Application Note

VOICE CALL ASPECTS IN 5G NEW RADIO NETWORKS

Functional testing

Products: R&S®CMW500 R&S®CMX500

Christian Wicke, Fabian Bette | 1SL364 | Version 0e | 10.2021 https://www.rohde-schwarz.com/appnote/1SL364



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1 Overview

Although data services in the context of eMBB, URLLC and mMTC are the pivotal drivers behind the 5G evolution, legacy services like voice and video communications still represent important services that operators want to offer to their subscribers. As part of the technology evolution, we have seen a major change from circuit-switched 2G networks with an initial focus on telephony to fully packet-switched 4G networks focused on internet data communications.

This application note focuses on different details of voice services in 5G networks. Besides some theoretical background this document describes the procedure to setup a 5G network with R&S[®]CMW500 and R&S[®]CMX500 radio communication testers and how to carry out different functional voice call tests for 5G networks.

Moreover, this application note includes a 'Tips & Tricks' chapter which gives some hands-on advises for debugging and troubleshooting.

The audio quality tests are not explained in more detail in this document. However, the CMX500 offers maximum flexibility to connect different audio analyzers via IP Forward mode or the External Media Endpoint. Tests can be carried out with T&M devices from Rohde & Schwarz or other equipment. For more information please see section for <u>further reading</u>.

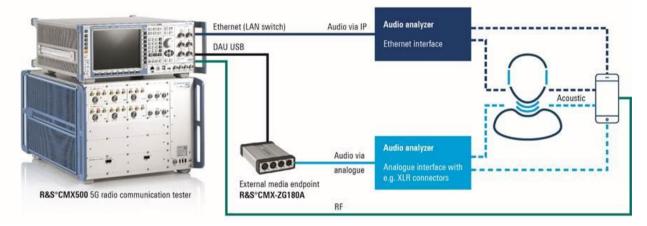


Figure 1: Flexibility of test setup for audio quality testing

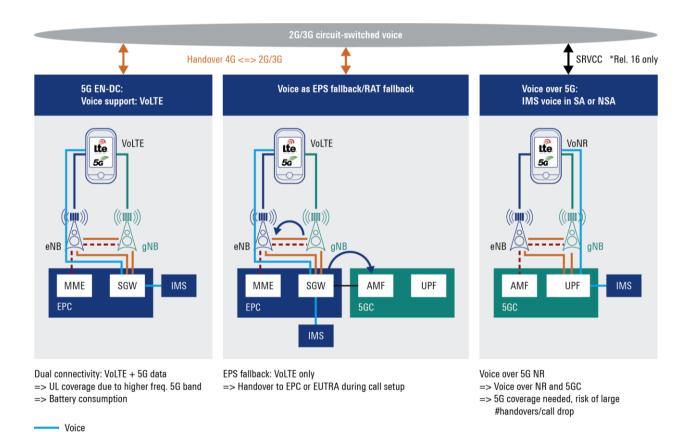
2 General voice call aspects in 5G NR networks

When talking about voice in 5G networks this is not limited to VoNR. However, depending on the deployment scenario, several additional ways to handle voice in 5G networks are possible (e.g. VoLTE, EPS/RAT fallback, etc.).

Like the predecessor technology VoLTE, VoNR bases on the IP multimedia subsystem (IMS) architecture. 5G voice calls are implemented as end-to-end voice over IP (VoIP) connections and are managed by the IMS core which acts as a service enabler for voice, video and text services. Unlike voice services provided by external applications, voice over IMS supports quality of service (QoS) management across the entire 5G system.

As mentioned in the beginning, voice aspects in 5G networks show that there is no single implementation of voice. Instead, various different deployment scenarios are supported. Which scenario is used depends i.a. on the Radio Access Technology (RAT) and what Core Network is available. More information about the different deployment scenarios can be found in the following paragraph.

2.1 Deployment scenarios





Data

2.2 Audio codec aspects

A test system for voice in 5G networks must support the legacy AMR-NB, AMR-WB and the EVS codecs. The EVS speech codec was introduced with LTE in several networks already, but 5G voice services rely on this advanced speech coding algorithm more extensively. This codec uses Fullband spectrum and allows to handle high-end audio (also called as Full-HD-Voice). Figure 3 visualizes the different bandwidths used by the audio codecs.

- 300 Hz to 3400 Hz: narrowband (NB)
- 50 Hz to 7000 Hz: wideband (WB)
- 50 Hz to 14000 Hz: super wideband (SWB)
- 20 Hz to 20000 Hz: fullband (FB)

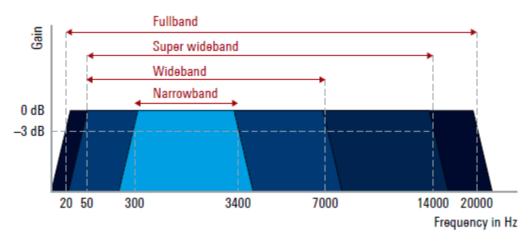


Figure 3: Audio bandwidth

- AMR NB
 - Adaptive Multi-Rate Narrowband
- AMR WB
 - Adaptive Multi-Rate Wideband
- Enhanced Voice Service (EVS)
 - Fullband → covers 20 Hz 20 kHz (complete audible frequency range of a typical human)

Further reading



https://www.rohde-schwarz.com/5G

3 R&S T&M equipment

3.1 Needed equipment and options

Please see chapter Ordering information for detailed information.

3.2 Different interfaces for CMX500

The CMX500 can be controlled via four different interfaces. Figure 4 summarizes them.

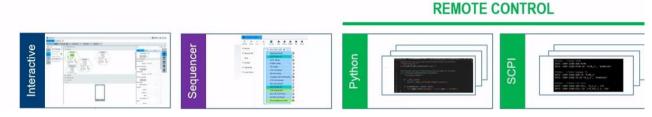


Figure 4: Four different interfaces for controlling the CMX500

- CMsquares: Interactive test mode (GUI)
- CMsequencer: Test campaign-based solution
- XLAPI: Python-based protocol test solution
- SCPI: Remote control via CMX SCPI commands

4 Performing functional tests

4.1 Overview

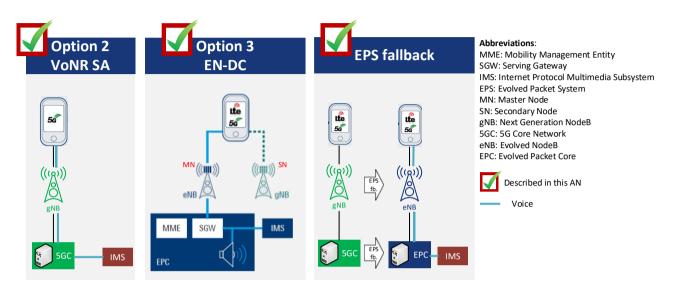


Figure 5: Deployment scenarios described in this application note

4.2 General setup routine before performing the different functional tests

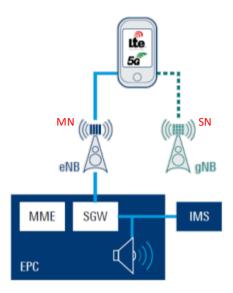
- 1. Insert the R&S SIM card into the UE
- 2. Connect the UE to the CMX \rightarrow Two possible ways
 - 1. Wired connection
 - 2. OTA connection via shielded box
- 3. Not required but highly recommended: Test connection
 - 1. Ping DUT
 - 2. Perform some fundamental e.g. NR Tx measurements

Further reading:

R&S Application Note 1SL368 5G NR FR1 Non-Standalone UE RF Conformance Testing: <u>https://www.rohde-schwarz.com/appnote/1SL368</u>

4.3 Network option 3 for NSA (EN-DC)

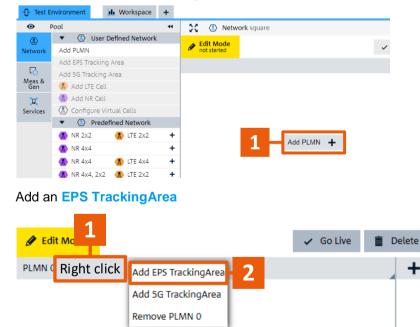
This section describes the testing procedure for the deployment scenario "Network option 3 in non-standalone mode".



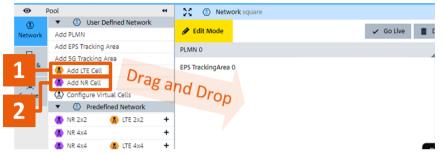
Setup procedure in CMsquares:

2.

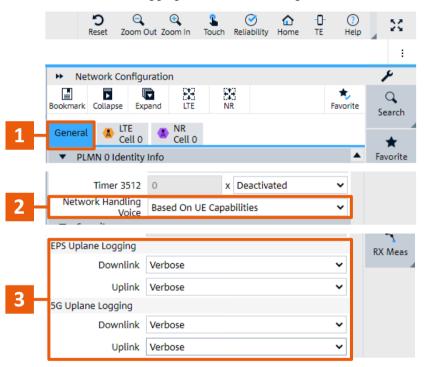
1. Add a PLMN to the network square



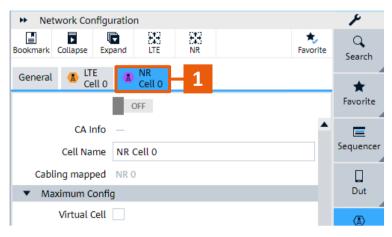
3. Add a LTE cell and a NR cell to the EPS TrackingArea



- 4. Adapt the General settings (sidebar)
 - Select 2 EPS Fallback Redirection as Network Handling Voice mode
 - Set the Uplane logging to ③ Verbose (for Uplink and Downlink)
 → This makes debugging and troubleshooting easier



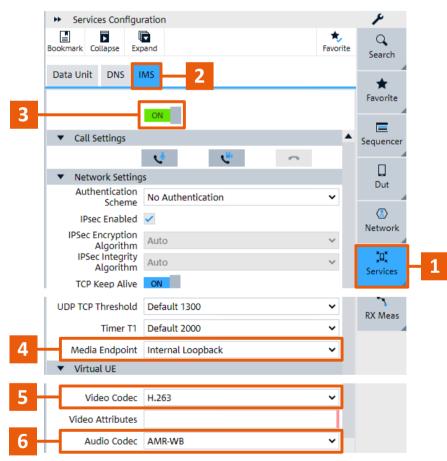
5. Adapt the 5G NR cell specific settings



6. Adapt the LTE cell specific settings

Network Configuration Bookmark Collapse Expand LTE NR Favorite General Calling Calling mapped LTE 0				
Bookmark Collapse Expand LTE NR Favorite General ITE Cell 0 ITE OFF CA Info Cell Name LTE Cell 0 LTE NR Favorite Search Search	 Network Configu 	uration		×
CA Info Cell Name LTE Cell 0				Q Search
CA Info — Cell Name LTE Cell 0	General General Cell 0	🚽 1 🛛		*
Cell Name LTE Cell 0 Sequencer		OFF		Favorite
Cell Name LIE Cell 0	CA Info	_	A	
Cabling mapped LTE 0	Cell Name	LTE Cell 0		Sequencer
	Cabling mapped	LTE O		

- 7. Adapt the IMS settings
 - Set Media Endpoint to (4) Internal Loopback
 - Select 5 Video Codec (only required for video calls)



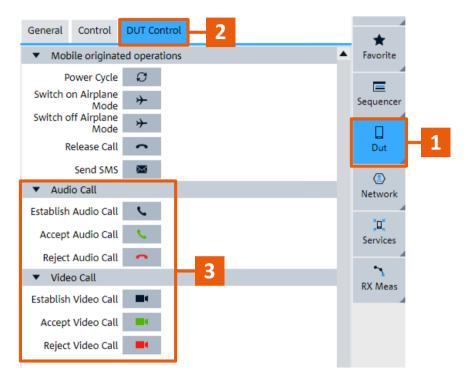
– Select 6 Audio Codec

8. Go live with this configuration

Network square		
🖉 Edit Mode	1 🗸 Go Live	📋 Delete
PLMN 0		+

9. Setup/Accept a call

- Setup from UE side
 - Dial any number on the UE
 - Accept the call in DUT control tab
- Setup a call in CMsquares
 - Establish a call



VoLTE as legacy in LTE

	ideo and services	Audio codec	ł						•		ideo and services	Audio codec
SIP	HTTP/ XCAP	RTP/ Rtcp	ł						•	SIP	HTTP/ XCAP	RTP/ RTCP
T	CP/UDP I	Р	←	-1	►	TCP/L	JDP IP	+	⇒	1	CP/UDP I	Р
	NR PDCP			-		NR PDCP	EPS bearer,					
	NR RLC			-		NR RLC	QCI 5 and QCI 1 for SIP					
	NR MAC			-		NR MAC	signaling					
	NR PHY			-		NR PHY	and audio					
	UE					E-UTRA	with EPC				IMS	

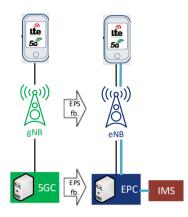
VoLTE using NR PDCP

	ideo and services	Audio codec						•		ideo and services	Audio codec
SIP	HTTP/ XCAP	RTP/ RTCP	+					→	SIP	HTTP/ XCAP	RTP/ RTCP
T	CP/UDP I	Р	←	→	TCP/l	JDP IP	←	→	T	CP/UDP I	Р
	NR PDCP		-		NR PDCP	EPS bearer,					
	NR RLC		k -		NR RLC	QCI 5 and QCI 1 for SIP					
	NR MAC		-		NR MAC	signaling					
	NR PHY		-		NR PHY	and audio					
	UE				E-UTRA	with EPC				IMS	

Figure 6: Network option 3 for NSA (EN-DC) scenario

4.4 EPS Fallback Redirection

This section describes the testing procedure for the EPS fallback redirection scenario. In this scenario all voice calls are redirected to LTE.

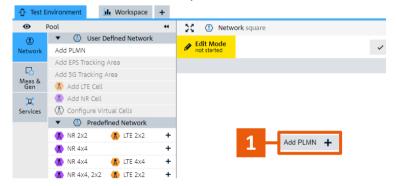


Kind of double handover:

- RAT change from NR to LTE
- Core network handover from 5GC to EPC

Setup procedure in CMsquares:

1. Add a **PLMN** to the network square

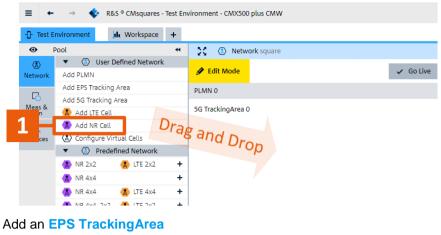


2. Add a 5G TrackingArea to the PLMN

🖉 Edit Mo		🗸 Go Live	📋 Delete
PLMN 0 Right click	Add EPS TrackingArea		+
	Add 5G TrackingArea		
	Remove PLMN 0		

3. Create a NR cell in this 5G tracking area

4.



🖉 Edit Mo		🗸 Go Live	📋 Delete
PLMN C Right click	Add EPS TrackingArea		+
	Add 5G TrackingArea		
	Remove PLMN 0		

5. Create one or more LTE cell(s) in the EPS tracking area

•	Pool	41	Network squ	quare	
	🔻 🕘 User Defined	d Network			
Network	Add PLMN		🖉 Edit Mode	🗸 Go Live	i
	Add EPS Tracking Area		PLMN 0		
	Add 5G Tracking Area				-
1 &	🔥 Add LTE Cell	D	EPS TrackingArea 0	5G TrackingArea 0	
	Add NR Cell	Urag ar	Id Drop	Cell 0	
Services	Configure Virtual Ce	ells	UProp		
	 Predefined N 	letwork	σp	OFF	
	🔥 NR 2x2 🔥	LTE 2x2 +			
	A NR 4x4	+			
	🔥 NR 4x4 🔥	LTE 4x4 +			D
	🔥 NR 4x4, 2x2 🔥	LTE 2x2 +			
	🔥 NR 4x4 🛛 🔥	LTE 2x2, 2x2 +			MI EP
	🔥 NR 4x4, 4x4	+			5G
			Activate EN-DC Mode 0	Create Additional QoS Flow Delete QoS Flow	RR

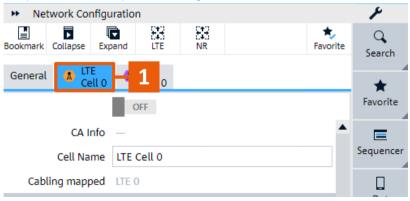
- 6. Adapt the General settings (sidebar)
 - Select 2 EPS Fallback Redirection as Network Handling Voice mode
 - Set the Uplane logging to ③ Verbose (for Uplink and Downlink)
 → This makes debugging and troubleshooting easier

	S Q Reset Zoom C	Cut Zoom In Touc	h Reliability Home	TE Help	×
					:
	 Network Configu 	iration			۴
		and LTE	NR	★ Favorite	Q Search
1 -	General 🚯 LTE Cell 0	NR Cell 0			4
	 PLMN 0 Identity 				Favorite
	Timer 3512	0	x Deactivated	~	
2 –	Network Handling Voice	Based On UE Ca	pabilities	~	
					~
	EPS Uplane Logging				RX Meas
	Downlink	Verbose		~	
2	Uplink	Verbose		~	
3	5G Uplane Logging				
	Downlink	Verbose		~	
	Uplink	Verbose		~	

7. Adapt the 5G NR cell specific settings

 Network Configu 	uration			1
	pand LTE	NR	* Favorite	Q Search
General 🚯 LTE Cell 0	NR Cell 0	1		*
	OFF			Favorite
CA Info	_		^	
Cell Name	NR Cell 0			Sequencer
Cabling mapped	NR 0			
 Maximum Confi 	g			Dut
Virtual Cell				

8. Adapt the LTE cell specific settings



9. Adapt the IMS settings

- Set Media Endpoint to (4) Internal Loopback
- Select (5) Video Codec (only required for video calls)
- ۶ Services Configuration ľ ► * Ē Q Bookmark Collapse Favorite Expand Search 2 Data Unit DNS IMS * Favorite 3 ON Call Settings ۸ Sequencer Ľ \sim C Network Settings • Dut Authentication No Authentication ~ Scheme ٨ IPsec Enabled 🗸 Network **IPSec Encryption** Auto × Algorithm IPSec Integrity ~ Auto Algorithm 1 Services TCP Keep Alive ON 7 UDP TCP Threshold Default 1300 × **RX** Meas Default 2000 ~ Timer T1 4 Media Endpoint Internal Loopback ~ Virtual UE Video Codec H.263 ~ Video Attributes Audio Codec AMR-WB v 6
- Select 6 Audio Codec

10. Go live with this configuration

🔀 🕼 Netw	ork square			
🖋 Edit Mode		1	🗸 Go Live	📋 Delete
PLMN 0				+

11. Setup/Accept a call

- Setup from UE side
 - Dial any number on the UE
 - Accept the call in DUT control tab
- Setup a call in CMsquares
 - Establish a call

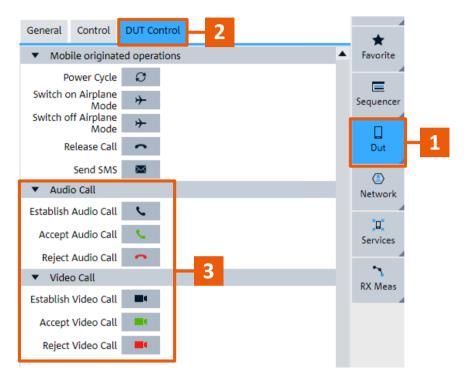


Figure 7: EPS fallback scenario

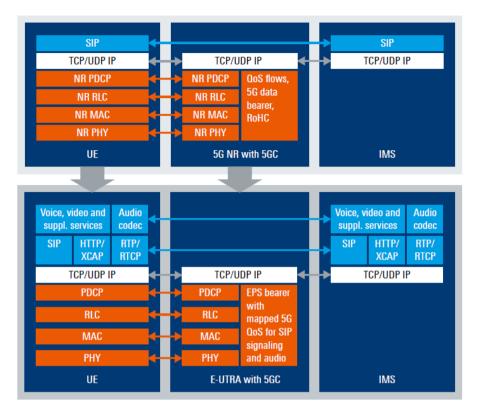
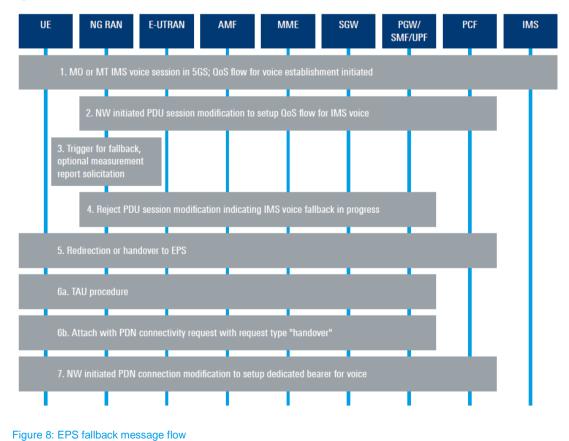


Figure 7: EPS fallback scenario



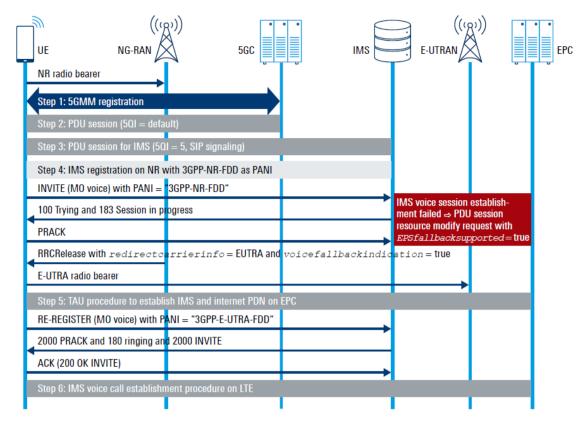


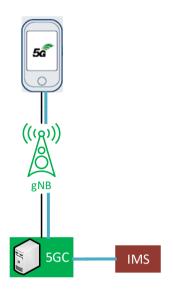
Figure 9: EPS fallback signaling procedure

4.5 EPS Fallback Handover

In the EPS Fallback Handover scenario are all voice calls handovered to LTE. However, this scenario is not described in the current version of application note.

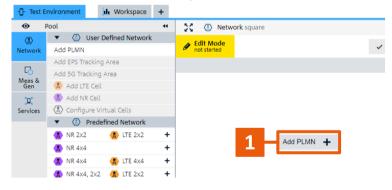
4.6 Voice over NR (SA)

This section describes the testing procedure for the Voice over New Radio standalone scenario.



Setup procedure in CMsquares:

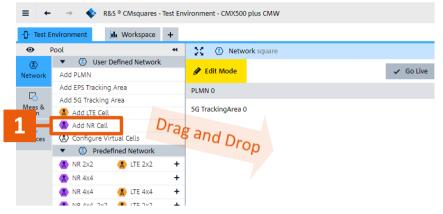
1. Add a **PLMN** to the network square



2. Add a 5G TrackingArea to the PLMN



3. Create a NR cell in this 5G tracking area



4. Adapt the General settings (sidebar)

5.

- 1. Select 2 Voice Over NR as Network Handling Voice mode
- Set the Uplane logging to ③ Verbose (for Uplink and Downlink)
 → This makes debugging and troubleshooting easier

➡ Network Configu	uration			
	and LTE N	e R	Favorite	s
General 🕼 NR Cell 0				
 PLMN 0 Identity 	Info		A	Fa
Timer 3512	0 x	Deactivated	~	
Network Handling Voice	Voice Over NR		~	
EPS Uplane Logging				R
Downlink	Verbose		~	10
Uplink	Verbose		~	
5G Uplane Logging				
Downlink	Verbose		~	
Uplink	Verbose		~	

٢ ▶ Network Configuration E‡3 LTE € NR ► Ē * Q Bookmark Collapse Expand Favorite Search General 1 Å Cell 0 * Favorite OFF ٠ MCS Table 64 QAM × Sequencer CDRX Auto Adjust Schodulor

6. Adapt the IMS settings

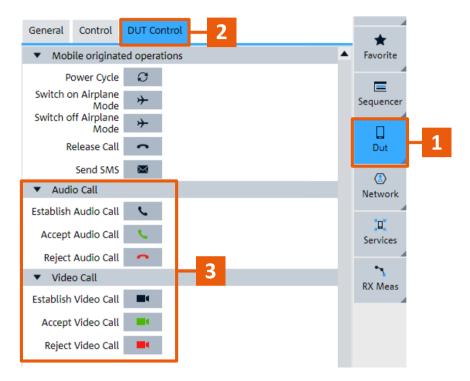
- Set Media Endpoint to (4) Internal Loopback
- Select (5) Video Codec (only required for video calls)
- ۶ Services Configuration ľ * ► Ē Q Bookmark Collapse Favorite Expand Search 2 Data Unit DNS IMS * Favorite 3 ON Call Settings ۸ Sequencer Ľ \sim C Network Settings • Dut Authentication No Authentication ~ Scheme ٨ IPsec Enabled 🗸 Network **IPSec Encryption** Auto v Algorithm IPSec Integrity ~ Auto Algorithm 1 Services TCP Keep Alive ON ٦ UDP TCP Threshold Default 1300 × **RX** Meas Default 2000 ~ Timer T1 4 Media Endpoint Internal Loopback ~ Virtual UE Video Codec H.263 ~ Video Attributes Audio Codec AMR-WB v 6
- Select 6 Audio Codec

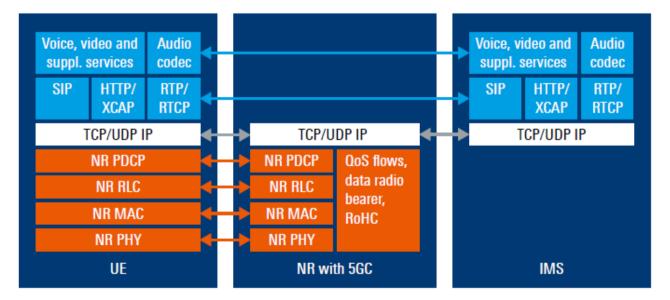
7. Go live with this configuration



8. Setup/Accept a call

- Setup from UE side
 - Dial any number on the UE
 - Accept the call in DUT control tab
- Setup a call in CMsquares
 - Establish a call







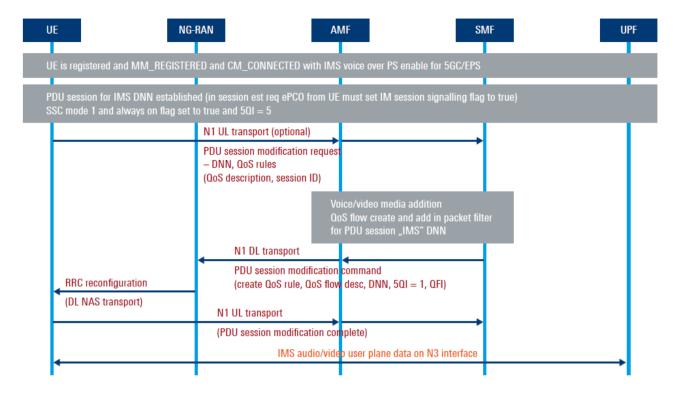


Figure 11: Voice over NR message flow

5 Tips and Tricks

5.1 Debugging with CMXmars

R&S[®]CMXmars provides a huge feature set for analysis and debugging. Simplified views of the message sequencer chart, user equipment capability views and detailed views of message content trees help to monitor the test execution in real time. Of course, the same message log is available offline and can be downloaded along with the measurement report.

ø	Views **	Message Table 🗙	() X ×	× MSC ×	⑦ ∺ ×
Mars	🔟 Select All	🔍 🕒 goto 109 🔟 defaultOnlineTable 🍹 T	T_ T_ T_ T_ T_ T_	🕒 goto 48 defaultMSC To To To To	τ₀ ∽ ← τ _×
	Message Table	Service Primitive PDU	Auxiliary	Time Stamp NR LTE UE	
5			stemInformationBlockType2(2);SystemInformationBlc Cell Typ 🔺		
Reset	MSC MSC	EPS NAS SECURITY PROTECTED Find EpsL3MessageUL		19:41:52.971 Result= OK (0);	
H		PDCP_C_DATA Ind ULInformationTransfer	RBId = (487 UUnformationTransfer	
Multi	Message Tree	CRRC_UL_DCCH_MESSAGE Ind ULInformationTransfer	Result=	· · · · · · · · · · · · · · · · · · ·	
Tab	Bit	EPS NAS PEER MESSAGE Ind EMM Attach Complete;ESM Activat EPS NAS PEER MESSAGE Reg ESM Activate Dedicated EPS Bearer		19:41:52.976 Result= OK (0);	
тар	Dit Dit	EPS NAS SECURITY PROTECTED I Reg EpsL3MessageDL	context nequest	488 EMM Attach Complete;ESM Activate Default EPS Bei	arer Context Accept
	Hex	CRRC_DL_DCCH_MESSAGE Reg UECapabilityEnquiry		19:41:52.976	
		RRRC_STATUS Ind UE_NR_Capability;UE_EUTRA_Capa	bility	807 ESM Activate Dedicated EPS Bearer Context Request	
	Bookmarks	PDCP_C_DATA Req UECapabilityEnquiry	RBId = (\longrightarrow	
		PDCP_C_DATA Ind UECapabilityInformation	RBId = (
	Verdict	CRRC_UL_DCCH_MESSAGE Ind UECapabilityInformation	Result=	809 UECapabilityEnquiry	
	-	CrrcDIDcchMsg Req RRCReconfiguration		19:42:25.600	
	Search Results	CRRC_DL_DCCH_MESSAGE Req RRCConnectionReconfiguration;RRC RRRC_STATUS Ind UE_EUTRA_Capability	Reconfiguration	820 UECapabilityInformation	
	-	RRRC_STATUS Ind UE_EUTRA_Capability PDCP_C_DATA Reg	Reconfiguration RBId = (
	Compare		plete;RRCReconfigurationComplete RBId = (19:42:25.627 Result= OK (0);	
		RRRC_STATUS Ind UE_EUTRA_Capability	preseption compare the state of	827 RRCReconfiguration	
	Parent Children		plete:RRCReconfigurationComplete Result=	19:42:25.635	
		EPS NAS SECURITY PROTECTED Find EpsL3MessageUL		848 RRCConnectionReconfiguration;RRCReconfiguration	
	UE Capabilities	EPS NAS PEER MESSAGE Ind ESM Activate Dedicated EPS Bearer			
		PDCP_C_DATA Ind ULInformationTransfer	RBid = (👻	 19:42:25.655 	
	PHY Monitor		•	 RRCConnectionReconfigurationComplete;RRCReconfigurationComplet	figurationComplete 🔹
	MAC Monitor	Message Tree ×	() 11 ×	Bit × UE Capabilities ×	() X ×
	RLC Monitor	Q ID=827 TS=2021-03-09 19:42:25.635 RFN=0 MDDB=NR_CRRC 7.1			
		ine Details		Group by Category + Collection +	
	SDAP Monitor	7 E 2 c1 = rrcReconfiguration (0)		Capability	
		8 😑 🖶 rrcReconfiguration	10		
		9 rrc_TransactionIdentifier = (0)		■ 5G NR (71 items)	
	RRC Monitor	0 E 🛊 criticalExtensions = rrcReconfiguration (0)		 Additional Parameters (1 item) 	
				accessStratumRelease = rel15 (0)	
		2 radioBearerConfig 3 e e drb_ToAddModList = (1)		Bands (4 items)	
	Storyboard	4 E = value		bandNR = (41)	
	Timeline		entity (0)	bandNR = (66)	
				bandNR = (71)	
		7		bandNR = (2)	
				Feature Sets Downlink Per CC (6 Items)	
				supportedSubcarrierSpacingDL = kHz30 (1)	
		0 discard Timer = infinit		supportedBandwidthDL = fr1 (0) fr1 = mhz100 (10)	
		1 arin SN Sizell - I	antShite.(1)	111 - 1112 100 (10)	

Figure 12: Screenshot of R&S®CMXmars

CMXmars can be accessed via the browser-based GUI of CMX.

5.2 Packet capture feature

The CMsquares allows to download the detailed packet capture logs. This functionality allows to export the packet capture session (.pcapng file) and analyze them with the open source packet analyzer Wireshark

The packet capture feature can be accessed via the Home screen \rightarrow Data Services \rightarrow Packet capture.

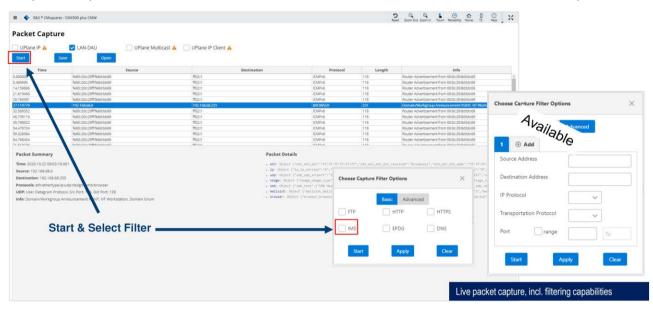


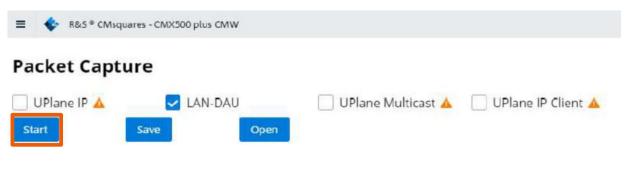
Figure 13: Screenshot of Packet Capture feature

5.2.1 Export packet capture to Wireshark

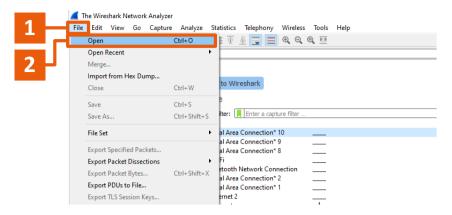
Note: For full functionality "Verbose Uplane logging" is required

Wireshark is an open source packet analyzer which provides various functions for network troubleshooting, analysis, software and communications protocol development. It enables a detailed analysis of RTP streams (timing, packet loss, packet ordering, etc.).

Export .pcapng file from CMsquares



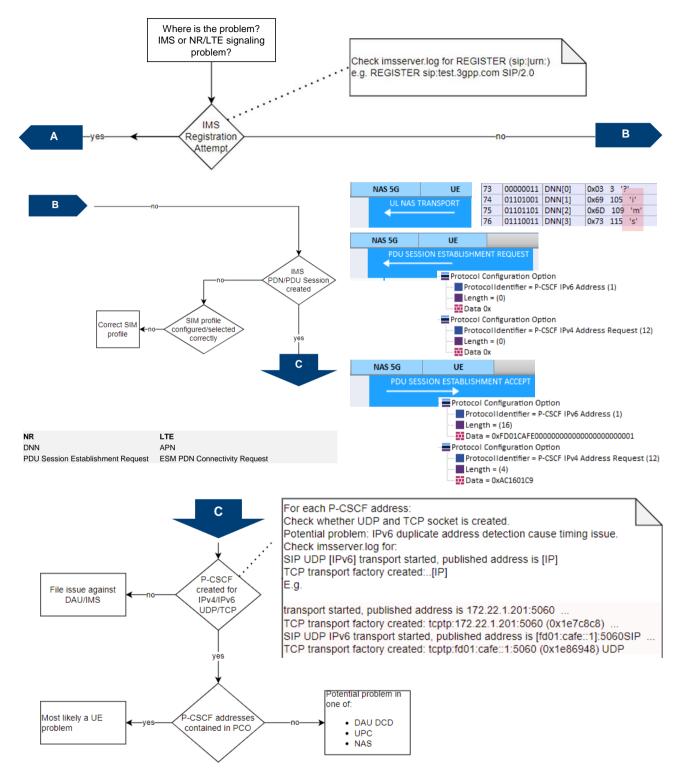
Open .pcapng file in Wireshark

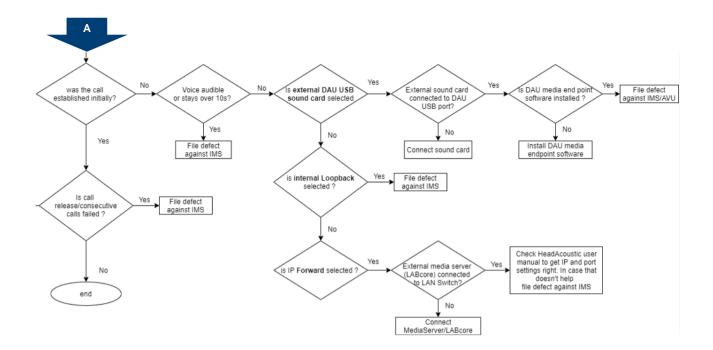


Further reading

https://www.wireshark.org/

5.3 Troubleshooting





6 Abbreviations

Abbreviation	Designation
5GC	5G core
5GS	5G system
5QI	5G QoS indicator
AMF	Access and mobility management function
AMR	Adaptive multi-rate
AMR-WB	AMR wideband
AS	Access stratum
CSFB	Circuit-switched fallback
DNN	Data network name
DRB	Data radio bearer
DRVCC	Dual radio voice call continuity
EPC	Evolved packet core (LTE core)
E-UTRAN	Evolved UMTS terrestrial radio network
EVS	Enhanced voice services
GBR	Guaranteed bit rate
GSM	Global system for mobile communications
GSMA	GSM association
GUI	Graphical user interface
HOS	Home operator services
IETF	Internet Engineering Task Force
IMS	IP multimedia subsystem
IP-CAN	IP connectivity access network
IVS	In-vehicle system
KPI	Key performance indicator
LRF	Location resource function
LTE	Long term evolution
MAC	Medium access control
MM	Mobility management
MME	Mobility management entity
MTSI	Multimedia telephony services for IMS
NAS	Non-access stratum
NSA	Non-standalone
PLMN	Public Land Mobile Network
QoE	Quality of experience
QoS	Quality of service

Abbreviation	Designation
RAN	Radio access network
RAT	Radio access technology
RLC	Radio link control
RTP	Real-time protocol
SA	Standalone
SIP	Session initiation protocol
SRB	Signaling radio bearer
SRVCC	Single radio voice call continuity
UE	User equipment
ViNR	Video over New Radio
VoLTE	Voice over LTE
VoNR	Voice over New Radio

7 Literature

- [1] Rohde & Schwarz, 5G New Radio Fundamentals, procedures, testing aspects.
- [2] Rohde & Schwarz, White Paper 5G Voice over New Radio (VoNR).

8 Ordering information

Designation	Туре	Order number	No.
CMW Wideband Radio Communication Tester			
Wideband Radio Communication Tester	CMW500	1201.0002K50	1
R&S [®] CMW500 Basic Assembly(mainframe), 70MHz to 3.3GHz (sel.)	CMW-PS505	1208.8921.06	1
Measurement Unit Advanced (MUA), H100H (sel.)	CMW-S100H	1202.4701.09	1
Baseband interconnection, flexible link H550N (sel.)	CMW-S550N	1202.4801.15	1
RF Converter (TRX), BW 160 MHz, H570H (sel.)	CMW-S570H	1202.5008.09	1
RF Frontend, advanced functionality, H590D (sel.)	CMW-S590D	1202.5108.03	1
CMW500 Frontpanel With Display/Keypad, H600B (sel.)	CMW-S600B	1201.0102.03	1
Solid State Drive (SSD), H052S (sel.)	CMW-S052S	1202.4201.20	1
Signaling Unit Advanced (SUA), H500I (HW opt.)	CMW-B500I	1208.7954.10	2
Data Application Unit, H450I (HW opt.)	CMW-B450I	1202.8759.10	1
Digital IQ Interface QUAD, H540I (HW opt.)	CMW-B540I	1211.2514.10	1
Multi-CMW PCIe enabler, H554N (HW opt.)	CMW-B554N	1208.8950.15	1

Extra RF Converter (TRX), BW 160 MHz, H570H (HW opt.)	CMW-B570H	1202.8659.09	3
Extra RF Frontend, advanced functionality, H590D (hw opt.)	CMW-B590D	1202.8707.03	1
Option Carrier, H660H (hw opt.)	CMW-B660H	1202.7000.09	1
Ethernet Switch, H661H (hw opt.)	CMW-B661H	1202.7100.09	1
OCXO, high stability, H690B (hw opt.)	CMW-B690B	1202.6004.02	1
6GHz Flat Rate, for up to 4 RF converters (TRXs) (SL)	CMW-PK364	1208.7319.02	1
LTE Rel.15 FDD Basic Signaling (SL)	CMW-KS505	1211.3862.02	1
LTE Rel.15 TDD Basic Signaling (SL)	CMW-KS555	1211.3885.02	1
10 GBPS Ethernet Switch	CMWC-Z70A	3628.1135K00	1
10 GBPS Ethernet Switch	CMWC-Z70A	3628.1135.00	1
Rohde & Schwarz Service Options			
CW2CMW500 WARR EXT+CAL 2Y, 2 CAL, 12M CAL INT, #4CH 3.3/6GHZ	CW2CMW500	3595.5796S07	1

CMX 5G Audio Configuration:

Designation	Туре	Order number	No.	
CMX Radio Communication Tester				
Radio Communication Tester	CMX500	1201.0002K70	1	
CMX500 Basic Assembly	CMX-PB70B	1222.0676.03	1	
Accelerator Unit	CMX-B200A	1222.0747.02	2	
Processing Unit	CMX-B300A	1222.0801.02	1	
CMX Application test feature set 1 (SL) (IMS, IPv4/6, Ping)	CMX-KA100	1222.1595.02	1	
1NR Signaling, NSA Mode Enabler Basic Level (SL)	CMX-KS600B	1222.1672.02	1	
NR Signaling, SA Mode Enabler Basic Level (SL)	CMX-KS601B	1222.2327.02	1	
Optional (required for audio quality tests)				
CMX Audio Enabler Basic (SL)	CMX-KA180	1222.4165.02	1	
CMX external Media Endpoint	CMX-ZG180A	1222.4313.02	1	
HEADSET CABLE SET	CM-Z91	1212.3050.02	1	

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