



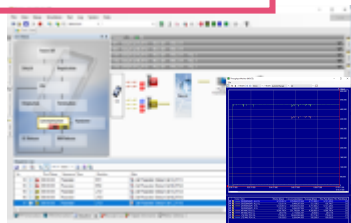
SmartStudio NR IP Performance MX800071A

Radio Communication Test Station
MT8000A



MT8000A Common Platform for Entire Cellular Device R&D/Mfg. Cycle

MX800070A SSNR
MX800071A SSIP



Smart Device Integration
/ Higher IP Throughput

ME7873NR
RF Conformance Test System



RF Conformance Test

MX800010A RF Measurement



RF Performance Verification

MT8000A
Radio Communication Test Station

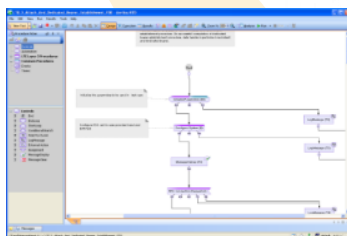


ME7834NR
5G NR Mobile Device Test Platform



Protocol Conformance Test
Carrier Acceptance Test

MX800050A RTD



Chipset/Protocol Development

MX800040A
NR mmW Production Test



MT8870A
Universal Wireless Test Set

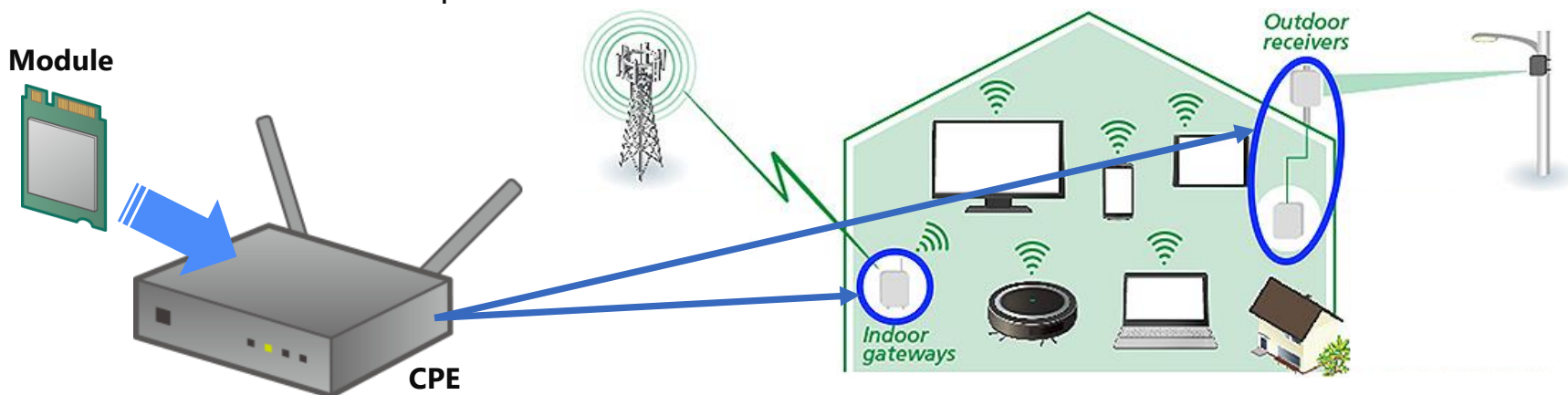


Volume Production



Challenges for Evaluating Higher IP Throughput

FWA (Fixed Wireless Access) services are evolving rapidly due to increased demand for Digital Transformation (DX), remote work, and home entertainment. To improve the User Experience (UX), the CPE (Customer Premises Equipment) used for FWA, and the built-in module must have sufficient transmission speed.



To support these use cases, chipset vendors are implementing various frequency bands and higher-layer CCs/MIMO. The CPE/module development scene tests IP throughput with various combinations of frequency bands/CCs/MIMO. Since there are more than 1000 pattern combinations, an efficient IP throughput test is required.

$$\text{System} \times \text{Frequency} \times \# \text{ of CCs} \times \# \text{ of MIMO} =$$

• LTE	• 4G
• 5G NSA	• 5G FR1
• 5G SA	• 5G FR2

Very Complex
&
Wide Variety

Product Outline



Efficient 5G Device IP Throughput Test

- SmartStudio NR IP Performance MX800071A -

Best test solution to evaluate IP throughput performance with higher-layer CCs/MIMO at any band combination

- ✓ **Single platform** supports FR1 SA/NSA and LTE systems, contributing to **easy-to-use, small-footprint** test systems
- ✓ Supports **wide variety of CCs/MIMO combinations**
- ✓ **Easy testing start** by verifying connection with advanced chipsets
- ✓ **Cost effective** with scalable HW/SW platform
- ✓ **Intuitive state machine GUI**



MT8000A

Cell Parameter
(CA, MIMO, TDD configuration, etc.)

Throughput Monitor

Color	Name	Marker Model	Accumulate [Start]	Average [Mean]	Max Rate [Max]	Min Rate [Min]
Blue	DFE-BENDANA - ALL UL		0.000000	0.000000	0.000000	0.000000
Blue	DFE-BENDANA - ALL DL		0.000000	0.000000	0.000000	0.000000
Blue	DFE-BENDANA - S UL		0.000000	0.000000	0.000000	0.000000
Blue	DFE-BENDANA - S DL		0.000000	0.000000	0.000000	0.000000
Blue	NR MAC PDU/UL		0.000000	0.000000	0.000000	0.000000
Blue	NR MAC PDU/DL		0.000000	0.000000	0.000000	0.000000
Blue	LTE MAC PDU/UL		0.000000	0.000000	0.000000	0.000000
Blue	LTE MAC PDU/DL		0.000000	0.000000	0.000000	0.000000

Simulation Parameter
(Frequency, Channel, BW, etc.)

UE Status

Sequence Log
between UE and MT8000A

MX800071A GUI

ANRITSU CORPORATION

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Scalable HW/SW Platform

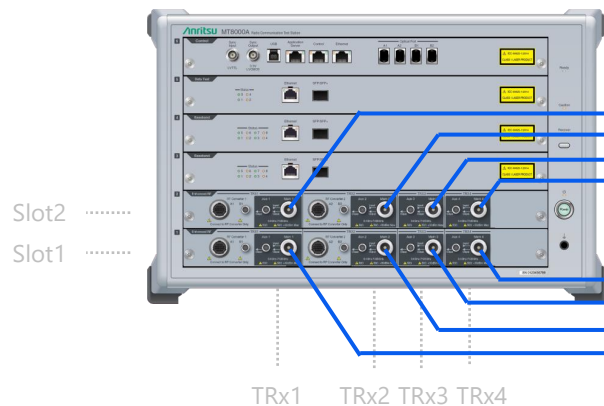
- MT8000A-033 and "RF Sharing" Function -

The MX800071A uses the MT8000A-033 as a standard platform and supports an **RF sharing function** that bundles/outputs signals with similar frequencies, covering a wide frequency/CCs/MIMO combination.

- **Small footprint and cost-effective platform**
- **Scalability for future advanced chipset performance**

Example: NR DL 2CC 4x4 MIMO + LTE DL4CC 4x4 MIMO

- ✓ NR: band n40A (2.3 to 2.4 GHz) + n78A (3.3 to 3.8 GHz)
- ✓ LTE: band1A (2.1 GHz) + 3A (1.8 GHz) + 7A (2.6 GHz) + 28A (700 MHz)



SG slot2 Tx-C SG slot2 Tx-D

Ant#1 band 1/7 + Ant#1 band 3/28
Ant#2 band 1/7 + Ant#2 band 3/28
Ant#3 band 1/7 + Ant#3 band 3/28
Ant#4 band 1/7 + Ant#4 band 3/28

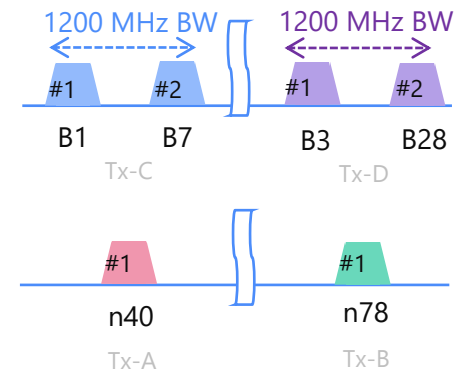
Ant#1 band n40 + Ant#1 band n78
Ant#2 band n40 + Ant#2 band n78
Ant#3 band n40 + Ant#3 band n78
Ant#4 band n40 + Ant#4 band n78

SG slot1 Tx-A SG slot1 Tx-B

Slot	Signal Generator	#	RAT	Band
2	Tx-C (in TRx1~TRx4)	#1	LTE	B1
		#2	LTE	B7
	Tx-D (in TRx1~TRx4)	#1	LTE	B3
		#2	LTE	B28
1	Tx-A (in TRx1~TRx4)	#1	NR	n40
		#2	N/A	
	Tx-B (in TRx1~TRx4)	#1	NR	n78
		#2	N/A	

RF sharing



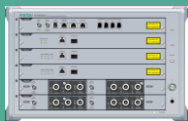
RF sharing





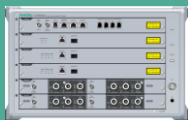
Supports Expanding CCs/MIMO Variations

SSIP can test CCs/MIMO conditions supported by advanced chipsets.

◆ DL Coverage

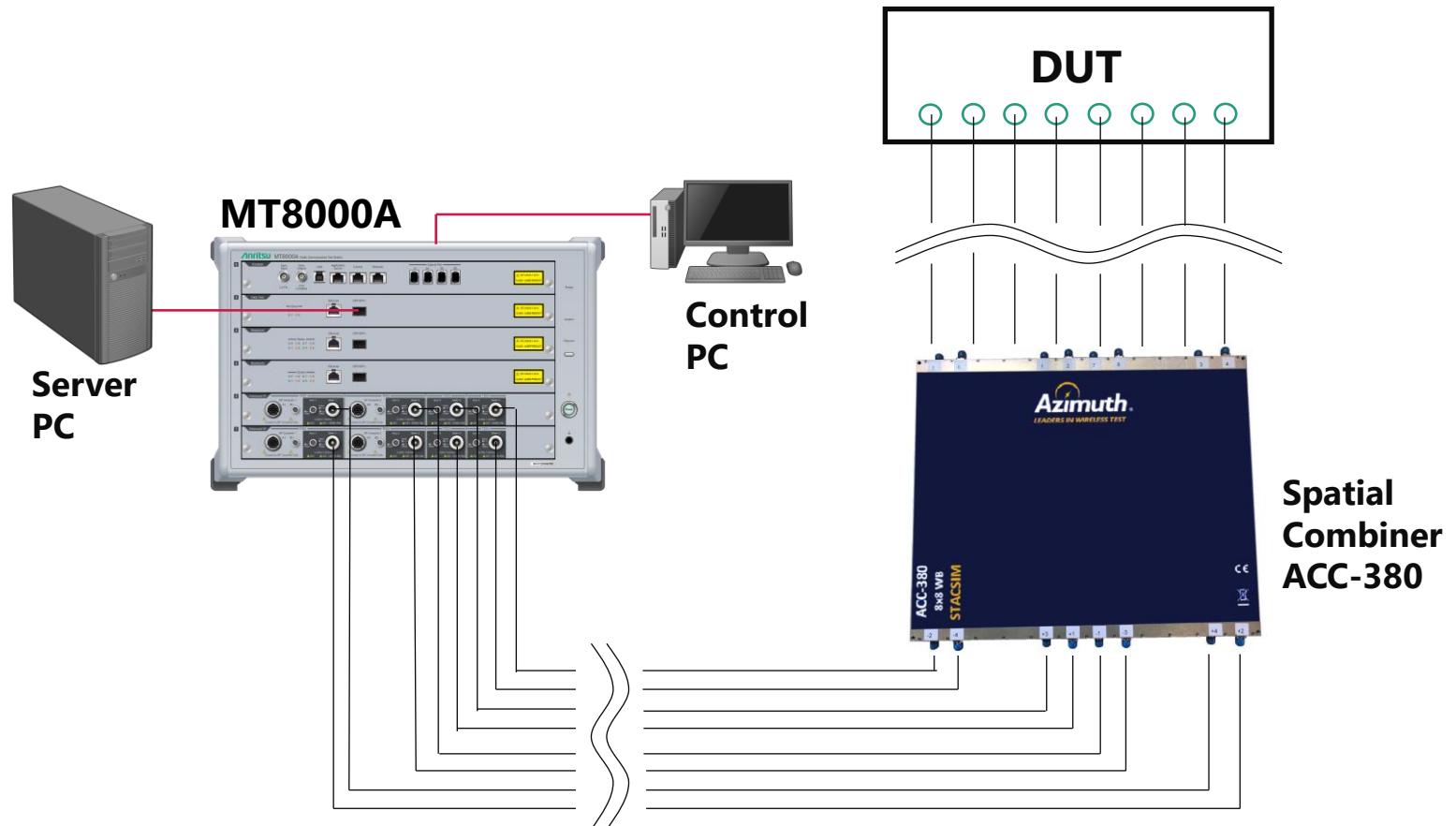
System	033 model  MT8000A x 1	033 model  MT8000A x 2	031 model 
FR1 SA	DL4CC (4B) 4x4	-	-
FR1 NSA	FR1 DL2CC (2B) 4x4 + LTE DL4CC (4B) 4x4	FR1 DL2CC (2B) 4x4 + LTE DL6CC (6B) 4x4	-
FR2 NSA	Under consideration	Under consideration	-
FR1+2	Under consideration	Under consideration	-
LTE	DL7CC (6B) 4x4	-	-

◆ UL Coverage

System	033 model  MT8000A x 1	033 model  MT8000A x 2	031 model 
FR1 SA	UL 2CC (2B) 2x2	-	-
FR1 NSA	FR1 UL 2CC (2B) 2x2 + LTE UL 2CC (2B) 1x1	FR1 UL 2CC (2B) 2x2 + LTE UL 2CC (2B) 1x1	-
FR2 NSA	Under consideration	Under consideration	-
FR1+2	Under consideration	Under consideration	-
LTE	UL2CC (2B) 1x1	-	-

Proposal for Automated Test System using ACC-380

The increasing number of CC/MIMO and Band combinations for 5G NR SA/NSA, LTE, requires frequent **changes of the physical RF cable connections** between the tester and DUT when test conditions are changed, which is a **difficult to automate**. Using the ACC-380 **eliminates the need to reconnect physical RF cables**, so engineers can build a test system to **automate IP throughput tests under different combinations of conditions**.





Example Throughput Measurement Results

Throughput Meas. Result (1) FR1 SA



Test result

RAT	LTE	NR	PHY-TPUT DL/UL	IP-TPUT DL/UL	DUT
FR1 SA	--	DL3CC 4x4 MIMO UL1CC SISO	1123/112 Mbps	1116/111 Mbps	Chipset vendor A device

iPerf command: iPerf3 -c 192.168.1.1 -w 8M -p 5201 -t 600 -P 10

Parameter settings and Throughput Monitor graph

Simulation Parameter Setup

Machine Config: MT8000A(NR)

RF Connector: Slot #1: RF Sub Module

Simulation Model: NR, LTE

RAT: NR, LTE

Cell: 3, 0

NR	NR1	NR2	NR3
NR Band	n1	n7	n28
Channel (DL)	428000	531000	155100
Frequency (DL)	2140.000	2655.000	780.500
Reference Point A (DL)	426092	529092	154192
Channel (UL)	Synchronizes with DL	Synchronizes with DL	Synchronizes with DL
Frequency (UL)	1950.000	2535.000	725.500
Reference Point A (UL)	388092	505092	143192
UL Frequency 7.5kHz Shift	OFF	OFF	OFF
DL Subcarrier Spacing	15kHz	15kHz	15kHz
UL Subcarrier Spacing	15kHz	15kHz	15kHz
SSB Subcarrier Spacing	15kHz	15kHz	15kHz
DL Bandwidth	20MHz	20MHz	20MHz

Band n1+n7+n28

All 20 MHz BW

NR	NR1	NR2	NR3
Frequency (Channel (SSB))	2139.600	2654.600	780.100
CORESET#0 Index	0	0	0
TDD Configuration	Auto	Auto	Auto
DL Schedule	Auto	Auto	Auto
Allocation Pattern	7DL 1SP 2UL	7DL 1SP 2UL	7DL 1SP 2UL
DCI Pattern	(Data)	(Data)	(Data)
DL/UL Periodicity	10ms,2	10ms,2	10ms,2
Number of PDCCH Symbols	2	2	2
Common/DCI Pattern	(Data)	(Data)	(Data)
Dedicated/DCI Pattern	(Data)	(Data)	(Data)
Number of DL Antennas	4	4	2
Number of UL Antennas	1	1	1
DL Modulation Order	256QAM	256QAM	256QAM
UL Modulation Order	256QAM	256QAM	256QAM
Physical Cell ID	0	0	0
UL Waveform	CP-OFDM	CP-OFDM	CP-OFDM
UL Waveform (Msg3)	CP-OFDM	CP-OFDM	CP-OFDM
Packet Scheduling Mode	Static	Static	Static
Static Scheduling Full Allocation	ON, BestEffort	ON, BestEffort	ON, BestEffort
Packet Rate	BestEffort	BestEffort	BestEffort

TDD configurations 7D1S2U

4x4+4x4+2x2 MIMO

All DL 256QAM

Message

	NR1	NR2	NR3
Mode	Default	Default	Default
Data	(Data)	(Data)	(Data)
SIB	Not Send	Not Send	Not Send
Mode(Communication)	Not Send	Not Send	Not Send

NR2, 3 SIB = Not send

Throughput Monitor (NR)

Color	Item	Marker [Mbps]	Accumulate [Bytes]	Average [Mbps]	Max Rate [Mbps]	Min Rate [Mbps]
Blue	QFEEBINSAP1-ALL DL	1,116.9270	82,022,781,596	1,045,708.8	1,116.475.4	0.0
Green	QFEEBINSAP1-ALL UL	111.793.3	8,147,111,900	103,837.9	111,994.9	0.0
Red	QFEEBINSAP1-5 DL	1,116.9270	82,022,781,596	1,045,708.8	1,116.475.4	0.0
Yellow	QFEEBINSAP1-5 UL	111.793.3	8,147,111,900	103,837.9	111,994.9	0.0
Purple	NR MAC PDU DL	1,123.827.4	85,308,900,398	1,044,127.5	1,129,872.4	0.0
Orange	NR MAC PDU UL	112.648.0	8,831,901,492	106,649.4	112,648.0	0.0

Note: DUT supports up to FR1 DL3CC (all FDD), but MX800071A supports up to FR1 DL4CC.

Throughput Meas. Result (2) FR1 SA



Test result

RAT	LTE	NR	PHY-TPUT DL/UL	IP-TPUT DL/UL	DUT
FR1 SA	--	DL2CC 4x4 MIMO UL1CC SISO	4367/29 Mbps	4340/26 Mbps	Chipset vendor A device

■ iPerf command: `iPerf3 -c 192.168.1.1 -w 8M -p 5201 -t 600 -P 20`

■ Parameter settings and Throughput Monitor graph

Simulation Parameter Setup

NR 2CC

NR TDD Configuration

NR1	NR2
NR Band: n78	n77
Channel (DL): 65666	650000
Reference Point A (DL): 633390	646724
DL Bandwidth: 100MHz	100MHz

Band n78, n77

All 100 MHz BW

NR SIB Settings

NR1	NR2
SIB Mode: Default (Data)	Default (Data)
SIB Mode (Communication): Not Send	Not Send

NR2 : SIB = Not send

TDD Configuration Setup - Manual(Dedicated)

TDD configuration: 19D1U

DL/UL Periodicity	Pattern1	Pattern2
Slot	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	
DL/UL Allocation	D D D D D D S D D D D D S D D D S U D	

Throughput Monitor (NR)

NR1 TDD Configuration

Manual(Dedicated)	Manual(Dedicated)
TDD Schedule: 7DL 1SP 2UL	7DL 1S
DL/UL Periodicity: 10ms	10ms
DL Modulation Order: 256QAM	256QAM
UL Modulation Order: 256QAM	256QAM

All 4x4 MIMO

All DL256QAM

Throughput Meas. Result (3) FR1 NSA



Test result

RAT	LTE	NR	PHY-TPUT DL/UL	IP-TPUT DL/UL	DUT
FR1 NSA	DL4CC 2x2 MIMO UL1CC SISO	DL2CC 4x4 MIMO UL1CC SISO	5148/134 Mbps	5120/132 Mbps	Chipset vendor A device

■ iPerf command: iPerf3 -c 192.168.1.1 -w 8M -p 5201 -t 600 -P 20

Parameter settings

Simulation Parameter Setup

NR 2CC + LTE 4CC

RF sharing = ON

NR SIB = Not send

NR Band n78 + n78

100 + 100 MHz BW

TDD configuration: 19D1U

LTE Band 1+3+7+7

All 20 MHz BW

All 4x4MIMO

All DL256QAM

All DL256QAM

All 2x2MIMO

All DL256QAM

Machine Config: MT8000A(NR + LTE)

Simulation Model: NR, LTE

RF Sharing: LTE DL: LTE1, LTE2, LTE3, LTE4; UL: LTE1, LTE2

NR1, NR2: Duplex Mode TDD; NR Band n78; Channel (DL) 636666; Frequency (DL) 3549.99; Reference Point A (DL) 643390; Channel (UL) SameAsDL; Frequency (UL) SameAsDL; Reference Point A (UL) SameAsDL; UL Frequency 7.5kHz Shift OFF; DL Subcarrier Spacing 30kHz; UL Subcarrier Spacing SameAsDL; SSB Subcarrier Spacing 30kHz; DL Bandwidth 100MHz; UL Bandwidth SameAsDL

TDD Configuration Setup - Manual(Dedicated): DL/UL Periodicity Pattern1; Slot 0-19; DL/UL Allocation; Number of DL Symbols; Number of UL Symbols; PDSCH; PUSCH #1; PUSCH #2

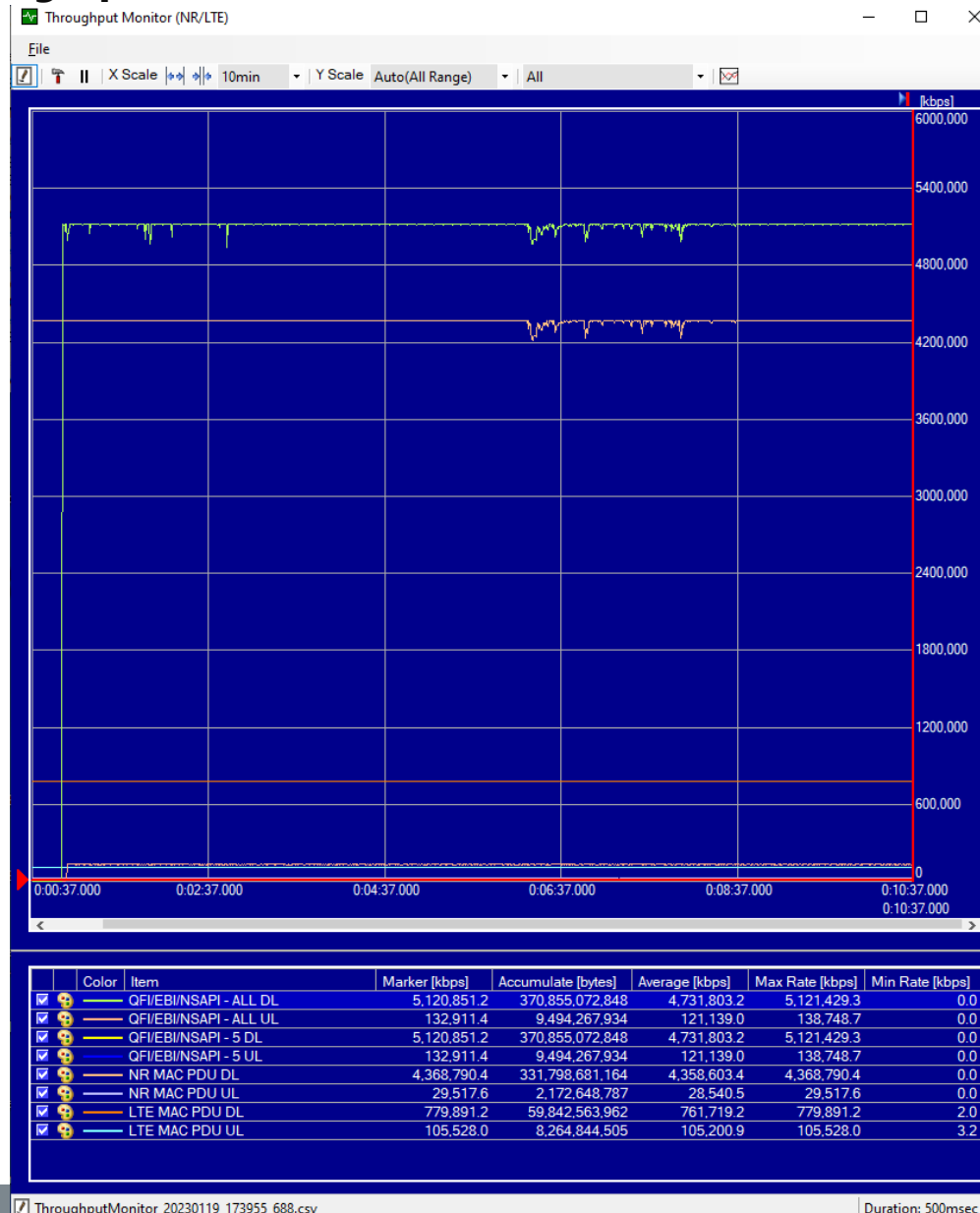
LTE1, LTE2, LTE3, LTE4: Duplex Mode FDD; E-UTRA Band Band1, Band3, Band7, Band7; Channel (DL) 300, 1575, 3100, 3100; Frequency (DL) 2140.0, 1842.5, 2655.0, 2655.0; Channel (UL) Synchronizes with DL; Frequency (UL) 1950.0, 1747.5; DL Bandwidth 20MHz; UL Bandwidth SameAsDL; Number of DL Antennas 2, 2; Transmission Mode TM3; DL Modulation Order 256QAM; UL Modulation Order 256QAM

NR TDD Configuration: Allocation Pattern Auto; DCI Pattern (Data); DL/UL Periodicity 10ms, 1; Number of PDCCH Symbols 1; Common/DCI Pattern (Data); Dedicated/DCI Pattern (Data); Number of DL Antennas 4; Number of UL Antennas 1; DL Modulation Order 256QAM; UL Modulation Order 256QAM

Note: DUT supports up to LTE DL4CC (3B) in NSA mode, but MX800071A supports up to LTE DL4CC (4B) in NSA mode.

Throughput Meas. Result (3) FR1 NSA

Throughput Monitor graph



Throughput Meas. Result (4) FR1 NSA



Test result

RAT	LTE	NR	PHY-TPUT DL/UL	IP-TPUT DL/UL	DUT
FR1 NSA	DL6CC 4x4 MIMO UL1CC SISO	DL1CC 4x4 MIMO UL1CC SISO	4134/134 Mbps	3992/132 Mbps	Chipset vendor A device

■ iPerf command: `iPerf3 -c 192.168.1.1 -w 8M -p 5201 -t 600 -P 10`

Parameter settings and Throughput Monitor graph

Simulation Parameter Setup

2 x MT8000A

Machine Config: MT8000A(NR) + MT8000A(LTE)

RF Connector: RF Sub Module

Simulation Model: NR, LTE

RF Sharing: ON

RF Sharing: LTE DL: LTE2, LTE3, LTE5, LTE6

NR

NR1

NR Band: n78

Channel (DL): 3549.890

Frequency (DL): 3533.90

Reference Point A (DL): 3533.90

Channel (UL): SameAsDL

Frequency (UL): SameAsDL

Reference Point A (UL): SameAsDL

UL Frequency 7.5kHz Shift: OFF

DL Subcarrier Spacing: 30kHz

UL Subcarrier Spacing: 30kHz

SSB Subcarrier Spacing: 30kHz

DL Bandwidth: 100MHz

UL Bandwidth: SameAsDL

NR

NR1

TDD Configuration: Manual(Dedicated)

TDD Schedule: Manual(Dedicated)

Auto: 7DL 1SP 2UL

Allocation Pattern: 7DL 1SP 2UL

DCI Pattern: (Data)

Manual: 10ms, 1

DL/UL Periodicity: 10ms

Number of PDCCH Symbols: 1

Common/DCI Pattern: (Data)

Dedicated/DCI Pattern: (Data)

Number of DL Antennas: 4

Number of UL Antennas: 1

DL Modulation Order: 256QAM

UL Modulation Order: 256QAM

LTE

LTE Band 1+3+3+28+7+7

	LTE1	LTE2	LTE3	LTE4	LTE5	LTE6
E-UTRA Band	Band1	Band3	Band3	Band28	Band7	Band7
Channel (DL)	300	1575	1773	9360	3100	3298
Frequency (DL)	2140.0	1842.5	1862.3	773.0	2655.0	2674.8
Channel (UL)	Synchronizes with DL	Synchronizes with DL	-	-	-	-
Frequency (UL)	1950.0	1747.5	-	-	-	-
DL Bandwidth	20MHz	20MHz	20MHz	20MHz	20MHz	20MHz
UL Bandwidth	SameAsDL	SameAsDL	-	-	-	-
Number of DL Antennas	2	4	4	2	4	4
Transmission Mode	TM3	TM3	TM3	TM3	TM3	TM3
DL Modulation Order	256QAM	256QAM	256QAM	256QAM	256QAM	256QAM
UL Modulation Order	256QAM	256QAM	256QAM	256QAM	256QAM	256QAM

2x2+4x4+4x4+2x2+4x4+4x4 MIMO

All DL256QAM

TDD Configuration Setup - Manual(Dedicated)

TDD configuration: 19D1U

DL/UL Periodicity	Pattern1	Pattern2
Slot	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	
DL/UL Allocation	D D D D D S D D D D D D D S D D S U D	
Number of DL Symbols	14 14 14 14 14 14 12 14 14 14 14 14 12 14 14 14 14 13 0 14	
Number of UL Symbols	0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 14 0	

NR

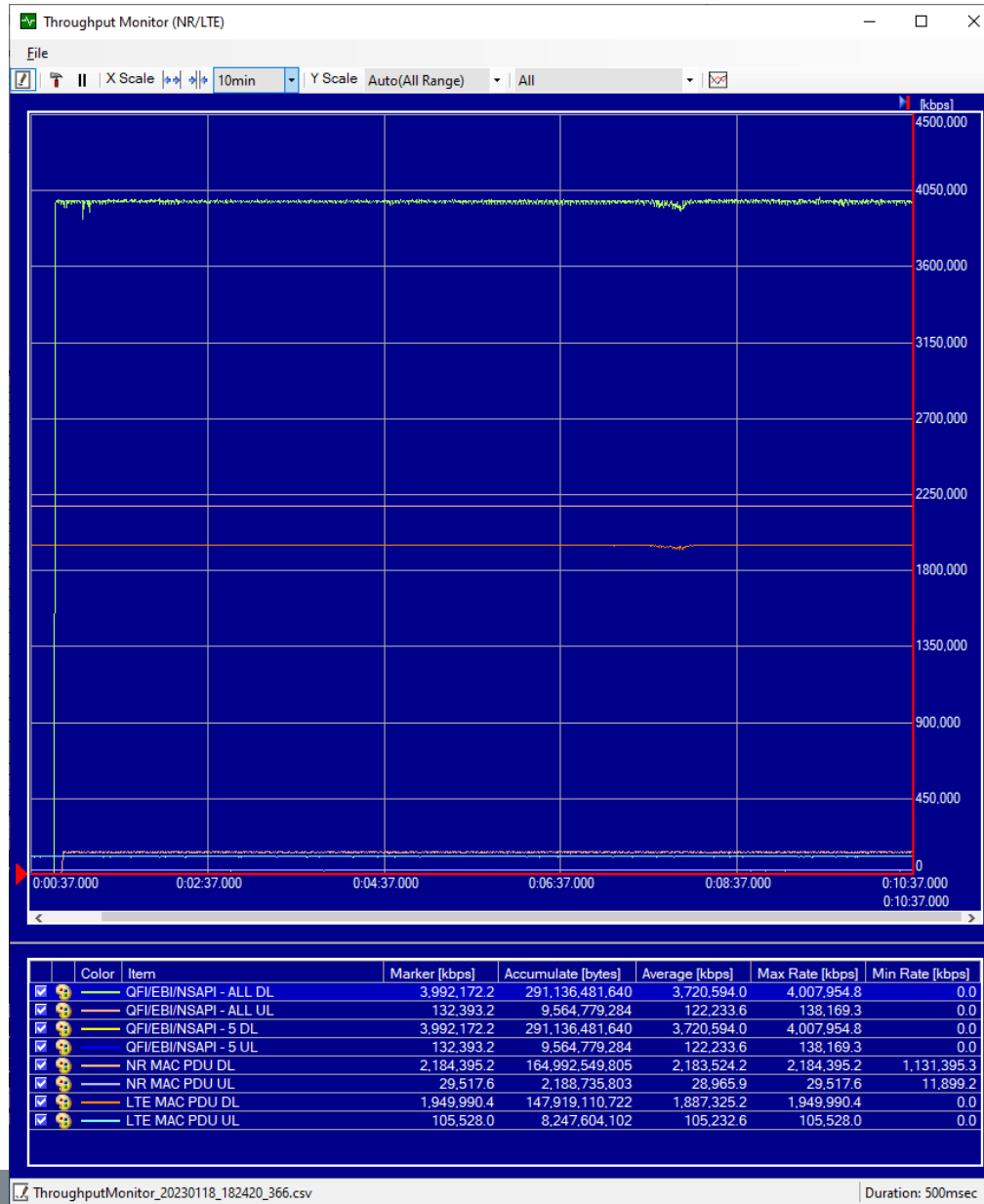
NR1

NR SIB = Not send

Note: DUT supports up to NR1CC (1B) + LTE DL6CC (4B/All FDD) in NSA mode, but MX800071A supports up to NR 2CC (2B) + LTE DL6CC (6B) in NSA mode.

Throughput Meas. Result (4) FR1 NSA

Throughput Monitor graph



Throughput Meas. Result (5) LTE



Test result

RAT	LTE	NR	PHY-TPUT DL/UL	IP-TPUT DL/UL	DUT
LTE	DL7CC 4x4 MIMO UL1CC SISO	--	1950/105 Mbps	1944/105 Mbps	Chipset vendor A device

■ iPerf command: `iPerf3 -c 192.168.1.1 -w 8M -p 5201 -t 600 -P 10`

■ Parameter settings and Throughput Monitor graph

Simulation Parameter Setup

Machine Config: MT8000A(LTE)

Simulation Model

RAT	NR	LTE
Cell	0	7

RF Sharing = ON

RF Sharing: LTE DL: LTE1,LTE3 LTE4,LTE5 LTE6,LTE7

LTE

Apply Restore

Band 1+28+1+3+3+7+7

	LTE1	LTE2	LTE3	LTE4
Duplex Mode	FDD	FDD	FDD	FDD
E-UTRA Band	Band1	Band28	Band1	Band3
Channel (DL)	300	9360	500	1575
Frequency (DL)	2140.0	773.0	2160.0	1842.5
Channel (UL)	Synchronizes with DL	Synchronizes with DL	-	-
Frequency (UL)	1950.0	718.0	-	-
DL Bandwidth	20MHz	20MHz	20MHz	20MHz
UL Bandwidth	SameAsDL	SameAsDL	-	-
Number of DL Antennas	4	2	2	4
Transmission Mode	TM3	TM3	TM3	TM3
DL Modulation Order	256QAM	256QAM	256QAM	256QAM
UL Modulation Order	256QAM	-	-	-

All 20 MHz BW

All DL 256QAM

LTE

Apply Restore

	LTE5	LTE6	LTE7
Duplex Mode	FDD	FDD	FDD
E-UTRA Band	Band3	Band7	Band7
Channel (DL)	1773	3100	3298
Frequency (DL)	1862.3	2655.0	2674.8
Channel (UL)	-	-	-
Frequency (UL)	-	-	-
DL Bandwidth	20MHz	20MHz	20MHz
UL Bandwidth	-	-	-
Number of DL Antennas	4	2	2
Transmission Mode	TM3	TM3	TM3
DL Modulation Order	256QAM	256QAM	256QAM
UL Modulation Order	256QAM	256QAM	256QAM

4x4+2x2+2x2+4x4+4x4+2x2+2x2 MIMO

Throughput Monitor (LTE)

Color	Item	Marker (Bps)	Accumulate (bytes)	Average (Bps)	Max Rate (Bps)	Min Rate (Bps)
Blue	QPS-BANDSAPR - ALL DL	1,944,795.5	143,696,514,500	1,820,353.4	1,949,549.4	0.0
Blue	QPS-BANDSAPR - ALL UL	105,227.2	7,720,055,918	97,633.6	105,213.7	0.0
Blue	QPS-BANDSAPR - S-DL	1,944,795.5	143,696,514,500	1,820,353.4	1,949,549.4	0.0
Blue	QPS-BANDSAPR - S-UL	105,227.2	7,720,055,918	97,633.6	105,213.7	0.0
Blue	LTE MAC PDU DL	1,949,524.8	143,112,158,409	1,864,513.8	1,949,524.8	0.0
Blue	LTE MAC PDU UL	105,528.0	8,321,010,847	105,162.9	105,528.0	0.0

Note: DUT supports up to LTE DL7CC (4B), but MX800071A supports up to LTE DL7CC (6B).

Appendix

5G Chipset and UE Test Platform

5GNR ALL-in-ONE Test Platform

Install each application in all-in-one platform and switch by system number

Platform GUI

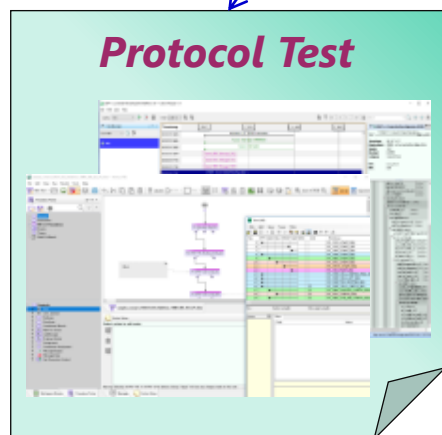


MT8000A

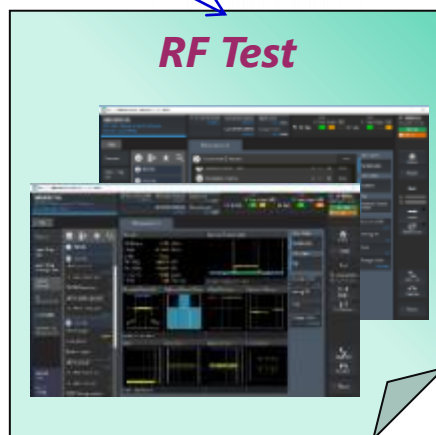
Radio Communication Test Station



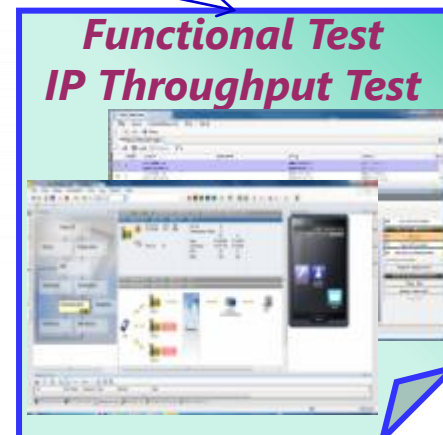
Test Applications



MX800050A
Rapid Test Designer Platform (RTD)



MX800010A
TRx Measurement.

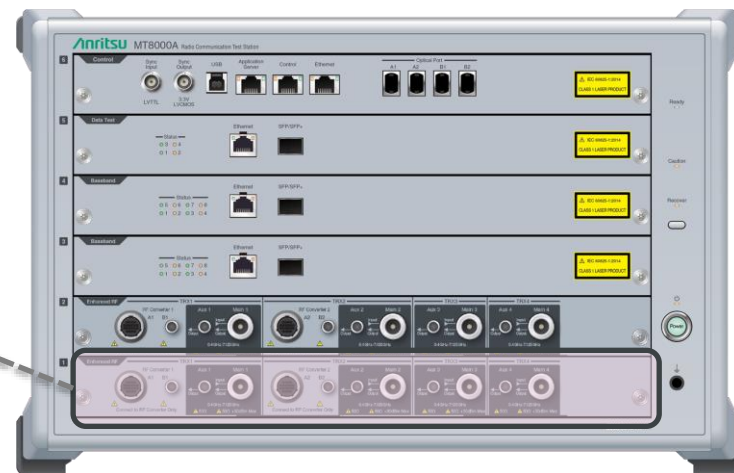
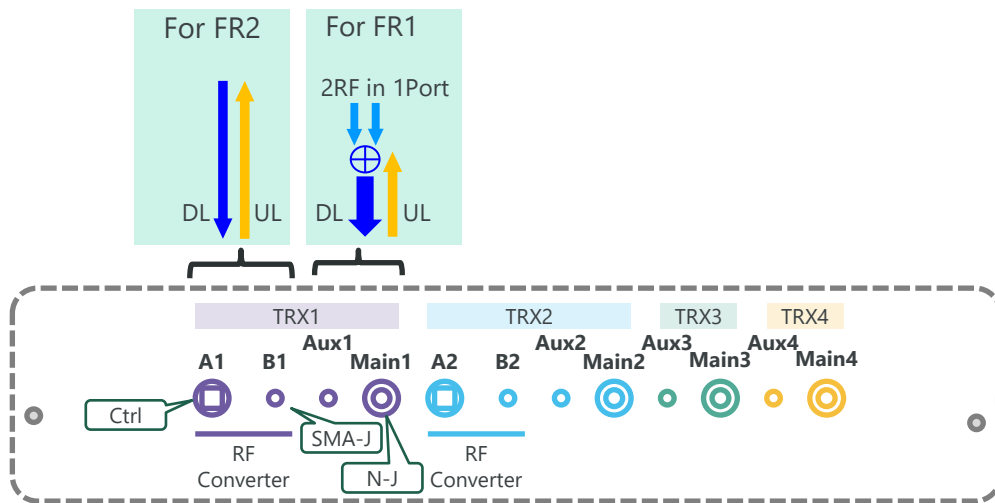


MX800070A SSNR
MX800071A SSIP

MT8000A-033 0.4 to 7.125 GHz Enhanced RF Module

- Features
 - Four sets of RF input/output connectors per slot (N-type Main In/Out and SMA-type Aux Out)
 - Eight RF transmitters per slot (total of 16 Tx and four 4x4 MIMO bands)
 - Four RF receivers per slot (total of 8 Rx for UL 2x2 MIMO and UL antenna switch)
 - Frequency range: **FR1: 400 to 7125 MHz, FR2: external RF converter interface**
- Input/Output (4 Ports/slot)
 - Main 1/2/3/4 – RF In/Out
 - Aux 1/2/3/4 – RF Out (exclusive with Main output)
 - RF Converter 1/2 – for MX8000 1/2/3A external RF converter connection
- Transmitter
 - FR1 Bandwidth: **OBW 800 MHz (IBW 1200 MHz)**
 - FR2 Bandwidth: **1000 MHz**
 - FR1 Upper freq: Four Tx up to 7125 MHz and remaining four Tx up to 5000 MHz
- Receiver
 - Receive waveform bandwidth: FR1 800 MHz / FR2 1000 MHz
 - Signal analysis bandwidth: FR1 **1200 MHz (max.)**/FR2 1000 MHz

Output/Input for FR1 or FR2



The Anritsu logo is displayed in a bold, teal, sans-serif font. Below it, the tagline "Advancing beyond" is written in a smaller, black, sans-serif font. The background features a light green gradient with several curved, parallel lines in shades of green and yellow on the right side.

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