

GTI 5G Sub-6GHz Device Field Test Specification- SA Mode

The logo consists of the letters 'GTI' in a bold, white, sans-serif font, centered on a dark blue background. The background features a glowing blue grid pattern that recedes into a bright light source, creating a sense of depth and technology.

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GTI 5G Sub-6GHz Device Field Test Specification-SA Mode



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Document History

Date	Meeting #	Version #	Revision Contents
02-11-2018	23 rd GTI Workshop	V1.0	The first version of GTI 5G Sub-6GHz Device Field Test Specification-SA Mode. This specification targets eMBB scenario for 5G Sub-6GHz Chipset, Module and Device products testing. It stipulates the 5G device field tests in SA Mode (Option 2).

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1 Scope

This specification targets enhanced Mobile Broadband (eMBB) scenario for 5G Sub-6GHz Chipset, Module and Device products testing. It stipulates the 5G device field tests in SA Mode (Option 2) and how the tests shall be conducted.

This specification provides evaluation criteria for basic performance in the 5G field test. Considering various test requirements, specific test cases and methods are designed, together with the basic requirements for each test category, number of test devices, and tailored agreements.

This specification is one of the 5G Sub-6GHz device test specifications which are used in GTI 5G Device Certification.

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of the present document. For documents marked with date information, the subsequent modifications (except corrigendum) or revisions do NOT apply to this document. If there are later revisions, the parties related to this document should discuss the applicability of the latest version. For reference documents without date information, the latest version applies to this document.

Reference 3GPP specifications are as follows:

- Terminal: The terminal used in NSA NR tests shall conform to 3GPP R15 corespecifications released in September 2018, and the terminal used in SA NR tests shall conform to 3GPP R15 corespecifications released in September 2018.

3 Abbreviations

Abbreviation	Explanation
AMC	AdaptiveModulationandCoding
BLER	Block Error Rate
CDF	CumulativeDistributedFunction
CP	CyclicPrefix
DL	Downlink
DwPTS	DownlinkPilot Timeslot
eNB	EvolvedNodeB
GPS	Global Positioning System
HARQ	HybridAutomaticRepeat-reQuest
IR	Incremental Redundancy
MCS	Modulation andCodingScheme
MIMO	MultipleInput MultipleOutput
non-GBR	nonguaranteed Bit Rate
PDCCH	PhysicalDownlinkControl Channel
PDF	ProbabilityDistributedFunction
PDSCH	PhysicalDownlinkShared Channel
PUCCH	PhysicalUplinkControl Channel
PUSCH	PhysicalUplinkShared Channel
QPSK	QuadraturePhaseShift Keying
RSRP	ReferenceSignalReceivedPower
RSRQ	ReferenceSignalReceivedQuality
SFBC	Space FrequencyBlockCodes
SIMO	SingleInput MultipleOutput
SM	Space Multiplexing
SNR	Signal toNoise Ratio
SINR	Signal toInterference&Noise Ratio
TCP	TransmissionControlProtocol
UDP	UserDatagramProtocol
UE	User Equipment
UL	Uplink
UpPTS	Uplink PilotTimeslot

4 Basic requirements for the test environment

4.1 Network architecture and scale

Perform the field test in dense or typical urban areas. The radio network shall form regular multi-layer cellular structures.

The test network consists of the NSA coverage area and SA coverage area. In the SA coverage area, at least 30 base stations are available.

4.2 Test area and route

Depending on the test objective, test personnel can choose either of the following test areas:

1. A single cell is the cell under test, and other cells are either not loaded or loaded with data as interference to the cell under test according to the designated method. It's required that the cell under test be located in the center of the testing area with multiple neighboring cells in its surrounding areas. Radial and ring testing routes within the coverage of the cell under test should be included.
2. More than 50 cells providing contiguous coverage are available. A drive test shall be performed in an area with a relatively regular cellular structure. During the drive test (DT), the test routes shall cover as many major roads, minor roads, and branch roads as possible, and include all cells in the specified test area. If not otherwise specified, the test vehicle should move at about 30 km/h based on the actual traffic.

4.3 Test network basic configuration

The following table lists the default configuration in the SA mode test.

Table 4-1 Typical test configuration parameters

Item	Value	Remarks
NR frequency band	N41/N78/N79	
NR bandwidth	80 MHz /100MHz	
NR frame structure	2ms: single-periodicity 2.5ms: single-/dual-periodicity 5ms: periodicity	Choose the supported periodicity.

CP length	normal	
GP in the special subframe	2-4 symbols	
PRACH format	Format0/Format B4/Format C2	At least one long format and one short format. Perform PRACH tests by modifying the timeslot configuration ratio.
PUCCH format	Format0/Format1+Format2/Format3	Select at least one format between formats {0,1} and at least one format between format {2,3}.
PBCH sub-carrier spacing	30kHz	
PBCH SSB beam quantity	1~ 8	Fixed position, horizontal direction
PBCH period	20ms	
PDCCH beam quantity	Same as the SSB, narrow beam	Same as the SSB beam quantity.
Number of PDCCH symbols	1	
UL power control	Enabled	PUCCH, PUSCH, Sounding
HARQ	Enabled	
AMC	Enabled	
SRS	Transmission with antenna switching	
Terminal multi-antenna mode	2T4R	
Terminal Tx power	The total Tx power of the terminal supporting SA system is 26 dBm.	

4.4 Assistance test equipment

Table 4-2 Assistance test equipment

Name	Quantity	Model and version (fill in during test)
Drive testterminal	Configure as needed	
Test PC	Configure as needed	
Test vehicle	1	

4.5 Interference adding method

DL interference adding scheme (PDSCH and PDCCH)

- Omnidirectional interference adding: This scheme does not use beamforming and has a large difference from the commercial network scenario.
- Narrow beam scanning: This scheme defines the number of specific beams (such as 8) and the facing direction (antenna weights). The interference cell uses one weight per slot until all weights are used. Based on 8-beam scanning, design the scanning rule with changed time, random scanning direction and same scanning direction on the 50 PRBs (the PRBs are randomly selected).
- Fixed narrow beams: This scheme defines the specific antenna weights for interference adding. Such an interference adding scheme has a great impact on the test results and is almost equivalent to no interference addition.

UL interference adding scheme (PUSCH)

- Use real UEs to add interference at the cell edge.
- Signal generator

Table 4-3 Interference levels

	DL loading	UL IoT
Level 1	50%	3

4.6 Test result format

The test data is recorded in the CSV or EXCEL format. The following data shall be recorded:

1. Basic info: time, GPS, PCI, NCGI
2. Coverage information:
 - RSRP (CSI-RS-RSRP/SS-RSRP), SINR (CSI-RS-SINR/SS-SINR), and RSSI of the serving cell;

- RSRP (CSI-RS-RSRP/SS-RSRP), SINR (CSI-RS-SINR/SS-SINR) of the neighboring cell
3. Scheduling information:
 - UL/DL MCS, UL/DL number of RBs scheduled per TTI, UL/DL transmission mode, UL/DL BLER, DL CQI, DL PMI, DL RI, UL Tx power, UL transmission mode, SRS transmission status
 4. Performance information
 - UL/DL PDCP-/RLC-/MAC-/PHY-layer rate, UL/DL SDAP rate, control-plane delay, user-plane delay
 5. Data to be recorded on the base station: number of UE streams, feedback mode (SU-MIMO/MU-MIMO), and number of paired UEs, etc.

4.7 Point selection principle

Good, medium and bad points are defined based on the CDF curve in the drive test.

5 UE searching network upon boot-up

5.1 Cell selection and registration upon UE boot-up

Test item	Cell selection	Sub-item	Cell selection and registration upon boot-up of a single UE																		
Reference document		Network configuration	Network environment without load																		
Test level	Mandatory																				
Test purpose	To verify the cell selection success rate of the UE in areas with different signal strength levels.																				
Test conditions:																					
<p>(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".</p> <p>(2) Test area: Choose a cell for test. In the cell, select four static test points: excellent point, good point, medium point, bad point. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test.</p> <p>(3) DUT quantity: Only one UE of each brand is allowed in a single test.</p> <p>(4) The UE under test is not allowed to lock to the default frequency of the network.</p>																					
Test procedure:																					
<p>(1) Choose a point with excellent signal quality, and boot the UE in a static environment. The UE performs initial cell searching.</p> <table border="1" data-bbox="406 1355 1182 1742"> <thead> <tr> <th>UE –AMF</th> <th>Message</th> </tr> </thead> <tbody> <tr> <td>...</td> <td>...</td> </tr> <tr> <td>--></td> <td>REGISTRATION REQUEST</td> </tr> <tr> <td><--</td> <td>AUTHENTICATION REQUEST</td> </tr> <tr> <td>--></td> <td>AUTHENTICATION RESPONSE</td> </tr> <tr> <td><--</td> <td>SECURITY MODE COMMAND</td> </tr> <tr> <td>--></td> <td>SECURITY MODE COMPLETE</td> </tr> <tr> <td><--</td> <td>REGISTRATION ACCEPT</td> </tr> <tr> <td>--></td> <td>REGISTRATION COMPLETE</td> </tr> </tbody> </table> <p>(2) Check whether the UE has successfully searched cells and camped on a cell. Check the UE tracing messages and record field strength (RSRP(CSI-RS-RSRP/SS-RSRP),SINR(CSI-RS-SINR/SS-SINR)) in the serving and neighboring cells, record the time interval (Tcell_in) from UE boot-up to network registration.</p> <p>(3) Repeat steps 1 to 2 for 20 times and record the success rate.</p>				UE –AMF	Message	-->	REGISTRATION REQUEST	<--	AUTHENTICATION REQUEST	-->	AUTHENTICATION RESPONSE	<--	SECURITY MODE COMMAND	-->	SECURITY MODE COMPLETE	<--	REGISTRATION ACCEPT	-->	REGISTRATION COMPLETE
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-->	SECURITY MODE COMPLETE																				
<--	REGISTRATION ACCEPT																				
-->	REGISTRATION COMPLETE																				

- (4) Place the UE in three test points with good, medium and bad signal quality, respectively. Repeat steps 1 to 3.

Note: Tcell_in refers to the time interval from the time when the first MIB is received by the UE to the time when the UE finishes network registration.

Expected results:

- (1) The UE can perform cell selection in areas with different signal strength levels, and the cell selection success rate is 100%.

Data statistics and processing:

- (1) Record the time interval T1 from the time when the first MIB is received by the UE to the time when the UE camps on the cell. Record time interval T2 from the time when the UE sends Msg1 to the time when the UE sends the Attach Complete message.
- (2) Calculate the time interval Tcell_in from boot to network registration, and measure the maximum value Tmax, minimum value Tmin and mean value Taverage of Tcell_in. Note that "Tcell_in = T1 + T2".
- (3) Cell selection and camping success rate = Number of times the UE successfully performs cell selection and camps on the cell/Total number of times the UE initiates cell selection and camping

Remarks:

In test points with bad signal quality, the relative relation of signal qualities between cells may change frequently. Therefore, record cell measurements when the UE accesses the cell each time, and analyze the measurement results.

5.2 Cell search after returning to the coverage area

Test item	Cell selection	Sub-item	Cell search after returning to the coverage area
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify that the UE can re-initiate cell searching and camping after an out-of-service (OoS).		
Test conditions:			
(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".			
(2) Test area: Select two cells under test (Cell 1 and Cell 2).			
(3) DUT quantity: Only one UE of each brand is allowed in a single test.			
(4) The UE is set to automatic network selection mode and is not allowed to lock to the default frequency of the network.			

<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Boot the UE in the area covered by Cell 1 in static environment. The UE successfully camps on the cell and initiate services (such as FTP download). (2) Place the UE into a shielding box until the UE is out of service. Move the UE toward Cell 2 and then take it out of the shielding box. The UE re-initiates network selection. Record the UE's network selection and registration status in Cell 2 and the required time Tcell_in. Record the signal quality (parameters such as RSRP and RSRQ) in the serving cell. (3) Repeat steps 1~2 for 20 times and record the success rate. <p>Note: Tcell_in refers to the time interval from the time that the UE restores with signal receiving to the time that the UE finishes network registration.</p>
<p>Expected results:</p> <ol style="list-style-type: none"> (1) The UE can perform cell searching and camping in areas with different signal strength levels, and the success rate is 100%.
<p>Data statistics and processing:</p> <ol style="list-style-type: none"> (1) Measure the time required for cell searching, and calculate the average time Taverage, maximum time Tmax and minimum time Tmin of cell searching. (2) If the cell searching fails, analyze the causes based on signaling messages transmitted between the system and UE.
<p>Remarks:</p>

5.3 Normal registration

Test item	Registration Update	Sub-item	Normal Registration
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify the UE can initiate registration update in mobility.		
Test conditions:			
<ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test route: The test area should include two TAs (with different TAIs), and the test route should cover the two TAs. (3) One test vehicle; (4) DUT quantity: At least one DUT of each brand should be used in a single test. (5) UE is registered in CELL1, and in the state 5GMM-REGISTERED /5GMM-IDLE 			

mode.										
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Boot the UE at the start position of the test route. The UE registers with the network in one TA, establishes a PS service (such as web browsing), and then stops the service. Verify that the UE can work properly. (2) Drive the test vehicle along the test route at a moderate speed between 30 to 40 km/h. (3) The UE roams to another TA. Analyze the UE tracing messages to check whether the UE has successfully initiated and finished registration Update. (4) In the new TA, the UE re-establish a PS service (such as web browsing). Verify that the UE can work properly. UE enters CELL2 from CELL1. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">UE -MME</th> <th style="text-align: center;">Messgae</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">...</td> <td style="text-align: center;">...</td> </tr> <tr> <td style="text-align: center;">--></td> <td style="text-align: center;">REGISTRATION REQUEST</td> </tr> <tr> <td style="text-align: center;"><--</td> <td style="text-align: center;">REGISTRATION ACCEPT</td> </tr> <tr> <td style="text-align: center;">--></td> <td style="text-align: center;">REGISTRATION COMPLETE</td> </tr> </tbody> </table> <ol style="list-style-type: none"> (5) Repeat steps 1-4 for 20 times and measure the RAN-based notification area update success rate. 	UE -MME	Messgae	-->	REGISTRATION REQUEST	<--	REGISTRATION ACCEPT	-->	REGISTRATION COMPLETE
UE -MME	Messgae									
...	...									
-->	REGISTRATION REQUEST									
<--	REGISTRATION ACCEPT									
-->	REGISTRATION COMPLETE									
<p>Expected results:</p> <ol style="list-style-type: none"> (1) The UE can successfully perform normal Registration Update and no exceptions such as OoS occur. (2) The UE can successfully establish services in the cell belonging to the new TA. (3) The Registration Update success rate is 100%. (4) In the REGISTRATION REQUEST sent by UE, 5GS REGISTRATION type IE is "mobility REGISTRATION updating"; (5) UE receives REGISTRATION ACCEPT with network assignment 5G-GUTI and TA list. If there is a GUTI, UE sends REGISTRATION COMPLETE to AMF for confirmation. 										
<p>Remarks:</p>										

5.4 Periodic registration

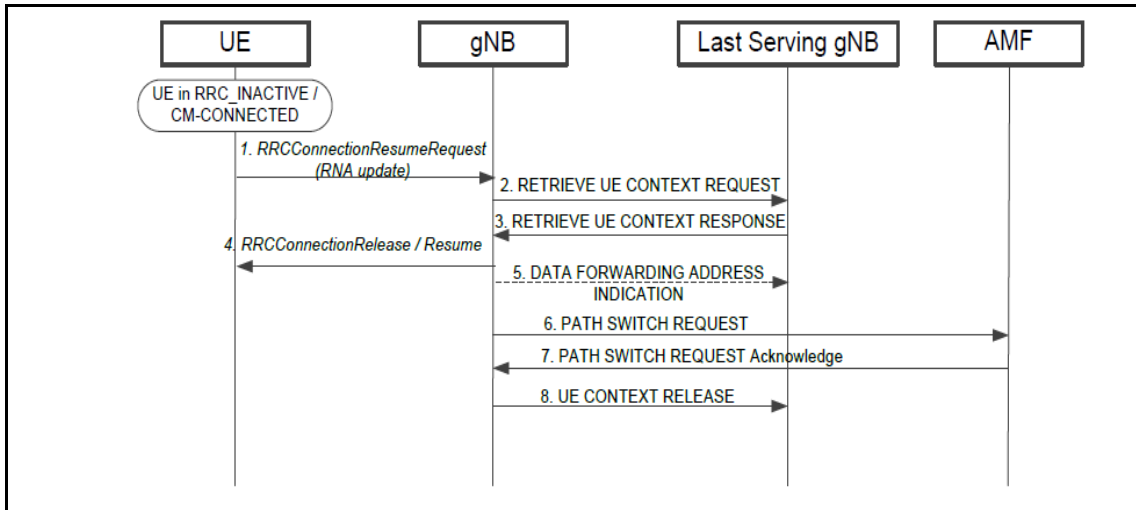
Test item	Registration Update	Sub-item	Periodic Registration
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test	To verify the UE supports periodic registration update.		

purpose											
Test conditions:											
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) The network configures a relative shorter periodic registration timer (T3412 timer), such as 6 min. (3) DUT quantity: At least one DUT of each model should be used in the test. (4) Test method: The test is performed in fixed locations. (5) UE is registered in CELL1, and in the state 5GMM-REGISTERED /5GMM-IDLE mode. 											
Test procedure:											
<ul style="list-style-type: none"> (1) Boot the UE. The UE registers with the network and is in RRC_IDLE state. (2) Wait for a while (until T3412 timer expires), and check the signal interacted between the UE and network. 											
<table border="1"> <thead> <tr> <th style="width: 30%;">UE -MME</th> <th>Message</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">...</td> <td style="text-align: center;">...</td> </tr> <tr> <td style="text-align: center;">--></td> <td>REGISTRATION REQUEST</td> </tr> <tr> <td style="text-align: center;"><--</td> <td>REGISTRATION ACCEPT</td> </tr> <tr> <td style="text-align: center;">--></td> <td>REGISTRATION COMPLETE</td> </tr> </tbody> </table>		UE -MME	Message	-->	REGISTRATION REQUEST	<--	REGISTRATION ACCEPT	-->	REGISTRATION COMPLETE
UE -MME	Message										
...	...										
-->	REGISTRATION REQUEST										
<--	REGISTRATION ACCEPT										
-->	REGISTRATION COMPLETE										
<ul style="list-style-type: none"> (3) Analyze the UE tracing messages to check whether the UE has successfully initiated and finished Registration Update. (4) Repeat steps 2~3 for 20 times, and check whether the UE can successfully perform Registration Update and whether the Registration Update interval is consistent with the timer value (6 min) configured on the network. (5) Record the info about each successful Registration Update and the Registration Update intervals, calculate the periodic Registration Update success rate, and analyze causes of exceptions. 											
Expected results:											
<ul style="list-style-type: none"> (1) The UE can successfully perform period Registration Update, and the Registration Update interval is consistent with Registration Update period configuration on the network. (2) The Registration Update success rate is 100%. (3) In the REGISTRATION REQUEST sent by UE, the 5GS REGISTRATION type IE is "cymat REGISTRATION updating"; (4) UE receives REGISTRATION ACCEPT with network assignment 5G-GUTI and TAI list. If there is a GUTI, UE sends REGISTRATION COMPLETE to AMF for confirmation. 											
Remarks:											
After the periodic Registration Update timer expires, the UE sends a Tracking Area Update											

Request message, in which the Registration Update type is configured as periodic Registration Update and the Registration Update period is set to the same value as the timer configured on the network.

5.5 RAN-based notification area update

Test item	Tracking Area Update	Sub-item	RAN-based notification area update
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify that the UE can initiate RAN-based notification area update in mobility.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test route: The test area should include two RAN-based notification areas, and the test route should cover the two areas. (3) One test vehicle; (4) DUT quantity: At least one DUT of each brand should be used in a single test. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Boot the UE at the start position of the test route. The UE registers with the network in one RAN-based notification area, establishes a PS service (such as web browsing), and then stops the service. Verify that the UE can work properly. (2) Drive the test vehicle along the test route at a moderate speed between 30 to 40 km/h. (3) The UE roams to another RAN-based notification area. Analyze the UE tracing messages to check whether the UE has successfully initiated and finished RAN-based notification area update. (4) In the new RAN-based notification area, the UE re-establish a PS service (such as web browsing). Verify that the UE can work properly. (5) Repeat steps 1-4 for 20 times and measure the RAN-based notification area update success rate. 			



Expected results:

- (1) The UE can successfully perform normal RAN-based notification area update and no exceptions such as OoS occur.
- (2) The UE can successfully establish services in the cell belonging to the new RAN-based notification area.
- (3) The RAN-based notification area update success rate is 100%.

Remarks:

6 Terminal data service performance test

6.1 Single-user peak throughput - outdoor DL data - fixed point

Test item	Peak rate test	Sub-item	Peak rate test for a single UE at a fixed point in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of a single UE in a single cell in the live network.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The "excellent" points in the test cell, the cell has no load, and no interference is configured for the surrounding cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. (4) The UL Tx mode is set to dual-antenna transmission. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the DUT at the excellent point of the test cell. The DUT performs the full-buffer FTP download service. Keep the service for at least 1 minute when the rate is stable in 1 minute. Then, fill in the test results based on the data record table. The access fails if there is still no obvious download rate 30s later after the DUT activates its bearer. In this case, the DUT shall deactivate the bearer and then re-activate the bearer and start the download test. Repeatedly perform the download for at least 5 times, and record the number of downloading failures. 			
Expected results:			
<ul style="list-style-type: none"> (1) The UE can successfully initiate services and the service rates are stable. (2) The maximum download rate can be reached on the UE at the "excellent" point. For NR, in the case of DL 4 streams and 256QAM, the download rate is more than 80% of the theoretical rate configured for the current frame structure. 			
Test data recording and processing:			
<ul style="list-style-type: none"> (1) Record the maximum peak rate of the full-buffer FTP download service. (2) Record the test results at the record chart, and ensure that the recorded content 			

meet requirements specified in section 4.6.

(3) Record the network environment (including cell IDs and frequencies) at the test points.

Remarks:
In the FTP test, use the unified FTP tool and FTP address.

6.2 Single-user peak throughput - outdoor UL data - fixed point - UL 64QAM

Test item	Peak rate test	Sub-item	Peak rate test for a single UE at a fixed point in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of a single UE in a single cell in the live network.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The "excellent" points in the test cell, the cell has no load, and no interference is configured for the surrounding cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. (4) The highest UL modulation mode is 64QAM and the UL Tx mode is dual-antenna transmission. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the DUT at the excellent point of the test cell. The highest UL modulation mode of the base station is 64QAM. Keep the service for at least 1 minute when the rate is stable in 1 minute. Then, fill in the test results based on the data record table. The access fails if there is still no obvious upload rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer and then re-activate the bearer and start the upload test. Repeatedly perform the test for at least 10 times, and record the number of downloading failures. 			
Expected results:			
<ul style="list-style-type: none"> (1) The UE can successfully initiate services and the service rates are stable. (2) The maximum upload rate can be reached on the UE at the "excellent" point. 			

Note: For NR, in the case of UL 2 streams and 64QAM, the maximum upload rate is more than 80% of the theoretical value configured for the current frame structure.

Test data recording and processing:

- (1) Record the maximum peak rate of the full-buffer FTP upload service.
- (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.
- (3) Record the network environment conditions (including cell IDs and frequencies) at the test points.

Remarks:

In the FTP test, use the unified FTP tool and FTP address.

6.3 Single-user peak throughput - outdoor UL data - fixed point - UL 256QAM

Test item	Peak rate test	Sub-item	Peak rate test for a single UE at a fixed point in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of a single UE in a single cell in the live network.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The "excellent" points in the test cell, the cell has no load, and no interference is configured for the surrounding cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. (4) The highest UL modulation mode is 256QAM and the UL Tx mode is dual-antenna transmission. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the DUT at the excellent point of the test cell. The DUT performs the full-buffer FTP upload service. Keep the service for at least 1 minute when the rate is stable in 1 minute. Then, fill in the test results based on the data record table. The access fails if there is still no obvious upload rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer and then re-activate the bearer and start the upload test. Repeatedly perform the test for at 			

least 10 times, and record the number of downloading failures.
<p>Expected results:</p> <ul style="list-style-type: none"> (1) The UE can successfully initiate services and the service rates are stable. (2) The maximum upload rate can be reached on the UE at the "excellent" point. For NR, in the case of UL 2 streams and 256QAM, the maximum upload rate is more than 80% of the theoretical value configured for the current frame structure. <p>Test data recording and processing:</p> <ul style="list-style-type: none"> (1) Record the maximum peak rate of the full-buffer FTP upload service. (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (3) Record the network environment conditions (including cell IDs and frequencies) at the test points.
<p>Remarks:</p> <p>In the FTP test, use the unified FTP tool and FTP address.</p>

6.4 Single-user peak throughput - outdoor concurrent UL/DL data - fixed point - UL 64QAM

Test item	Peak rate test	Sub-item	Peak rate test for a single UE at a fixed point in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of a single UE in a single cell in the live network.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The "excellent" points in the test cell, the cell has no load, and no interference is configured for the surrounding cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. (4) For NR and LTE: 256QAM is adopted in the DL, 64QAM is adopted in the UL, and the UL transmission mode is dual-antenna transmission. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the DUT at the excellent point of the test cell. 			

The DUT performs full-buffer FTP upload and download services concurrently. Keep the services for at least 1 minute when the rates are stable in 1 minute. Then, fill in the test results based on the data record table.

The access fails if there is still no obvious download or upload rate 30s later after the DUT activates its bearers. In this case, The DUT shall deactivate the bearers and then re-activate the bearers and start the upload or download test. Repeatedly perform the test for at least 10 times, and record the number of downloading or uploading failures.

Expected results:

- (1) The UE can successfully initiate services and the service rates are stable.
- (2) The UE's maximum DL/UL rates are more than 80% of the theoretical values configured for the current frame structure at the "excellent" point.

Note: For NR, the conditions are as follows: DL: 4 streams and 256QAM; UL: 2 streams and 64QAM.

Test data recording and processing:

- (1) Record the maximum peak rate of the full-buffer FTP upload/download service.
- (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.
- (3) Record the network environment conditions (including cell IDs and frequencies) at the test points.

Remarks:

In the FTP test, use the unified FTP tool and FTP address.

6.5 Single-user peak throughput - outdoor concurrent UL/DL data - fixed point - UL 256QAM

Test item	Peak rate test	Sub-item	Peak rate test for a single UE at a fixed point in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of a single UE in a single cell in the live network.		
Test conditions:			
<ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The "excellent" points in the test cell, the cell has no load, and no 			

<p>interference is configured for the surrounding cells.</p> <p>(3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately.</p> <p>(4) 256QAM is adopted at both UL and DL, and the UL Tx mode is dual-antenna transmission.</p>
<p>Test procedure:</p> <p>(1) Place the DUT at the excellent point of the test cell. The highest UL modulation mode of the base station is 256QAM.</p> <p>(2) The DUT performs full-buffer FTP upload and download services concurrently. Keep the services for at least 1 minute when the rates are stable in 1 minute. Then, fill in the test results based on the data record table.</p> <p>The access fails if there is still no obvious download or upload rate 30s later after the DUT activates its bearers. In this case, The DUT shall deactivate the bearers and then re-activate the bearers and start the upload or download test. Repeatedly perform the test for at least 10 times, and record the number of downloading or uploading failures.</p>
<p>Expected results:</p> <p>(1) The UE can successfully initiate services and the service rates are stable.</p> <p>(2) The UE's maximum download/UL rates are more than 80% of the theoretical values configured for the current frame structure at the "excellent" point.</p> <p>Note: For NR, the conditions are as follows: DL: 4 streams and 256QAM; UL: 2 streams and 256QAM.</p> <p>Test data recording and processing:</p> <p>(1) Record the maximum peak rate of the full-buffer FTP upload/download service.</p> <p>(2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.</p> <p>(3) Record the network environment conditions (including cell IDs and frequencies) at the test points.</p>
<p>Remarks:</p> <p>In the FTP test, use the unified FTP tool and FTP address.</p>

6.6 Single-user multi-point throughput - outdoor DL data

Test item	Throughput test	Sub-item	Throughput test for a single UE at multiple points in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		

Test purpose	To verify the peak throughput of the UE at test points of different field strength in no-load condition of a single cell in the live network.
<p>Test conditions:</p> <ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: 4 test points in the test cell (1 excellent point, 1 good point, 1 medium point, and 1 bad point). The test points should better be scattered evenly in the test cell. (3) DUT quantity: Only UEs of one brand are allowed for a single test. UEs of different brands must be tested separately. (4) The UL Tx mode is set to dual-antenna transmission. 	
<p>Test procedure:</p> <ul style="list-style-type: none"> (1) Enable the neighboring cell without interference added. (2) Place the DUT at the preset test point. The DUT performs the full-buffer FTP download service. Keep the service for at least 1 minute when the rate is stable in 1 minute. Then, fill in the test results based on the data record table. <p>The access fails if there is still no obvious download rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer, then re-activate the bearer and start the download test. Repeatedly perform the download for at least 5 times, and record the number of downloading failures.</p>	
<p>Expected results:</p> <ul style="list-style-type: none"> (1) The UE can successfully initiate services at each preset test point and the service rates are stable. <p>Test data recording and processing:</p> <ul style="list-style-type: none"> (1) Record the maximum peak rate of the full-buffer FTP download service. (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (3) Record the network environment (including cell IDs and frequencies) at the test points. 	
<p>Remarks:</p> <p>Use the unified FTP tool and the unified FTP address in the FTP tests. You are advised to finish the DL, UL and concurrent UL&DL data tests at one test point before moving to another test point.</p>	

6.7 Single-user multi-point throughput - outdoor UL data

Test item	Throughput test	Sub-item	Throughput test for a single UE at multiple points in a single cell
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Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of the UE at test points of different field strength in no-load condition of a single cell in the live network.		
<p>Test conditions:</p> <ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: 4 test points in the test cell (1 excellent point, 1 good point, 1 medium point, and 1 bad point). The test points should better be scattered evenly in the test cell. (3) DUT quantity: Only UEs of one brand are allowed for a single test. UEs of different brands must be tested separately. (4) The highest UL modulation mode is 64QAM and the UL Tx mode is dual-antenna transmission. 			
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Enable the neighboring cell without interference added. (2) Place the DUT at the preset test point. The DUT performs the full-buffer FTP upload service. Keep the service for at least 1 minute when the rate is stable in 1 minute. Then, fill in the test results based on the data record table. <p>The access fails if there is still no obvious upload rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer, then re-activate the bearer and start the download test. Repeatedly perform the test for at least 5 times, and record the number of downloading failures.</p>			
<p>Expected results:</p> <ol style="list-style-type: none"> (1) The UE can successfully initiate services at each preset test point and the service rates are stable. <p>Test data recording and processing:</p> <ol style="list-style-type: none"> (1) Record the maximum peak rate of the full-buffer FTP upload service. (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (3) Record the network environment (including cell IDs and frequencies) at the test points. 			
<p>Remarks:</p> <p>Use the unified FTP tool and the unified FTP address in the FTP tests. You are advised to finish the DL, UL and concurrent UL&DL data tests at one test point before moving to another test point.</p>			

6.8 Single-user multi-point throughput - outdoor UL/DL data

Test item	Throughput test	Sub-item	Throughput test for a single UE at multiple points in a single cell
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the peak throughput of the UE at test points of different field strength in no-load condition of a single cell in the live network.		
<p>Test conditions:</p> <ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: 4 test points in the test cell (1 excellent point, 1 good point, 1 medium point, and 1 bad point). The test points should better be scattered evenly in the test cell. (3) DUT quantity: Only UEs of one brand are allowed for a single test. UEs of different brands must be tested separately. (4) The highest UL modulation mode is 64QAM and the UL Tx mode is dual-antenna transmission. 			
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Enable the neighboring cell without interference added. (2) Place the DUT at the specified test point. The DUT performs full-buffer FTP upload and download services concurrently. Keep the services for at least 1 minute when the rates are stable in 1 minute, and then record each test point based on the data record table. The server and UE send UL and DL data through NR. Fill in the test results based on the data record table. <p>The access fails if there is still no obvious download or upload rate 30s later after the DUT activates its bearers. In this case, The DUT shall deactivate the bearers and then re-activate the bearers and start the upload or download test. Repeatedly perform the test for at least 5 times, and record the number of downloading or uploading failures.</p>			
<p>Expected results:</p> <ol style="list-style-type: none"> (1) The UE can successfully initiate services at each test point and the service rates are stable. <p>Test data recording and processing:</p> <ol style="list-style-type: none"> (1) Record the maximum peak rate of the full-buffer FTP upload/download service. (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. 			

(3) Record the network environment (including cell IDs and frequencies) at the test points.

Remarks:

Use the unified FTP tool and the unified FTP address in the FTP tests. You are advised to finish the DL, UL and concurrent UL&DL data tests at one test point before moving to another test point.

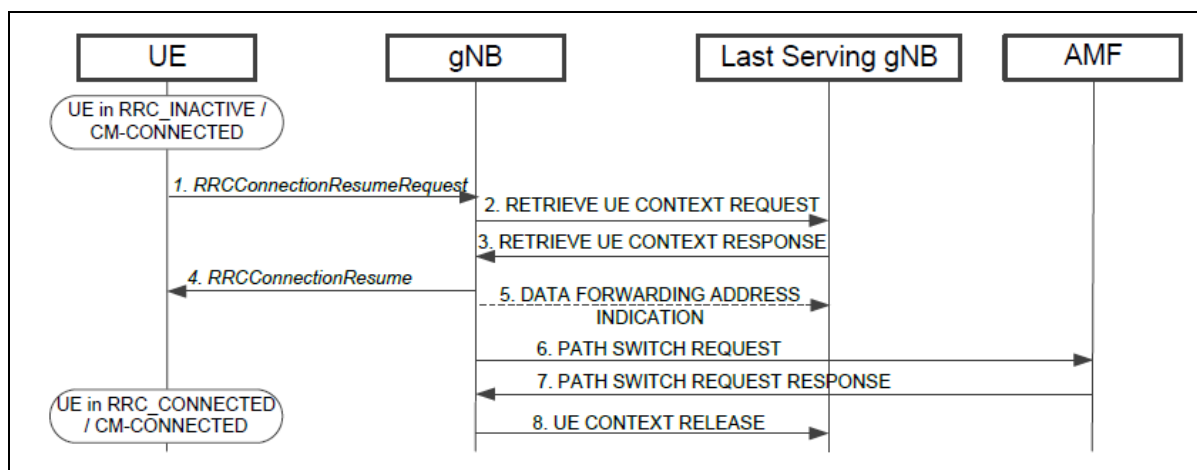
7 Delay and paging tests

7.1 Control-plane delay test in idle state

Test item	State transition and delay test	Sub-item	Control-plane delay test in idle state
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the control-plane delay of the UE at the static point in field tests.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: One cell is selected for the test. (3) A total of four excellent, good, medium, and bad static test points are selected in a single cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (4) Number of DUTs: Only one UE of one brand is used in a single test. UEs of different brands must be tested separately. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Initially configure the system with no load and no interference as required. (2) Perform the test at the excellent static test point in the cell. (3) Start the UE and record the time. (4) Power on a single UE, and enable it to access the network and stay in idle state. (5) Record the time from when the UE initiates RACH preamble in idle state to when it sends an RRC Connection Reconfiguration Complete message (that is, the control-plane delay). (6) Repeat steps (4) and (5) for 20 times. (7) Repeat steps (3) through (6) at the good, medium, and bad static test points respectively. 			
Test data recording and processing:			
<ul style="list-style-type: none"> (1) Record the maximum, minimum, and average access delay at each test point. 			
Remarks:			
Control-plane delay: time when the UE transits from idle state to active state. That is, the time from when the UE initiates the first random preamble to when it sends an RRC Connection Reconfiguration Complete message.			

7.2 Control-plane delay test in inactive state

Test item	State transition and delay test	Sub-item	Control-plane delay test in inactive state
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the control-plane delay of the UE at the static point in field tests.		
<p>Test conditions:</p> <ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: One cell is selected for the test. (3) A total of four excellent, good, medium, and bad static test points are selected in a single cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (4) Number of DUTs: Only one UE of one brand is used in a single test. UEs of different brands must be tested separately. 			
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Initially configure the system with no load and no interference as required. (2) Perform the test at the excellent static test point in the cell. (3) Start the UE and record the time. (4) Power on a single UE, and enable it to access the network and stay in inactive state. (5) Record the time from when the UE initiates RACH preamble in inactive state to when it initiates the RRC connection Reconfiguration complete message (that is, the control-plane delay). (6) Repeat steps (4) and (5) for 20 times. (7) Repeat steps (3) through (6) at the good, medium, and bad static test points respectively. <p>Signaling flowchart of transition from inactive state to active state (SA):</p>			



Test data recording and processing:

- (1) Record the maximum, minimum, and average access delay at each test point.

Remarks:

Control-plane delay: time when the UE transits from inactive state to startup state. That is, the time from when the UE initiates the first random preamble to when it initiates RRC connection Resume.

7.3 User-plane delay test

Test item	State transition and delay test	Sub-item	User-plane delay test
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the user-plane delay of the UE at the static point in field tests.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: One cell in the dense urban area is selected for the test. (3) A total of four excellent, good, medium, and bad static test points are selected in a single cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (4) Number of DUTs: Only one UE of one brand is used in a single test. UEs of different brands must be separately tested. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Initially configure the system, enable the neighboring cell, and do not add 			

<p>interference as required on the system side.</p> <ol style="list-style-type: none"> (2) Perform the test at the excellent static test point in the cell. (3) Power on a single UE, select the cell, and enable the UE to access the cell. (4) After accessing the network, the UE performs the 100 consecutive Ping operations with the packet sized of 32 Bytes and 1500 Bytes, respectively. (5) Record the delay for the 100 times of Ping operation, including the maximum user-plane delay, minimum user-place delay, average user-plane delay, and Ping success rate. (6) Repeat steps (3) and (5) at the good, medium, and bad static test points respectively.
<p>Expected results:</p> <ol style="list-style-type: none"> (1) Record the maximum user-plane delay, minimum user-place delay, average user-plane delay, and ping success rate.
<p>Remarks:</p>

7.4 Fixed-point paging test

Test item	State transition and delay test	Sub-item	Fixed-point paging test
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the UE paging delay and paging success rate		
<p>Test conditions:</p> <ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: One cell is selected for the test. (3) A total of four excellent, good, medium, and bad static test points are selected in a single cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (4) Number of DUTs: Only one UE of one brand is used in a single test. 			
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Initially configure the system, enable the neighboring ell, and do not add interference as required on the system side. (2) Perform the test at the excellent static test point in the cell. (3) Power on a single UE, select the cell, and enable the UE to access the cell and 			

<p>stay in RRC_IDLE state.</p> <p>(4) On the EPS side, initiate paging.</p> <p>(5) The UE is successfully paged and initiates an RRC connection establishment procedure. The UE enters RRC_CONNECTED state. In RRCConnectionRequest, the value of establishmentCause is "mt-Access".</p> <p>(6) Repeat step 5 and step 6 for 15 times respectively, and record the paging success rate.</p> <p>(7) Meanwhile, record the paging delay.</p> <p>(8) Repeat steps (3) and (7) at the good, medium, and bad static test points respectively.</p>
<p>Expected results:</p> <p>(1) Record the paging success rate and paging delay.</p>
<p>Remarks:</p> <p>(1) The paging delay includes the paging delay at the gNB side and the paging delay at the UE side.</p> <p>(2) Paging delay on the gNB side: time from when the gNB initiates the Paging message to when it receives RRC Connection Setup Complete.</p> <p>(3) Paging delay on the UE side: time from when the UE receives the Paging message to when it sends RRC Connection Setup Complete. The DRX cycle is set to 64 ms.</p>

7.5 Paging test during mobility

Test item	State transition and delay test	Sub-item	Paging test when the UE is in mobility state
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the paging delay and paging success rate during UE mobility.		
Test conditions:			
<p>(1) The NR system is deployed according to section 4.3 "Test network basic configuration".</p> <p>(2) Test route: The test route shall cover as many main roads, secondary roads, and branch roads as possible, and include as many all cells as possible in the specified test area.</p> <p>(3) Number of DUTs: Only one UE of one brand is used in a single test.</p> <p>(4) Paging retransmission is disabled on the 5GC (that is, the paging message over</p>			

the N1 interface is sent only once)

Test procedure:

Cause the network to be without any load.

- (1) Prepare one test vehicle carrying one DUT. Drive the test vehicle at a moderate constant speed (about 30 km/h) depending on the traffic condition.
- (2) Enable one DUT to attach to the network and stay in RRC_IDLE state. The 5GC needs to transmit data to the DUT and therefore initiates paging.
- (3) Monitor the signaling at both the UE and 5GC sides. Record the paging success/failure.
- (4) After connecting the 5GC to the DUT, keep the connection for 40s and then release the connection so that the DUT enters RRC_IDLE state again.
- (5) Repeat steps (2) to (4) at an interval of 20s. Drive the test vehicle along the test route for at least one round and page the DUT for at least 30 times.

Test data recording and processing:

The following data shall be recorded during the test:

Record the L1, L2, L3 signaling and control data on the UE (including RSRP, RSRQ, PRACH Preamble, Msg2, SINR, MIMO mode, and RRC signaling) of each test.

The base station records the signaling and control data on the UE for each test.

Requirements of post-test data processing: Calculate the total number of paging requests initiated by the 5GC and the number of successful paging times.

Paging success rate = Number of successful paging times/Total number of paging requests initiated by the 5GC

Where:

5GC-initiated paging request: 5GC initiates a paging (sending the Paging message over the N1 interface)

Paging success: After initiating paging (sending the Paging message over the N1 interface), the 5GC receives the INITIAL UE MESSAGE (NAS: Service Request) from the N1 interface. Then, the paging is considered successful.

Paging failure: After initiating paging, if the 5GC does not receive the INITIAL UE MESSAGE from the N1 interface within 2s, the paging is considered failed.

Analyze the RSRP, RSRQ and neighboring cell information (PCI and RSRP of a neighboring cell) at each point where paging fails. Mark the locations on the test route map.

Remarks:

8 UL high power test

This chapter applies to test scenarios with the SA mode deployed. The NR UE transmit power is defined as 26 dB. The NR system uses two transmit antennas in the UL with the transmit power 23 dB of each antenna. The maximum transmit power equals the sum of the transmit power of the two antennas.

8.1 Test on data services of UEs with the power of 26 dBm

Test item	UL high power test	Sub-item	Maximum UL transmit power 26 dBm in single-cell multi-point tests
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the performance gain of UL high transmit power of the UE in outdoor scenarios.		
Test conditions:			
<ul style="list-style-type: none"> (1) Test area: A single cell is used in the test. The NR system is deployed according to section 4.3 "Test network basic configuration". (2) The UE maximum transmit power is 26 dBm (The NR system uses two transmit antennas with the transmit power 23 dB of each antenna). (3) DUT: One UE. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the DUT at the four test points in the tested cell and perform the UL FTP service at full buffer. In each test point, record the service for more than 1 min into the data recording table 1 min later after the data rate maintains stable. The RSRP should be as stable as possible during data recording. <ul style="list-style-type: none"> a) Test point 1: SS-RSRP = -90dBm±3dBm b) Test point 2: SS-RSRP = -100dBm±3dBm c) Test point 3: SS-RSRP = -110dBm±3dBm d) Test point 4: SS-RSRP = -120dBm±3dBm (2) Record data for more than 5 min after the data rate is stable. Record the test result into the data recording table. <p>The access fails if there is still no obvious upload rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer and then re-activate the bearer and start the upload test. Repeatedly perform the upload for at least 5 times, and record the number of upload failures.</p>			

Test data recording and processing:

- (1) Record the maximum peak rate of the full-buffer FTP upload service.
- (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.
- (3) Record the network environment (including cell IDs and frequencies) at the test points.

Remarks:

Use the unified FTP tool and FTP address in FTP tests. The test points selected in this test case are the same as those in the data service test of UEs with the transmit power 23 dBm.

8.2 Test on data services of UEs with the power of 23 dBm

Test item	UL high power test	Sub-item	Maximum UL transmit power 23 dBm in single-cell multi-point tests
Reference document		Network configuration	No-load
Test level	Mandatory		
Test purpose	To verify the performance gain of UL high transmit power of the UE in outdoor scenarios.		
Test conditions:			
<ol style="list-style-type: none"> (1) Test area: A single cell is used in the test. The NR system is deployed according to section 4.3 "Test network basic configuration". (2) The UE maximum transmit power is 23 dBm (The NR system uses two transmit antennas with the transmit power 20 dB of each antenna). (3) DUT: One UE. 			
Test procedure:			
<ol style="list-style-type: none"> (1) Place the DUT at the four test points in the tested cell and perform the UL FTP service at full buffer. In each test point, record the service for more than 1 min into the data recording table 1 min later after the data rate maintains stable. The RSRP should be as stable as possible during data recording. <ol style="list-style-type: none"> a) Test point 1: SS-RSRP = -90dBm±3dBm b) Test point 2: SS-RSRP = -100dBm±3dBm c) Test point 3: SS-RSRP = -110dBm±3dBm d) Test point 4: SS-RSRP = -120dBm±3dBm (2) Record data for more than 5 min after the data rate is stable. Record the test 			

result into the data recording table.

The access fails if there is still no obvious upload rate 30s later after the DUT activates its bearer. In this case, The DUT shall deactivate the bearer and then re-activate the bearer and start the upload test. Repeatedly perform the upload for at least 5 times, and record the number of upload failures.

Test data recording and processing:

- (1) Record the maximum peak rate of the full-buffer FTP upload service.
- (2) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.
- (3) Record the network environment (including cell IDs and frequencies) at the test points.

Remarks:

Use the unified FTP tool and FTP address in FTP tests. The test points selected in this test case are the same as those in the data service test of UEs with the transmit power 23 dBm.

9 BWP configuration test

9.1 Full-bandwidth BWP configuration test

Test item	BWP feature	Sub-item	Full-bandwidth BWP configuration test
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify the full-bandwidth BWP configuration capability of the DUT in excellent channel condition.		
Test conditions:			
<ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: Choose a cell for test. In the cell, select an excellent static test point. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
Test procedure:			
<ol style="list-style-type: none"> (1) Start the PC client at the excellent test point, power on the UE and enable it to camp on the network successfully. (2) Configure one BWP at the system side, and configure full bandwidth for the BWP. (3) Power on the DUT to initiate random access. Use the DUT to initiate upload and download services, and check the DUT log and signaling process. Record the DUT signaling log, PRB quantities scheduled in UL&DL, DL CSI_RS_RSRP, RSSI, and PUSCH transmit power. 			
Expected results:			
<ol style="list-style-type: none"> (1) The system supports full-bandwidth BWP configuration. (2) The BandwidthPart-Config field in the RRC configuration message contains the following information: downlinkBandwidthPartsToAddModList (including configuration of 1 BandwidthPart IE), defaultDownlinkBwp-Id, uplinkBandwidthPartsToAddModList (including configuration of 1 BandwidthPart IE), and bandwidthPartInactivityTimer. In the BandwidthPart IE, parameters DL-BWP-mu/ UL-BWP-mu, DL-BWP-CP/UL-BWP-CP, DL-BWP-BW/UL-BWP-BW (full-bandwidth configured), DL-BWP-index/UL-BWP-index, and DL-BWP-loc/UL-BWP-loc are included. (3) The DUT services are normal. Check that the BWP configuration takes effect, as 			

indicated in the UE log.
Remarks

9.2 Configuration of four BWPs: single-UE multiple-point outdoor test

Test item	BWP feature	Sub-item	Configuration of four BWPs
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify that the DUT supports being configured with two groups of BWP bandwidth settings in DL&UL in medium and bad channel conditions.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: Choose a cell for test. In the cell, select a medium and a bad static test point. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Start the PC client at the excellent test point, power on the UE and enable it to camp on the network successfully. (2) The system configures four BWPs. (3) Power on the DUT to initiate random access. Use the DUT to initiate FTP services at full buffer in UL&DL. Record the DUT signaling log, PRB quantities scheduled in UL&DL, and PUSCH transmit power. (4) Reconfigure the second BWP group via RRC signaling. Use the DUT to initiate FTP services at full buffer in UL&DL. Activate the second group of BWP configurations via UL&DL DCI scheduling. Record the DUT signaling log, PRB quantities scheduled in UL&DL, DL CSI_RS_RSRP, RSSI, and PUSCH transmit power. (5) Repeat step 4 to activate the third group of BWP configuration. Record the DUT signaling log, PRB quantities scheduled in UL&DL, DL CSI_RS_RSRP, RSSI, and PUSCH transmit power. (6) Repeat step 4 to activate the four group of BWP configuration. Record the DUT signaling log, PRB quantities scheduled in UL&DL, DL CSI_RS_RSRP, RSSI, and 			

<p>PUSCH transmit power.</p> <p>(7) Suspend UL&DL services for a while (the DUT returns to use the default BWP after the timer expires). Record the DUT log and check whether the BWP ID is 0.</p> <p>(8) Repeat steps 1 to 7 in the bad point.</p>
<p>Expected results:</p> <p>(1) The system supports configuring 4 BWPs for the DUT. The starting position and bandwidth of each BWP are configurable.</p> <p>(2) The BandwidthPart-Config field in the RRC configuration message contains the following information: downlinkBandwidthPartsToAddModList (including configurations of 1-4 BandwidthPart IEs), defaultDownlinkBwp-Id, uplinkBandwidthPartsToAddModList (including configurations of 1-4 BandwidthPart IEs), and bandwidthPartInactivityTimer. In the BandwidthPart IE, parameters DL-BWP-mu/UL-BWP-mu, DL-BWP-CP/UL-BWP-CP, DL-BWP-BW/UL-BWP-BW, DL-BWP-index/UL-BWP-index, and DL-BWP-loc/UL-BWP-loc are included. The starting positions and bandwidths of the BWPs are consistent with parameter configurations.</p> <p>(3) The DUT services are normal. The traced signaling and the quantity of scheduled PRBs indicate that the BWP configurations have taken effect.</p>
<p>Remarks:</p>

9.3 Mobility test with different BWP configurations

Test item	BWP feature	Sub-item	Mobility test with different BWP configurations
Reference document		Network configuration	Empty load
Test level	Mandatory		
Test purpose	To verify that the DUT supports mobility among at least four NR cells with different BWP configurations.		
<p>Test conditions:</p> <p>(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".</p> <p>(2) Test area: One NR cell surrounded by at least another three NR cells is selected for the test. The four NR cells are neighboring cells. The mobility test is performed within the four cells.</p> <p>The four NR cells have the following neighboring relations:</p> <ul style="list-style-type: none"> • NR cell 1 and NR cell 2 are neighboring cells; • NR cell 2 and NR cell 3 are neighboring cells; 			

- NR cell 3 and NR cell 4 are neighboring cells;
 - NR cell 4 and NR cell 1 are neighboring cells;
- (3) The test points are located in the overlapping areas of each two cells.

Test procedure:

- (1) Start the PC client at the excellent test point, power on the UE and enable it to camp on the network successfully.
- (2) The system configures four different BWPs for the four NR cells, with different starting PRB positions and PRB lengths.
- (3) Power on the DUT and the DUT access NR cell 1. Use the DUT to initiate upload and download services, and check the DUT log.
- (4) Move the DUT from NR cell 1 towards NR cell 2. Observe the data rate change during the mobility and check the BWP configuration in traced signaling.
- (5) Continue to move the DUT from NR cell 2 towards NR cell 3. Observe the data rate change during the mobility and check the BWP configuration in traced signaling.
- (6) Continue to move the DUT from NR cell 3 towards NR cell 4. Observe the data rate change during the mobility and check the BWP configuration in traced signaling.
- (7) Continue to move the DUT from NR cell 4 towards NR cell 1. Observe the data rate change during the mobility and check the BWP configuration in traced signaling.
- (8) Trigger at least 20 handovers, and record the test results into the data recording table.
- (9) Record KPIs including the access success rate, service drop rate, handover latency, and service interruption duration.

Expected results:

- (1) The system supports configuring BWPs with different bandwidth settings for the DUT.
- (2) The BandwidthPart-Config field in the RRC configuration message contains the following information: downlinkBandwidthPartsToAddModList (including configuration of 1 BandwidthPart IE), defaultDownlinkBwp-Id, uplinkBandwidthPartsToAddModList (including configuration of 1 BandwidthPart IE), and bandwidthPartInactivityTimer. In the BandwidthPart IE, parameters DL-BWP-mu/ UL-BWP-mu, DL-BWP-CP/UL-BWP-CP, DL-BWP-BW/UL-BWP-BW (full-bandwidth configured), DL-BWP-index/UL-BWP-index, and DL-BWP-loc/UL-BWP-loc are included.
- (3) The DUT services are normal. Signaling in the DUT log indicates that the BWP configuration have taken effect.

Remarks:

10 Handover tests in SA NR system

10.1 Outdoor DL data – handover

Test item	SA	Sub-item	Handover
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify handover performance in areas with only SA NR coverage.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The test area is covered by the SA NR cell in the moderate or densely populated urban area. Neighboring cells are planned for the NR cell. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the SA DUT at the test vehicle. Use the DUT to initiate the FTP download service at full buffer. Perform the test in the pre-planned test area, and drive the test vehicle at a low speed (< 30 km/h). Record the signaling flow at the NR side and the DUT side. Record the test result into the data recording table. (2) Record KPIs including the access success rate, service drop rate, handover latency, and service interruption duration. 			
Test data recording and processing:			
<ul style="list-style-type: none"> (1) Analyze the KPI changes during handovers and handover failure causes based on the test route. 			
Remarks:			

10.2 Outdoor UL data - handover

Test item	SA	Sub-item	Handover
Reference document		Network configuration	Network environment without load
Test level	Mandatory		

Test purpose	To verify handover performance in areas with only SA NR coverage.
Test conditions:	
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The test area is covered by the SA NR cell in the moderate or densely populated urban area. Neighboring cells are planned for the NR cell. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 	
Test procedure:	
<ul style="list-style-type: none"> (1) Place the SA DUT at the test vehicle. Use the DUT to initiate the FTP upload service at full buffer. Perform the test in the pre-planned test area, drive the test vehicle at a low speed (< 30 km/h), and record the test results into the data recording table. (2) Record KPIs including the access success rate, service drop rate, handover latency, and service interruption duration. 	
Test data recording and processing:	
<ul style="list-style-type: none"> (1) Analyze the KPI changes during handovers and handover failure causes based on the test route. 	
Remarks:	

10.3 Outdoor DL&UL concurrent data - handover

Test item	SA	Sub-item	Handover
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify handover performance in areas with only SA NR coverage.		
Test conditions:			
<ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The test area is covered by the SA NR cell in the moderate or densely populated urban area. Neighboring cells are planned for the NR cell. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
Test procedure:			
<ul style="list-style-type: none"> (1) Place the SA DUT at the test vehicle. Use the DUT to initiate the FTP UL&DL 			

services at full buffer. Perform the test in the pre-planned test area, drive the test vehicle at a low speed (< 30 km/h), and record the test results into the data recording table.

- (2) Record KPIs including the access success rate, service drop rate, handover latency, and service interruption duration.

Test data recording and processing:

- (1) Analyze the KPI changes during handovers and handover failure causes based on the test route.

Remarks:

11 SUL/CA comparison test

11.1 SUL

Test item	SUL/CA	Sub-item	SUL
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify handover performance in areas with only SA NR coverage.		
<p>Test conditions:</p> <ol style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The test area is covered by the SA NR cells supporting SUL-CC and UL-CC in the moderate or densely populated urban area. Neighboring cells are planned for the NR cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
<p>Test procedure:</p> <ol style="list-style-type: none"> (1) Use the DUT to access the NR cell with the frequency band UL-CC. In a near point in the cell, use the DUT to perform the FTP upload/download packet injection services, video on demand service, and the video broadcast service, respectively. (2) Move the DUT towards the far point in the cell at a low speed to ensure that the entire route mobility time takes no less than 10 min. Record the test data and location during the test. (3) Move the DUT towards the near point in the cell along the route vice versa at a low speed to ensure that the entire route mobility time takes no less than 10 min. Record the test data and location during the test. 			
<p>Expected results:</p> <ol style="list-style-type: none"> (1) During DUT mobility towards the far point, the DCI indicates that the carrier supporting UL transmission changes from the high-frequency carrier to the low-frequency carrier and the DUT performs UL&DL services properly. (2) During DUT mobility towards the near point, the DCI indicates that the carrier supporting UL transmission changes from the low-frequency carrier to the high-frequency carrier and the DUT performs UL&DL services properly. (3) Check the DUT log and check the configuration of UL/SUL indicator in DCI format0_1 or format0_1. 			

Remarks:

11.2 CA

Test item	SUL/CA	Sub-item	CA
Reference document		Network configuration	Network environment without load
Test level	Mandatory		
Test purpose	To verify handover performance in areas with only SA NR coverage.		
<p>Test conditions:</p> <ul style="list-style-type: none"> (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: The test area is covered by the SA NR cells supporting CC-f1 and CC-F in the moderate or densely populated urban area. Neighboring cells are planned for the NR cells. (3) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately. 			
<p>Test procedure:</p> <ul style="list-style-type: none"> (1) Use the DUT to access the NR cell with the frequency band CC-F. In a near point in the cell, use the DUT to perform the FTP upload/download packet injection services, video on demand service, and the video broadcast service, respectively. (2) Move the DUT towards the far point in the cell at a low speed to ensure that the entire route mobility time takes no less than 10 min. Record the test data and location during the test. (3) Move the DUT towards the near point in the cell along the route vice versa at a low speed to ensure that the entire route mobility time takes no less than 10 min. Record the test data and location during the test. 			
<p>Expected results:</p> <ul style="list-style-type: none"> (1) During DUT mobility towards the far point, the RRC signaling indicates that the MCC of the DUT changes from the high-frequency carrier to the low-frequency carrier and the DUT successfully adds the CC-F NR cell as its SCC. (2) During DUT mobility towards the near point, the RRC signaling indicates that the MCC of the DUT changes from the high-frequency carrier to the low-frequency carrier. (3) The DUT performs the DL&UL services properly, and the DUT log indicates that CA has taken effect. 			
Remarks:			

