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

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Document History

Date	Meeting #	Version #	Revision Contents
02-11-2018	23rd GTI Workshop	V1.0	The first version of GTI 5G Sub-6GHz Device Field Test Specification-NSA Mode. This specification targets eMBB scenario for 5G Sub-6GHz Chipset, Module and Device products testing. It stipulates the 5G device field tests in NSA Mode (Option 3/3a/3x).

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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 NSA Mode (Option 3/3a/3x) 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 core specifications released in September 2018, and the terminal used in SA NR tests shall conform to 3GPP R15 core specifications released in September 2018.

3 Abbreviations

Abbreviation	Explanation
AMC	Adaptive Modulationand Coding
BLER	Block Error Rate
CDF	Cumulative Distributed Function
CP	Cyclic Prefix
DL	Downlink
DwPTS	Downlink Pilot Timeslot
eNB	Evolved NodeB
GPS	Global Positioning System
HARQ	Hybrid Automatic Repeat-reQuest
IR	Incremental Redundancy
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output
non-GBR	nonguaranteed Bit Rate
PDCCH	Physical Downlink Control Channel
PDF	Probability Distributed Function
PDSCH	Physical Downlink Shared Channel
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
QPSK	Quadrature Phase Shift Keying
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
SFBC	Space Frequency Block Codes
SIMO	Single Input Multiple Output
SM	Space Multiplexing
SNR	Signal to Noise Ratio
SINR	Signal to Interference & Noise Ratio
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UE	User Equipment
UL	Uplink
UpPTS	Uplink Pilot Timeslot

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 NSA coverage area, the networking of Option 3/3a/3x is adopted, and at least 19 base stations are available to provide continuous coverage. 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 NSA mode test.

Table 4-1 Typical test configuration parameters

Item	Value	Remarks
NR frequency band	N41/N78/N79	NR frequency band
NR bandwidth	80 MHz /100MHz	NR bandwidth
LTE frequency used by	B3/B8/B40/B41	Choose the frequencies based

cells in NSA mode		on live network conditions in specific cities. Choose the frequencies preferentially.
LTE bandwidth used by cells in NSA mode	10MHz/20MHz	Choose the frequencies based on live network conditions in specific cities.
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/Form at 3	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	NSA NR：mandatory

		LTE：recommended
Terminal multi-antenna mode	NSA： NR: 1T4R LTE 1T4R or 1T2R	
Terminal Tx power	The total Tx power of the terminal supporting NSA is 26 dBm.	There are no power restrictions, and the terminal manufacturer needs to check whether 26dBm meets the requirement.

4.4 Assistance test equipment

Table 4-2 Assistance test equipment

Name	Quantity	Model and version (fill in during test)
Drive test terminal	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:
   - LTE: LTE-RSRP, LTE-RS-SINR;
   - NR: RSRP (CSI-RS-RSRP / SS-RSRP), RS-SINR (CSI-RS-SINR / SS-SINR), and RSSI of the serving cell
   - RSRP (CSI-RS-RSRP / SS-RSRP) of the neighboring cell
3. Scheduling information:
   - LTE: UL/DL MCS, UL/DL RB number, UL/DL RI, UL Tx power, DL transmission mode
   - NR: UL/DL MCS, UL/DL number of RBs scheduled per TTI, UL/DL transmission mode, UL/DL BLER, DL CQI, DL PMI, DL RI, PDCCH false detection rate, PBCH false detection rate, UL Tx power, UL transmission mode, SRS transmission status
4. Performance information
   - LTE: UL/DL physical-layer rate, UL/DL PDCP rate, control-plane delay, user-plane delay
   - NR: 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 Terminal data service performance test

5.1 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: (1) Network configuration: The NR system is deployed using the 3x architecture 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.			
Test procedure: (1) Place the DUT at the excellent point of the test cell. (2) 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 data based on the test result record table. (3) 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: (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. (3) 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. (4) For LTE, in the case of DL 2/4 streams, tm9/8/3, 256QAM, the DL rate is more than 90% of the theoretical rate configured for the current frame structure. (5) Test data recording and processing: (6) Record the maximum peak rate of the full-buffer FTP download service (at both LTE			

and NR sides). (7) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (8) 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. The peak rate test environment is as follows: LTE (1CC) + NR (1CC).

5.2 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: (1) Network configuration: The NR system is deployed using the 3x architecture 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 for both NR and LTE.			
Test procedure: (1) Place the DUT at the excellent point of the test cell. The highest UL modulation mode of the base station is 64QAM. (2) 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 data based on the test result record table. (3) 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:

(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 single-stream and 64QAM, the maximum upload rate is more than 80% of the theoretical value configured for the current frame structure.

For LTE, in the case of UL single-stream and 64QAM, the maximum upload rate is more than 90% 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 (at both LTE and NR sides).

(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.

5.3 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:

(1) Network configuration: The NR system is deployed using the 3x architecture 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 for both NR and LTE.

Test procedure: (1) Place the DUT at the excellent point of the test cell. (2) 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 data based on the test result 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: (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 single-stream and 256QAM, the maximum upload rate is more than 80% of the theoretical value configured for the current frame structure. For LTE, in the case of UL single-stream and 256QAM, the maximum upload rat is more than 90% 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 (at both LTE and NR sides). (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.

5.4 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:

(1) Network configuration: The NR system is deployed using the 3x architecture 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, DL 256QAM and UL 64QAM are adopted.

Test procedure:

(1) Place the DUT at the excellent point of the test cell.

(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 data based on the test result 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 download/UL rates are more than 80% of the theoretical values configured for the current frame structure at the "excellent" point.

For NR, the conditions are as follows:

DL: 4 streams and 256QAM; UL: single-stream and 64QAM.

For LTE, the conditions are as follows:

DL: 2/4 streams and 256QAM; UL: single-stream and 64QAM.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download/upload service (for both LTE and NR).

(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.

5.5 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:

(1) Network configuration: The NR system is deployed using the 3x architecture 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 at both UL and DL.

Test procedure:

(1) Place the DUT at the excellent point of the test cell. The highest UL modulation mode of the base station is 256QAM.

(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 data based on the test result 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 download/UL rates are more than 80% of the theoretical values configured for the current frame structure at the "excellent" point.

For NR, the conditions are as follows:

DL: 4 streams and 256QAM; UL: single-stream and 256QAM.

For LTE, the conditions are as follows:

DL: 2/4 streams and 256QAM; UL: single-stream and 64QAM.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download/upload service (for both LTE and NR).

(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.

5.6 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:**	Empty load
Test level:	Mandatory		
Test purpose:	To verify the peak throughput of the UE at test points of different field strength in no-load environment in the live network.		

Test conditions:

(1) Network configuration: The NR system is deployed using the 3x architecture 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 separately tested.

Test procedure:

(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 data based on the test result 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, 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:

(1) The UE can successfully initiate services at each preset test point and the service

rates are stable.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download service (at both LTE and NR sides).

(2) Record the proportion of UL data is split at the NR and at the LTE (if any) at each point.

(3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.

(4) 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. It is recommended that these data tests share the same test points with the test in the Option 3x architecture without splitting.

5.7 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
Reference document:		**Network configuration:**	Empty load
Test level:	Mandatory		
Test purpose:	To verify the peak throughput of the UE at test points of different field strength in no-load environment in the live network.		

Test conditions:

(1) Network configuration: The NR system is deployed using the 3x architecture 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.

Test procedure:

(1) Enable the neighboring cell without interference added.

(2) Place the DUT at fixed test points and perform the full-buffer FTP upload service. Keep the service for at least 1 minute when the rate is stable in 1 minute. The

network determines the SCG split bearer principle based on information such as the test environment and signal strength and determines whether to perform UL data split. Record test results at each test point. 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.
Expected results: (1) The UE can successfully initiate services at each preset test point and the service rates are stable. **Test data recording and processing:** (1) Record the maximum peak rate of the full-buffer FTP upload service (at both LTE and NR sides). (2) Record the proportion of UL data is split at the NR and at the LTE (if any) at each point. (3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (4) 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. It is recommended that these data tests share the same test points with the test in the Option 3x architecture without splitting.

5.8 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:**	Empty load
Test level:	Mandatory		
Test purpose:	To verify the peak throughput of the UE at test points of different field strength in no-load environment in the live network.		
Test conditions: (1) Network configuration: The NR system is deployed using the 3x architecture			

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.

Test procedure:

(1) Enable the neighboring cell without interference added.

(2) Place the DUT at specified test points. The DUT performs full-buffer FTP download and upload services concurrently. Keep the services for at least 1 minute when the rates are stable in 1 minute. The network side determines the splitting principle over the SCG split bearer and split UL/DL data based on information including the test environment and signal strength. Record the test results at each test point.

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.

Expected results:

(1) The UE can successfully initiate services at each test point and the service rates are stable.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download/upload service (for both LTE and NR).

(2) Record the proportion of DL&UL data is split at the NR and at the LTE (if any) at each point.

(3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.

(4) 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. It is recommended that these data tests share the same test points with the test in the Option 3x architecture without splitting.

6 Delay test

6.1 Control-plane delay test in idle state

Test item:	State transition and delay test	**Sub-item:**	Control-plane delay test - 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:

(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:

(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.

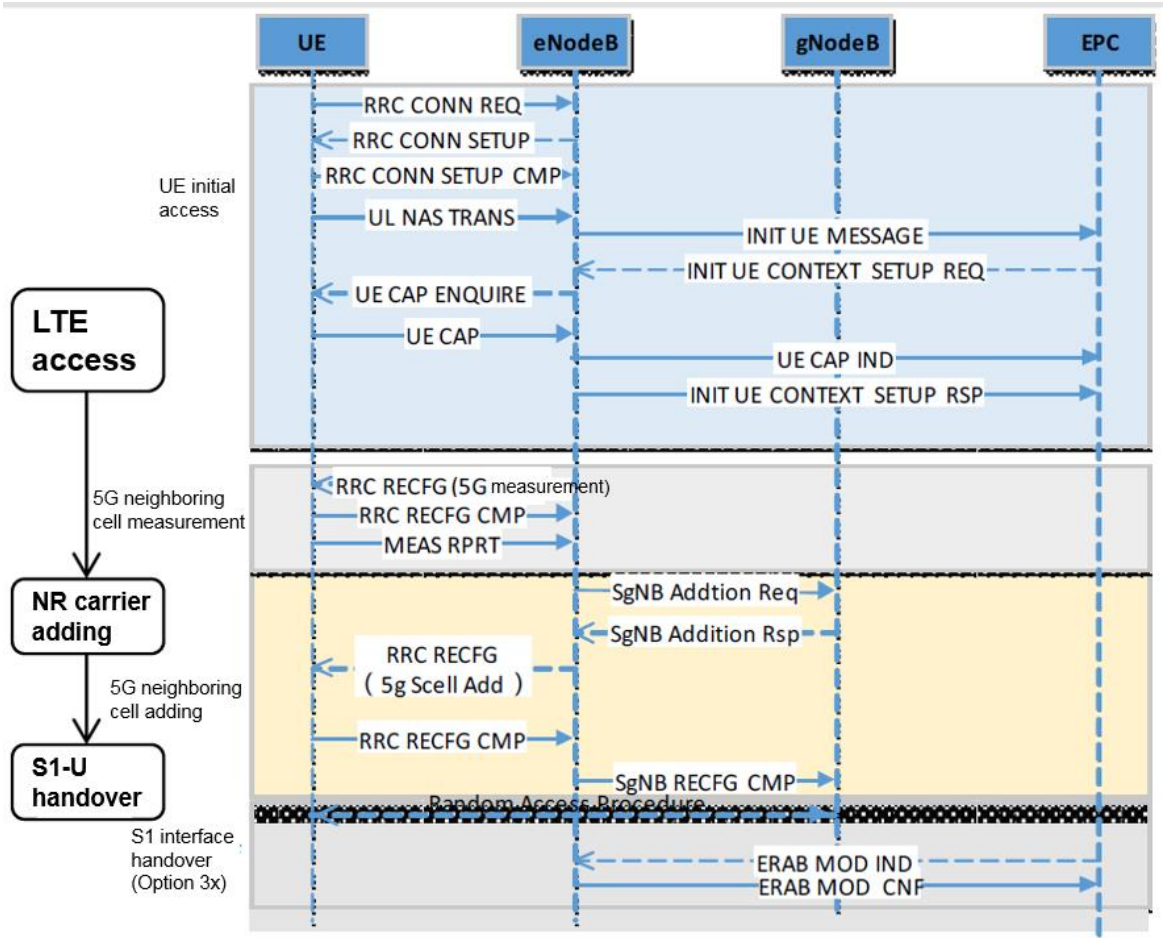
(4) Power on a single UE, and enable it to access the network and stay in idle state.

(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.

Signaling flowchart of transition from idle state to active state (NSA-DC has been established-Option 3x):



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 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.

6.2 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:

(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:

(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.

(4) After accessing the network, the UE performs at least 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.

Expected results:

(1) Record the maximum user-plane delay, minimum user-place delay, average user-plane delay, and ping success rate.

Remarks:

7 BWP configuration test

7.1 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:

(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:

(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:

(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:

7.2 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:

(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:

(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) Suspend UL&DL services for a while (the suspension exceeds the length specified by bwp-InactivityTimer, and the DUT returns to use the default BWP). Record the DUT log and check whether the BWP ID is 0.

(6) Repeat steps 1 to 7 in the bad point.

Expected results

(1) The system supports configuring 4 BWPs for the DUT. The starting position and

bandwidth of each BWP are configurable.

(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.

(3) The DUT services are normal. The traced signaling and the quantity of scheduled PRBs indicate that the BWP configurations have taken effect.

Remarks：

7.3 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.		

Test conditions:

(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".

(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.

The four NR cells have the following neighboring relations:

- NR cell 1 and NR cell 2 are neighboring cells, and NR cell 2 and NR cell 3 are neighboring cells;
- NR cell 3 and NR cell 4 are neighboring cells, and 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) Ensure that the mobility triggers at least 20 handovers.

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:

8 Architecture for SCG splitless bearer in Option 3x

8.1 Outdoor DL data test at fixed points

Test item:	Comparison between	**Sub-item:**	Architecture for SCG splitless

	architecture for SCG split bearer in Option 3x and architecture for SCG splitless bearer in Option 3x		bearer in Option 3x
Reference document		**Network configuration**	Network environment without load
Test level	Mandatory		
Test purpose	To verify DL data split performance of the DUT in fixed static points in architecture for SCG splitless bearer in Option 3x.		

Test conditions:

(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".

(2) Test area: Four test points in the single cell under test (one excellent point, one good point, one medium point, and one bad point.) The test points should better be scattered evenly in the test cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test.

(3) The NR is connected to the EPC, and the network adopts the architecture for SCG splitless bearer in Option 3x.

(4) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately.

Test procedure:

(1) Place the DUT at the selected test points to perform the test.

(2) The DUT performs the FTP download service at full buffer at each test point. 1 min later after the data becomes stable, record data within a period more than 1 min. The network determines the SCG split bearer principle based on information such as the test environment and signal strength and determines whether to perform DL data split. Record test results at each test point. 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.

Expected results:

(1) In the excellent, good and medium points, all DL data is delivered to the terminal from the NR and the data is not split.

(2) In the bad point, DL data may be split at the LTE side, depending on the split principle.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download service (at both

LTE and NR sides). (2) Record the proportion of DL data is split at the NR and at the LTE (if any) at each point. (3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6. (4) 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 outdoor data tests in architecture for SCG splitless bearer in Option 3x in one test point before moving to another test point. It is recommended that these data tests share the same test points with the single-UE multi-point throughput test in Option 3x.

8.2 Outdoor UL data test at fixed points

Test item:	Comparison between architecture for SCG split bearer in Option 3x and architecture for SCG splitless bearer in Option 3x	**Sub-item:**	Architecture for SCG splitless bearer in Option 3x
Reference document		**Network configuration**	Network environment without load
Test level	Mandatory		
Test purpose	To verify UL data split performance of the DUT in fixed static points in architecture for SCG splitless bearer in Option 3x.		
Test conditions: (1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration". (2) Test area: Four test points in the single cell under test (one excellent point, one good point, one medium point, and one bad point.) The test points should better be scattered evenly in the test cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test. (3) The NR is connected to the EPC, and the network adopts the architecture for SCG splitless bearer in Option 3x. (4) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately.			

Test procedure:

(1) Place the DUT at the selected test points to perform the test.

(2) The DUT performs the FTP upload service at full buffer at each test point. 1 min later after the data becomes stable, record data within a period more than 1 min. The network determines the SCG split bearer principle based on information such as the test environment and signal strength and determines whether to perform UL data split. Record test results at each test point. 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 upload test. Repeatedly perform the upload for at least 5 times, and record the number of uploading failures.

Expected results:

(1) In the excellent and good points, all UL data is delivered to the terminal from the NR and the data is not split.

(2) In the bad point, partial UL data may be split at the LTE side, depending on the split principle.

(3) In the bad point, 100% of UL data may be split at the LTE side, depending on the split principle.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP upload service (at both LTE and NR sides).

(2) Record the proportion of UL data is split at the NR and at the LTE (if any) at each point.

(3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.

(4) 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 outdoor data tests in architecture for SCG splitless bearer in Option 3x in one test point before moving to another test point. It is recommended that these data tests share the same test points with the single-UE multi-point throughput test in Option 3x.

8.3 Outdoor DL&UL concurrent data test at fixed points

Test item:	Comparison between architecture for SCG split bearer in Option 3x and architecture for SCG	**Sub-item:**	Architecture for SCG splitless bearer in Option 3x

	splitless bearer in Option 3x		
Reference document		**Network configuration**	Network environment without load
Test level	Mandatory		
Test purpose	To verify concurrent DL&UL data split performance of the DUT in fixed static points in architecture for SCG splitless bearer in Option 3x.		

Test conditions:

(1) Network configuration: The NR system is deployed according to section 4.3 "Test network basic configuration".

(2) Test area: Four test points in the single cell under test (one excellent point, one good point, one medium point, and one bad point.) The test points should better be scattered evenly in the test cell. Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test.

(3) Meanwhile, to prevent the UE from camping on neighboring cells during medium point and bad point tests, block neighboring cells during the test.

(4) The NR is connected to the EPC, and the network adopts the architecture for SCG splitless bearer in Option 3x.

(5) DUT quantity: Only one UE of each brand is allowed in a single test. UEs of different brands must be tested separately.

Test procedure:

(1) Place the DUT at the selected test points to perform the test.

(2) The DUT performs the DL&UL FTP services at full buffer at each test point. 1 min later after the data becomes stable, record data within a period more than 1 min. The network determines the SCG split bearer principle based on information such as the test environment and signal strength and determines whether to perform DL&UL data split. Record test results at each test point. The access fails if there is still no obvious download/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/upload test. Repeatedly perform the download/upload for at least 5 times, and record the number of downloading/uploading failures.

Expected results:

(1) In the excellent and good points, all DL&UL data is delivered to the terminal from the NR and the data is not split.

(2) In the medium point, partial UL data may be split at the LTE side, and DL data is terminated at the NR side, depending on the split principle.

(3) In the bad point, 100% of UL data may be split at the LTE side, and partial DL data may be split at the LTE side, depending on the split principle.

Test data recording and processing:

(1) Record the maximum peak rate of the full-buffer FTP download/upload service (at both LTE and NR sides).

(2) Record the proportion of DL&UL data is split at the NR and at the LTE (if any) at each point.

(3) Record the test results at the record chart, and ensure that the recorded content meet requirements specified in section 4.6.

(4) 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 outdoor data tests in architecture for SCG splitless bearer in Option 3x in one test point before moving to another test point. It is recommended that these data tests share the same test points with the single-UE multi-point throughput test in Option 3x.