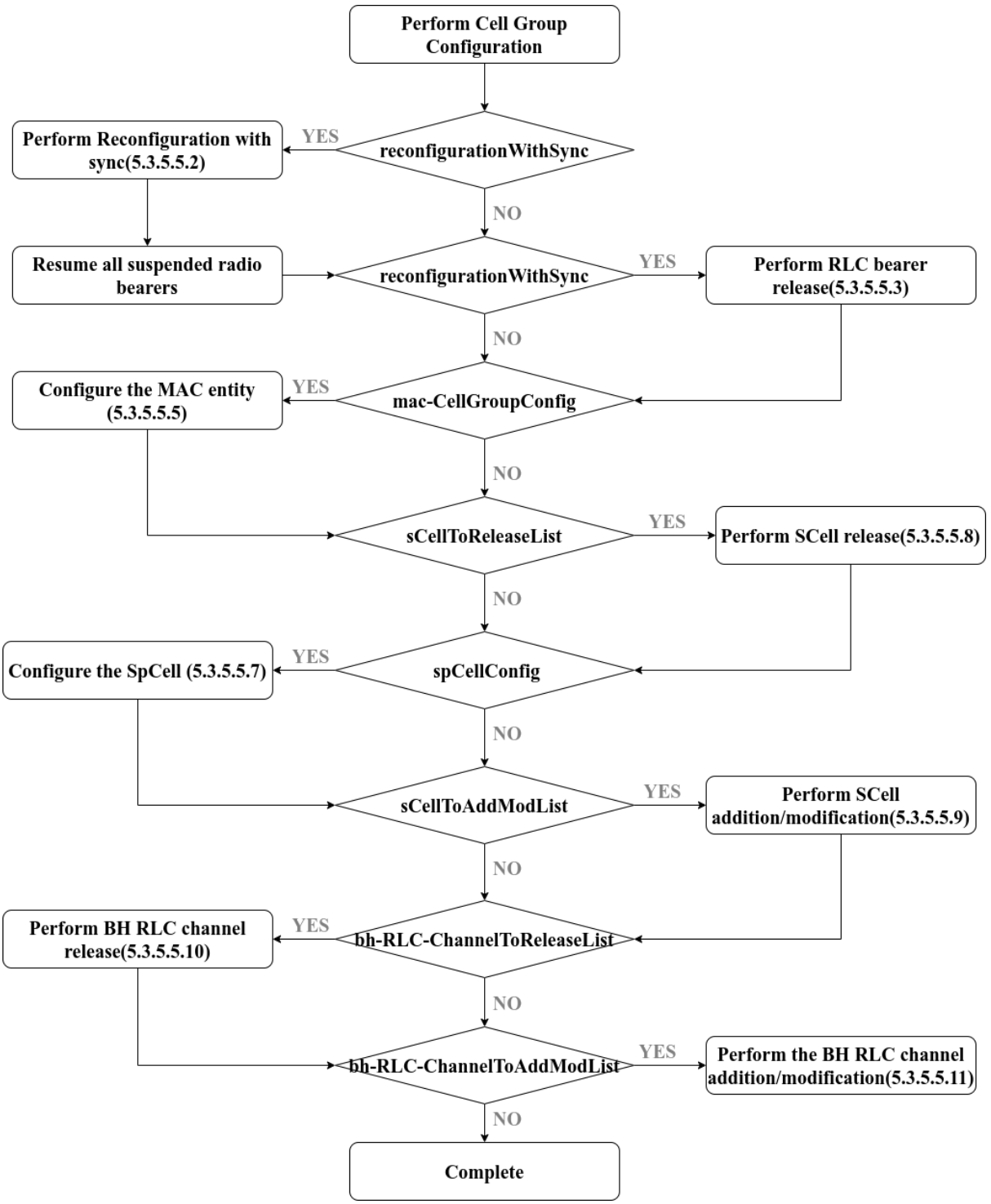
SRB	SRB0	SRB1	SRB2	SRB3
encryption protection	NO	YES	YES	YES
Channel	CCCH	DCCH	DCCH	DCCH
RRC	YES	YES	NO	NO
NAS	NO	YES	YES	YES

Cell Group configuration

See Cell Group configuration 5.3.5.5 Page 69

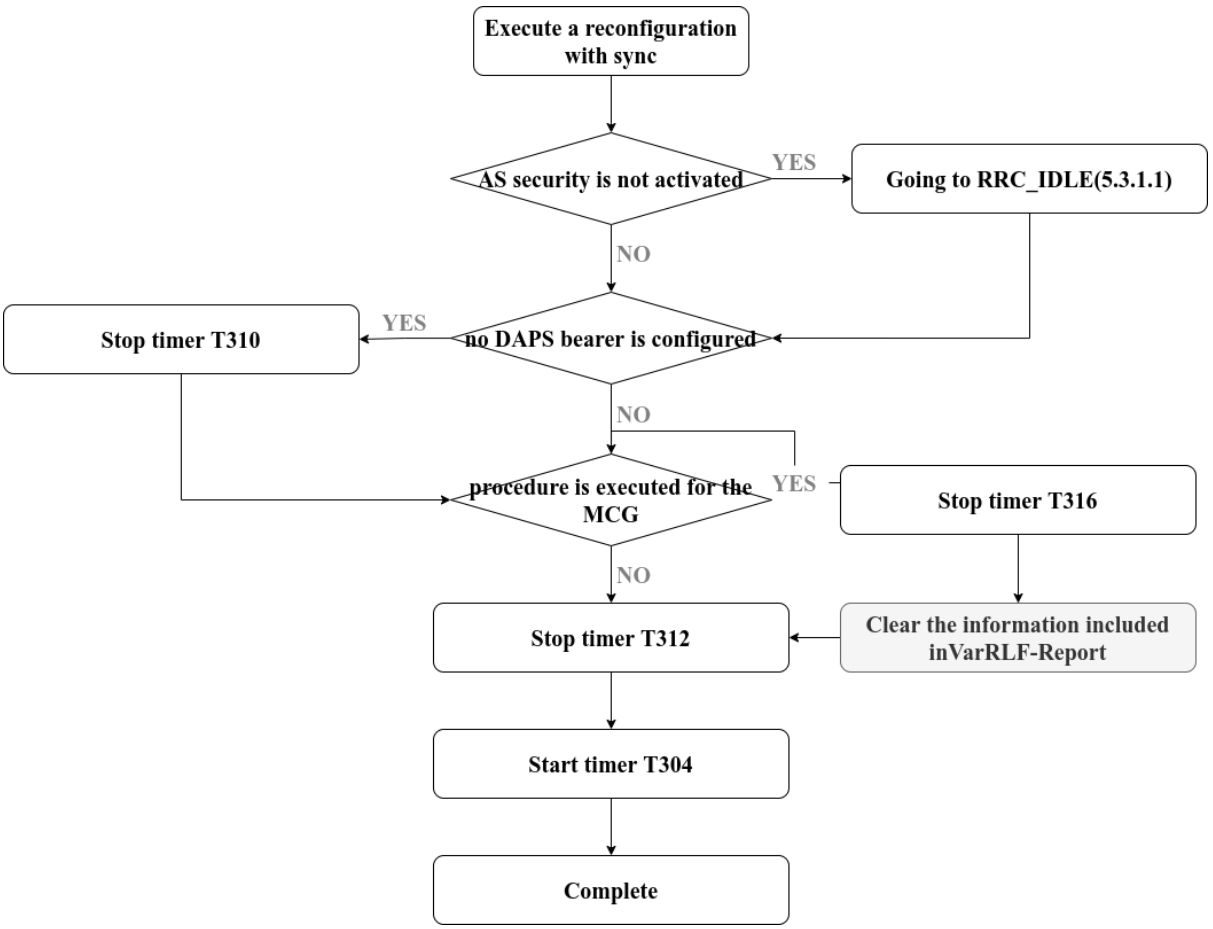
General

The network configures the UE with Master Cell Group (MCG), and zero or one Secondary Cell Group (SCG). In (NG)EN-DC, the MCG is configured as specified in TS 36.331 [10], and for NE-DC, the SCG is configured as specified in TS 36.331 [10]. The network provides the configuration parameters for a cell group in the CellGroupConfig IE.



Reconfiguration with sync

See Cell Group configuration 5.3.5.5.2 Page 70



This is used as an RNTI assigning a C-RNTI to a UE.38.331(v15.1)-5.3.5.5.2 states 'apply the value of the newUE-Identity as the C-RNTI for this cell group'

RLC bearer release

See Cell Group configuration 5.3.5.5.3 Page 72
The UE shall:
1> for each logicalChannelIdentity value included in the rlc-BearerToReleaseList that is part of the current UE
configuration within the same cell group (LCH release); or
1> for each logicalChannelIdentity value that is to be released as the result of an SCG release according to 5.3.5.4:
2> release the RLC entity or entities as specified in TS 38.322 [4], clause 5.1.3;
2> release the corresponding logical channel.

Not implemented in this system

MAC entity configuration

See Cell Group configuration 5.3.5.5.5 Page 73

Common Step:UE Access to 5G Core Network

Flow Chart

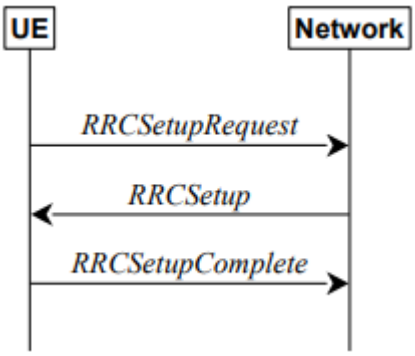
The First Stage:RRCSetUp

Introduction

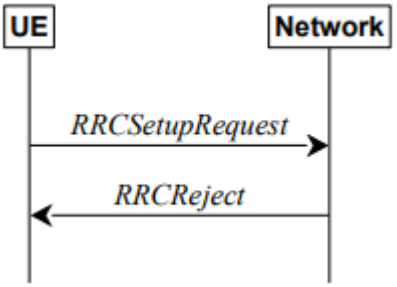
According to: ETSI TS 138 331 V16.3.1 (2021-01) 5G NR Radio Resource Control (RRC) Protocol specification (3GPP TS 38.331 version 16.3.1 Release 16)

The purpose of this procedure is to establish an RRC connection. RRC connection establishment involves SRB1 establishment. The procedure is also used to transfer the initial NAS dedicated information/ message from the UE to the network.

General



Successful

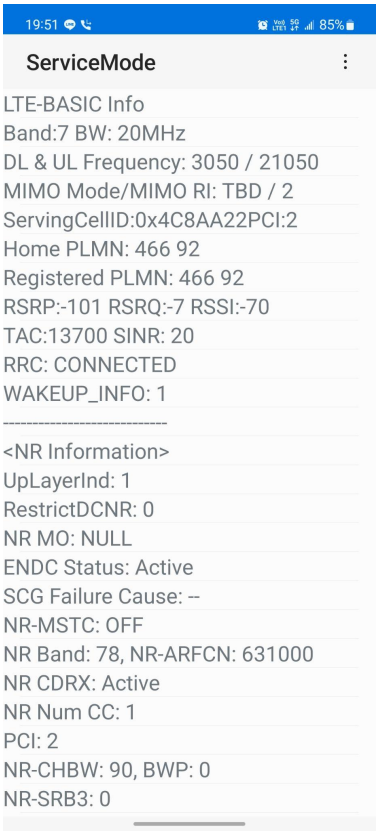


Network reject

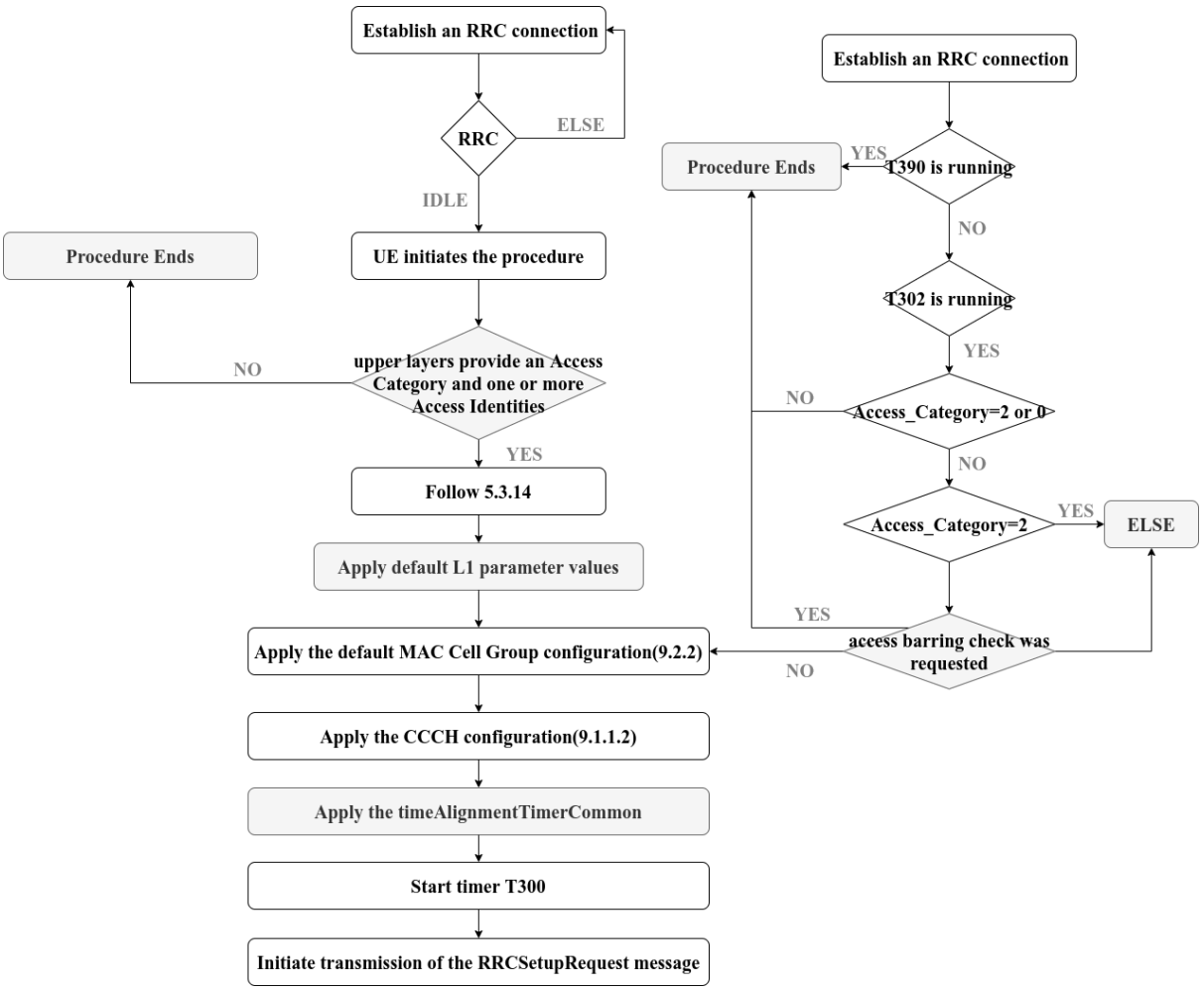
Initiation

The UE initiates the procedure when upper layers request establishment of an RRC connection while the UE is in RRC_IDLE and it has acquired essential system information

In the system we set a parameter which is called ‘RRC’.It shows that the RRC status of the UE as real in our life.



RRC_IDLE RRC_CONNCETED RRC_INACTIVE



Apply the default MAC Cell Group configuration

Parameters

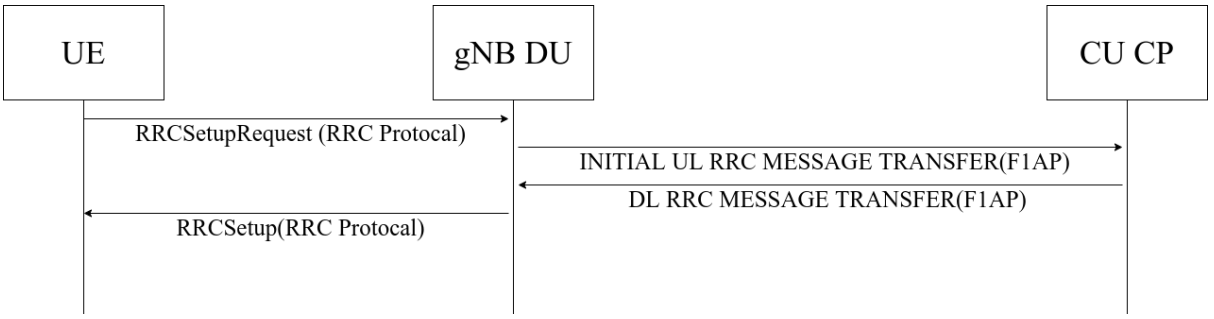
Name	Value	Semantics description	Ver
MAC Cell Group configuration			
bsr-Config			
>periodicBSR-Timer	sf10		
>retxBSR-Timer	sf80		
phr-Config			
>phr-PeriodicTimer	sf10		
>phr-ProhibitTimer	sf10		
>phr-Tx-PowerFactorChange	dB1		

Apply the CCCH configuration

Parameters

Name	Value	Semantics description	Ver
SDAP configuration	NOTUSED		
PDCP configuration	NOTUSED		
RLC configuration	TM		
Logical channel configuration			
>priority	1	Highest priority	
>prioritisedBitRate	INFINITY		
>bucketSizeDuration	ms1000		
>logicalChannelGroup	0		

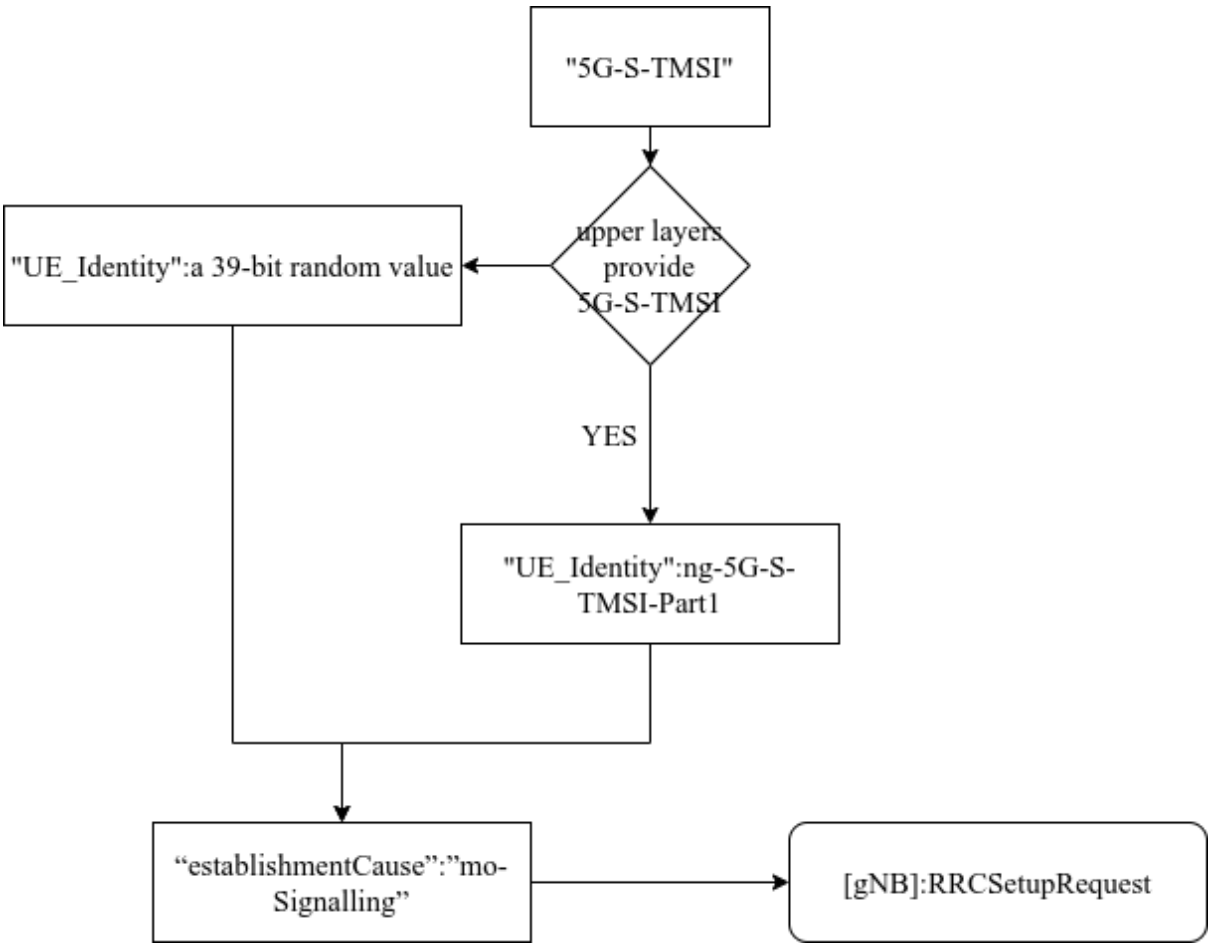
Flow Chart



RRCSetupRequest

Purpose: Request to establish an RRC connection .(5.3.3)

Carrying message: UE identity, RRC connection establishment reason



Parameter

Name	Value	Characteristic
UE_Identity		Dynamic/Allocated
establishmentCause	mo-Signalling	Static
UE_Name	UE_A	in UE Configuration
UE_IP	10.0.2.100	in UE Configuration

bearer signaling:SRB0
logical channel:CCCH

See Actions related to transmission of RRCSetupRequest message [5.3.3.3] page 55

INITIAL UL RRC MESSAGE TRANSFER

ETSI TS 138 473 V16.5.0 (2021-04) 5G NG-RAN F1 Application Protocol (F1AP)
(3GPP TS 38.473 version 16.5.0 Release 16)

See Initial UL RRC Message Transfer [8.4.1] page 58

General

The purpose of the Initial UL RRC Message Transfer procedure is to transfer the initial RRC message to the gNB-CU.
The procedure uses non-UE-associated signaling.

Successful operation

The establishment of the UE-associated logical F1-connection shall be initiated as part of the procedure.

Figure 8.4.1.2-1: Initial UL RRC Message Transfer procedure.

If the DU to CU RRC Container IE is not included in the INITIAL UL RRC MESSAGE TRANSFER, the gNB-CU should reject the UE under the assumption that the gNB-DU is not able to serve such UE.

If the gNB-DU is able to serve the UE, the gNB-DU shall include the DU to CU RRC Container IE and the gNB-CU shall configure the UE as specified in TS 38.331 [8].

The gNB-DU shall not include the ReconfigurationWithSync field in the CellGroupConfig IE as defined in TS 38.331 [8] of the DU to CU RRC Container IE.

If the SUL Access Indication IE is included in the INITIAL UL RRC MESSAGE TRANSFER, the gNB-CU shall consider that the UE has performed access on SUL carrier. (Not implemented in the system)

If the RRC-Container-RRCSetupComplete IE is included in the INITIAL UL RRC MESSAGE TRANSFER, the gNBCU shall take it into account as specified in TS 38.401 [4].

Send the first RRC message to the gNB-CU
This process will establish a UE-level F1 connection

Parameter

Name	Value	Characteristic
UE_Name	UE_Name	Dynamic form request

UE_IP	UE_IP	Dynamic form request
gNB_DU_UE_F1AP_ID		Allocate/Request
NR CGI		in Config
>PLMN	46692	in Config
>>MCC	466	in Config
>>MNC	92	in Config
>NR cell Identity		in Config
>>gNB Identity	1010010111000101010010	in Config
>>Cell Identity	1111001000000	in Config
C-RNTI		Allocate
RRC-Container	RRCSetupRequest	Static
DU to CU RRC Container	include CellGroupConfig	in Config
SUL Access Indication	True	Static
Transaction ID		Allocate

gNB-DU UE F1AP ID
The gNB-DU UE F1AP ID uniquely identifies the UE association over the F1 interface within the gNB-DU.
INTEGER$(0, 2^{32} - 1)$

C-RNTI
Cell RNTI(Radio Network Temporary Identity)
INTEGER(0..65535, ...)

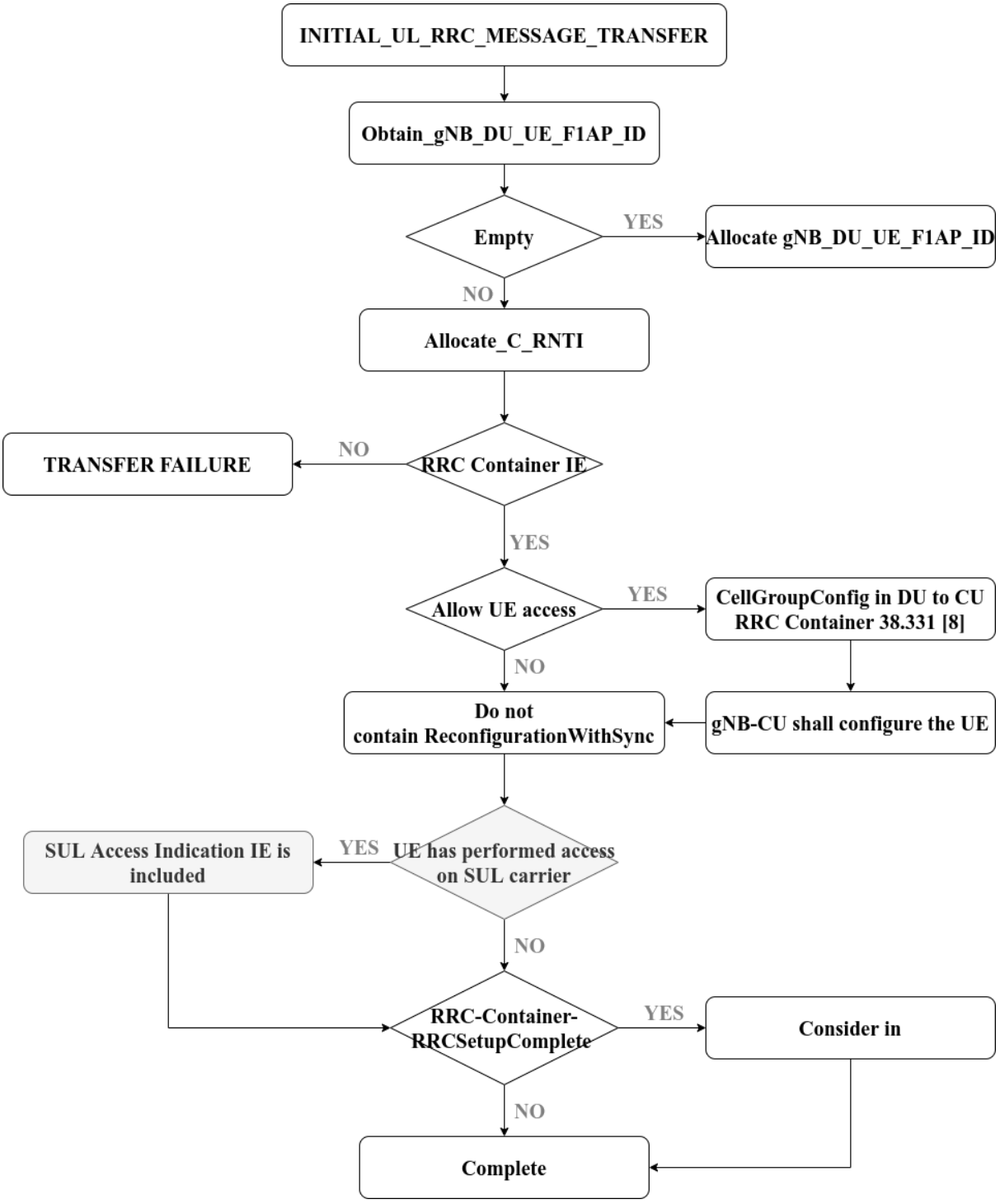
It is related to the cause and status of the UE access request. It is the most used RNTI. C-RNTI is not available at the beginning, but is allocated by the base station to the users who have successfully joined the network after the user accesses the network. If the UE is in the RRC_CONNECTED mode, it means that the C-RNTI has been allocated and needs to be reported when accessing; if the UE is in the IDLE mode, it means that there is no C-RNTI yet. Allocate a C-RNTI; when the user is handed over, the user can bring the C-RNTI allocated by this cell to the next cell, and there is no need to re-allocate the C-RNTI.

Transaction ID

The Transaction ID IE uniquely identifies a procedure among all ongoing parallel procedures of the same type initiated by the same protocol peer. Messages belonging to the same procedure use the same Transaction ID.

INTEGER (0..255, ...)

The Transaction ID is determined by the initiating peer of a procedure.



Abnormal Conditions

Not applicable.

DL RRC MESSAGE TRANSFER

Purpose: to forward the RRC message RRCSetup to the gNB-DU.

General

The purpose of the DL RRC Message Transfer procedure is to transfer an RRC message The procedure uses UE associated signalling.

Successful operation

If a UE-associated logical F1-connection exists, the DL RRC MESSAGE TRANSFER message shall contain the gNBDU UE F1AP ID IE, which should be used by gNB-DU to lookup the stored UE context.If no UE-associated logical F1-connection exists, the UE-associated logical F1-connection shall be established at reception of the DL RRC MESSAGE TRANSFER message.

If the Index to RAT/Frequency Selection Priority IE is included in the DL RRC MESSAGE TRANSFER, the gNB-DU may use it for RRM purposes. If the Additional RRM Policy Index IE is included in the DL RRC MESSAGE TRANSFER, the gNB-DU may use it for RRM purposes.

The DL RRC MESSAGE TRANSFER message shall include, if available, the old gNB-DU UE F1AP ID IE so that the gNB-DU can retrieve the existing UE context in RRC connection reestablishment procedure, as defined in TS 38.401[4].

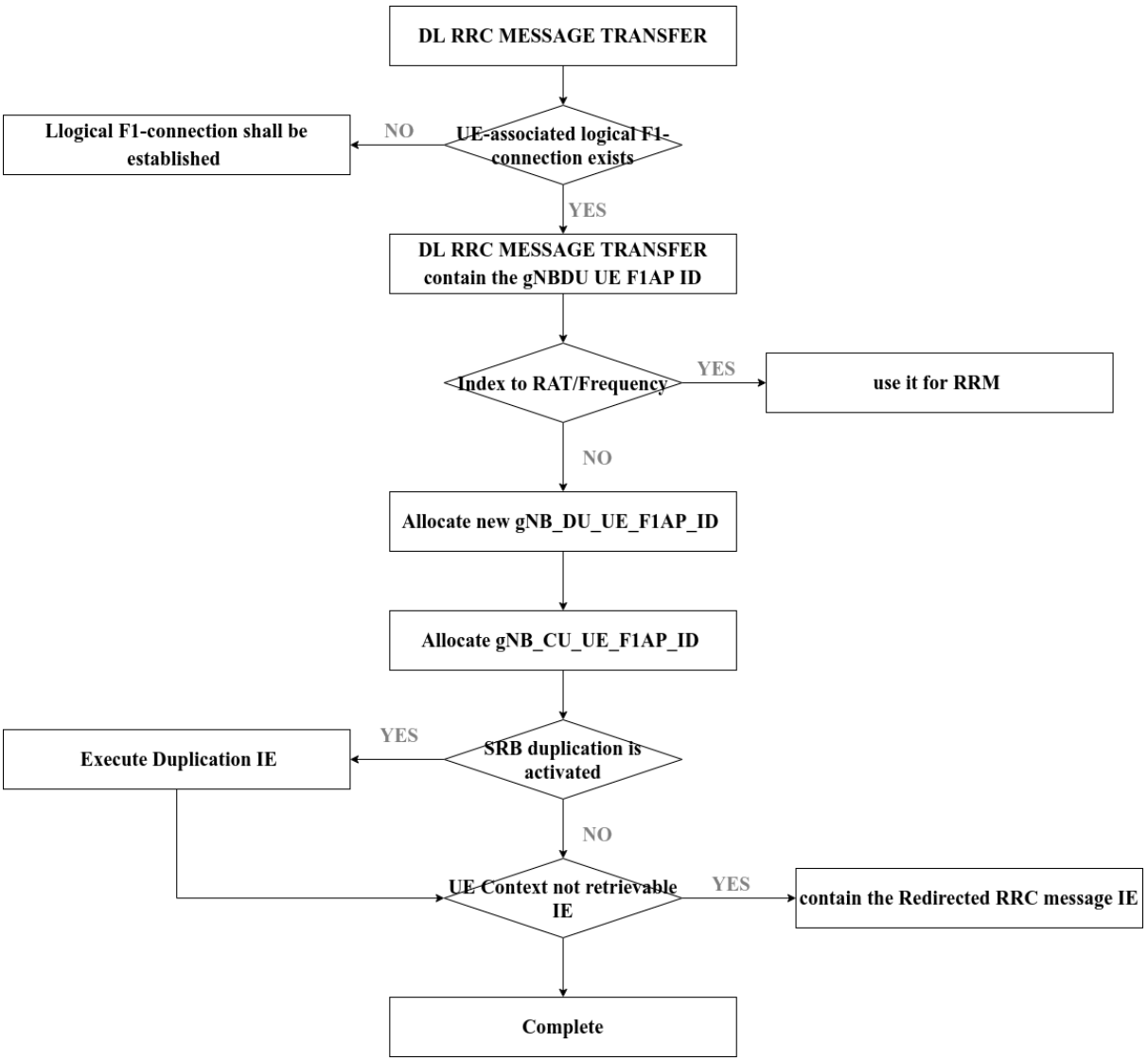
The DL RRC MESSAGE TRANSFER message shall include, if SRB duplication is activated, the Execute Duplication IE, so that the gNB-DU can perform CA based duplication for the SRB.

If the gNB-DU identifies the UE-associated logical F1-connection by the gNB-DU UE F1AP ID IE in the DL RRC MESSAGE TRANSFER message and the old gNB-DU UE F1AP ID

IE is included, it shall release the old gNB-DU UE F1AP ID and the related configurations associated with the old gNB-DU UE F1AP ID.

If the UE Context not retrievable IE set to "true" is included in the DL RRC MESSAGE TRANSFER, the DL RRC MESSAGE TRANSFER may contain the PLMN Assistance Info for Network Sharing IE, if available at the gNB-CU and may use it as specified in TS 38.401 [4].

If the DL RRC MESSAGE TRANSFER message contains the New gNB-CU UE F1AP ID IE, the gNB-DU shall, if supported, replace the value received in the gNB-CU UE F1AP ID IE by the value of the New gNB-CU UE F1AP ID and use it for further signalling.



Interactions with UE Context Release Request procedure:
If the UE Context not retrievable IE set to "true" is included in the DL RRC MESSAGE TRANSFER, the gNB-DU may trigger the UE Context Release Request procedure, as specified in TS 38.401 [4].

Parameter

Name	Value	Characteristic
gNB_DU_UE_F1AP_ID		Allocate
gNB_CU_UE_F1AP_ID		Allocate
SRB_ID	1	Static
RRC-Container	RRCSetup	Static
Execute Duplication	True	Static
RAT-Frequency Priority Information	True	Static
>EN-DC		
>>Subscriber Profile ID for RAT/Frequency priority	111111	Static/Changeable
>NG-RAN		
>> Index to RAT/Frequency Selection Priority	1010111	Static/Changeable
RRC Delivery Status Request	True	Static/Changeable

gNB-DU UE F1AP ID
The gNB-DU UE F1AP ID uniquely identifies the UE association over

RAT-Frequency Priority Information
See Initial UL RRC Message Transfer [9.3.1.34] page 184

The RAT-Frequency Priority Information contains either the Subscriber Profile ID for RAT/Frequency priority IE or the Index to RAT/Frequency Selection Priority IE. These parameters are used to define local configuration for RRM strategies.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE RAT-Frequency Priority Information	M			
>EN-DC				
>>Subscriber Profile ID for RAT/Frequency priority	M		INTEGER (1.. 256, ...)	
>NG-RAN				
>> *Index to RAT/Frequency Selection Priority*	M		INTEGER (1.. 256, ...)	

Abnormal Conditions

Not applicable.

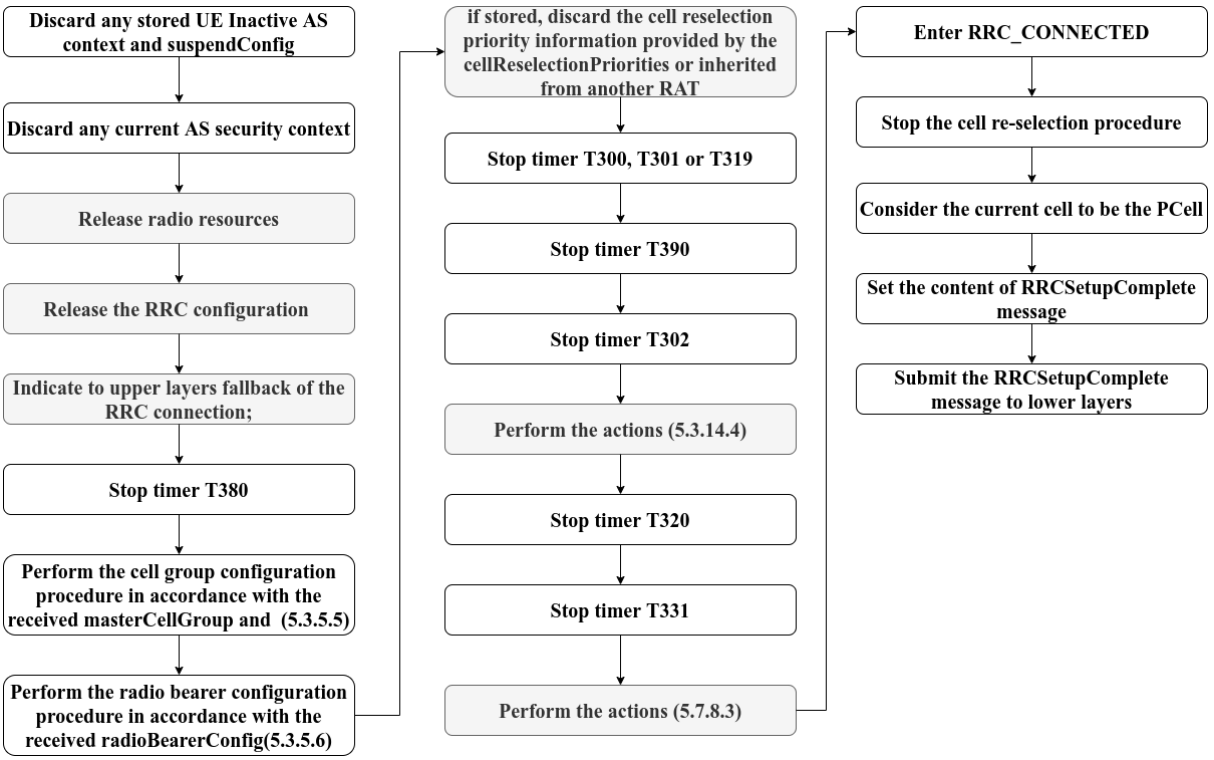
RRCSetup

See RRCSetup page 284
The RRCSetup message is used to establish SRB1.
Signalling radio bearer: SRB0
RLC-SAP: TM
Logical channel: CCCH
Direction: Network to UE

Return CellGroupConfiguration and radioBearerConfig

Reception of the RRCSetup by the UE

See Reception of the RRCSetup by the UE [5.3.3.4] page 55



List waited update:

1. Perform the cell group configuration procedure in accordance with the received masterCellGroup (5.3.5.5)
2. Perform the radio bearer configuration procedure in accordance with the received radioBearerConfig(5.3.5.6)
3. Perform the actions T302, T390 expiry or stop (Barring alleviation) (5.3.14.4)
4. Perform the actions T331 expiry or stop (5.7.8.3)

Reception of the RRCReject by the UE

See Reception of the RRCSetup by the UE [5.3.3.5] page 55
The UE shall:

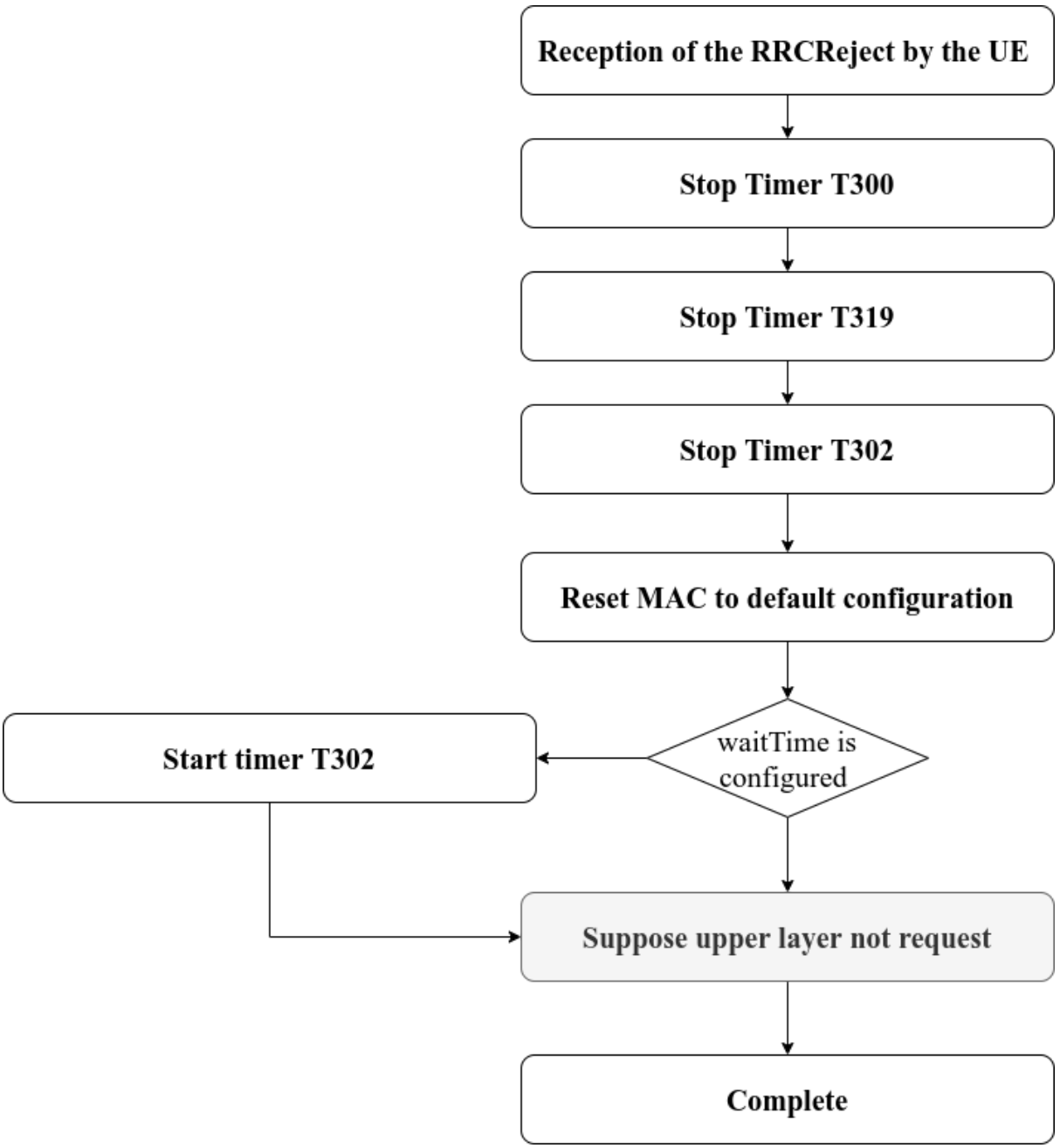
perform the actions as specified in 5.3.15;

Initiation

The UE initiates the procedure upon the reception of RRCReject when the UE tries to establish or resume an RRC connection.

Reception of the RRCReject by the UE

1. stop timer T300, if running;
2. stop timer T319, if running;
3. stop timer T302, if running;
4. reset MAC and release the default MAC Cell Group configuration
5. If waitTime is configured in the RRCReject:then start timer T302, with the timer value set to the waitTime;
6. if RRCReject is received in response to a request from upper layers:then inform the upper layer that access barring is applicable for all access categories except categories '0' and '2';
7. If timer T331 is running, the UE continues to perform idle/inactive measurements according to 5.7.8.



Single gNB LOS Simulation

Uma Model

UE

Introduction

User's Guidance

Setting Up

Virtual Machine Settings

Account	UE	
Password	ue	
System	Processor	2 CPUs
Network	NAT Network	SMRNetwork
	NAT	
RAM	10G	
Disk	50G	
Operation System	ubuntu-18.04.6-desktop-amd64.iso	

Software Package Install

Name	Version
python3	3.6
pip3	21.3.1
numpy	1.19.5
matplotlib	3.3.4
flask	2.0.3

Command

```
sudo apt install python3-pip
python3 -m pip install --upgrade pip
python3 -m pip install --upgrade Pillow
pip3 install numpy
pip3 install matplotlib
pip2 install flask
```

UE Configurations

UE Configurations

Key	Value
UE_Name	UE_A

RRC	RRC_IDLE/RRC_CONNECTED

Flow Chart

UE Access to Core Network
Getting gNB Information
Calculate RSRP
Show Posiiton in GUI
Response to gNB
gNB Response to CU
Show Same RSSI Line in GUI

gNB

Introduction

User's Guidance

Setting Up

Virtual Machine Settings

Account	gNB	
Password	gnb	
System	Processor	2 CPUs
Network	NAT Network	SMRNetwork
	NAT	
RAM	10G	
Disk	50G	
Operation System	ubuntu-18.04.6-desktop-amd64.iso	

Software Package Install

Name	Version
python3	3.6.9
pip3	9.0.1
flask	2.0.3
net-tools	

Command

sudo apt install python3-pip

sudo apt install net-tools

pip3 install flask

Reference

SRB
https://blog.csdn.net/qq_44775960/article/details/111464660?ops_request_misc=&request_id=&biz_id=102&utm_term=SRB1&utm_medium=distribute.pc_search_result.none-task-blog-2~all~sobaiduweb~default-1-111464660.142^v11^pc_search_result_control_group,157^v12^new_style&spm=1018.2226.3001.4187

MCG
https://blog.csdn.net/dandan920107/article/details/111354539?ops_request_misc=%257B%2522request%255Fid%2522%253A%252216539143951678143548826l%2522%252C%2522scm%2522%253A%252220140713.130102334..%2522%257D&request_id=165391439516781435488261&biz_id=0&utm_medium=distribute.pc_search_result.none-task-blog-2~all~top_click~default-1-111354539-null-null.142^v11^pc_search_result_control_group,157^v12^new_style&utm_term=RRC&spm=1018.2226.3001.4187

NR CGI
https://www.techplayon.com/5g-nr-cell-global-identity-planning/