LTE Video Quality Measurements with R&S CMWrun

Application Note

Products:

- R&S®CMW500
- R&S®VTC
- R&S®VTE
- R&S®CMWrun

This application note shows how to determine the quality of a video streamed by an LTE mobile with R&S®CMW500 Radio Communication Tester and R&S®VTE Video Analyzer. The R&S®CMWrun Test Software with CMW-KT051 General Purpose and CMW-KT105 AV Difference Analysis option allows the user to easily automate these tests.

Application Note
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1 Introduction

The increasing demand for hi-res video applications for mobile phones and tablets makes it necessary to maintain the necessary data rate even under non ideal RF and IP transmission conditions. The video test system described in this application note consists of an R&S®CMW500 Wideband Radio Communication Tester and an R&S®VTE or R&S®VTC Video Tester that is controlled by the R&S®CMWrun Measurement Software with an additional VTx feature. The figure below shows this compact, but complete Video over LTE test solution. The R&S®CMW acts as an LTE base station sending a video to the DUT via RF under fading or IP impairment conditions. From the mobile device's MHL / HDMI socket the decoded video signal is fed to the R&S®VTE or R&S®VTC Video Analyzer.

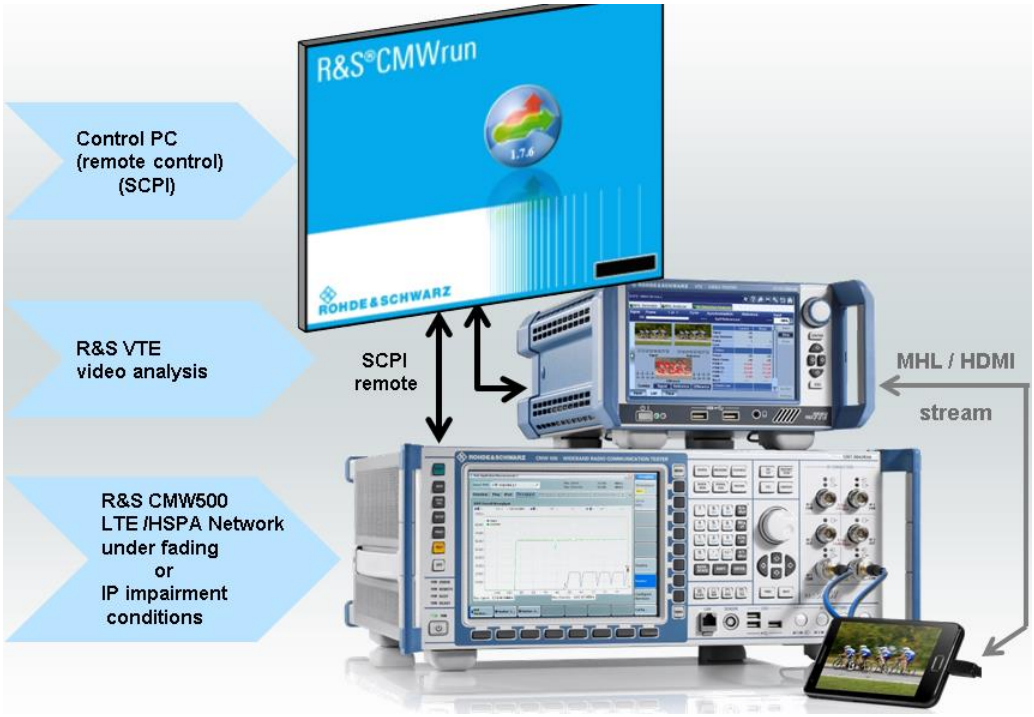


Fig. 1-1: Video Test System

The CMW-KT051 option contains functions for degrading the video data stream with fading and IP impairment, while the CMW-KT105 option contains functions for configuring and analyzing the video with an R&S®VTx Video Tester.

One characteristic for video quality is the channel capacity (kbps) over SNR (Signal to Noise Ratio) dependency.

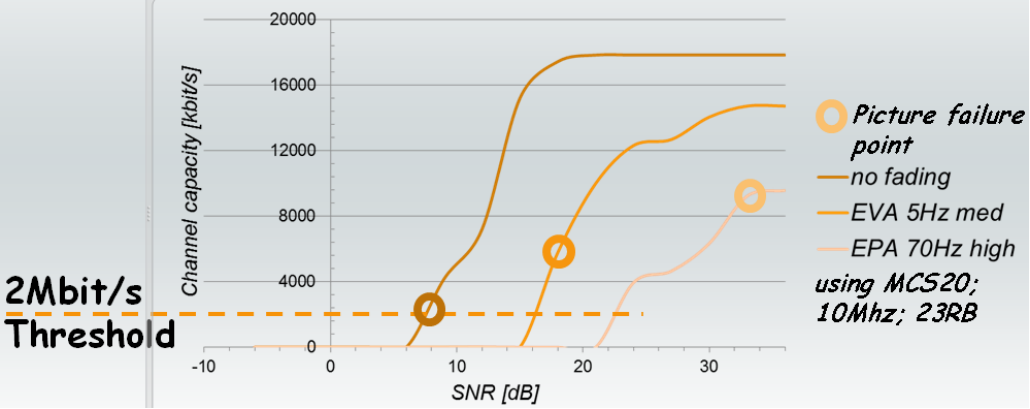


Fig. 1-2: Channel Capacity vs. SNR

With no disturber such as fading a picture fails as soon as the channel capacity drops below the threshold. With e.g. EVA 5Hz or EPA 70 Hz the picture failure point is located at significantly higher SNRs, making the signal much more sensitive to signal quality.

The following abbreviations are used in the following text for R&S® test equipment:

- The R&S®CMWrun Measurement Software is referred to as CMWrun.
- The R&S®CMW500 Wideband Communication Tester is referred to as CMW.
- The R&S®VTE Video Analyzer is referred to as VTE.
- The R&S®VTC Video Analyzer is referred to as VTC.
- The R&S®VTE or R&S®VTC Video Analyzer are referred to as VTx.
- R&S® stands for Rohde & Schwarz GmbH & Co KG.

2 Overview

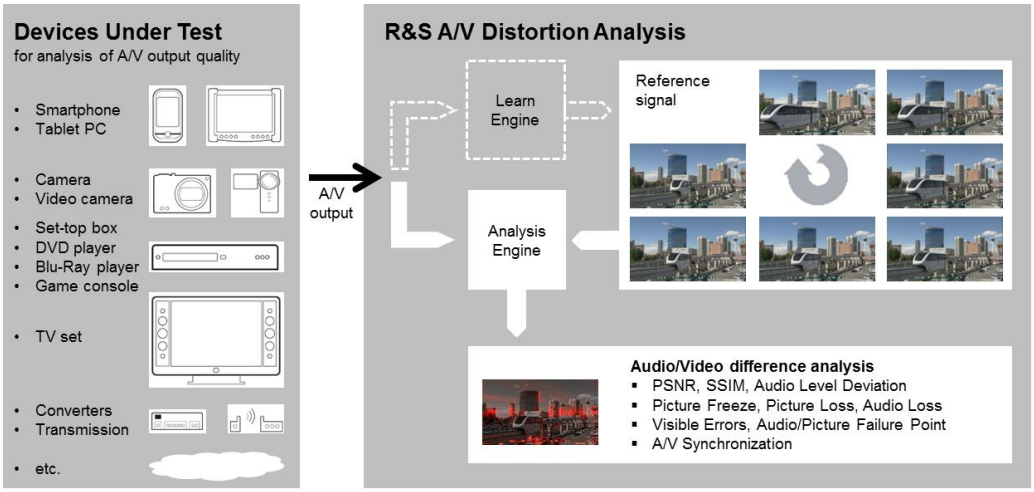


Fig. 2-1: A/V Distortion Analysis

The VTx video analyzer series A/V Distortion Analysis feature compares the video and audio output signal of a DUT with a reference Signal recorded earlier. For recording the reference signal, use the same video material and signal path. The A/V Distortion Analysis does not evaluate the absolute video and audio quality, but the deviation to a recorded reference. Using a reference signal has the advantage that all scaling happening along the video processing chain is excluded from the test. Instead the performance of the DUT is evaluated and all influence caused by erratic behavior of the DUT or disturbances can reliably be identified.

VTx AV Distortion Analysis allows 3 different methods of referencing:

- **SELF REFERENCED**: Every transmitted single image is compared to the one transmitted before. This requires no reference recording and is used for testing e.g. image stabilizers.
- **STILL PICTURE**: The DUT plays a fixed image in an endless loop. This image is saved once as reference. This method is appropriate for e.g. identifying pixel errors.
- **LOOP – APL** / **LOOP – APL SECTION** / **LOOP – TIME CODE**: Any A/V sequence with maximally 15 to 60 seconds refresh rate can be used as reference, which is kept the VTx memory during the analysis. The DUT plays the A/V sequence in an endless loop for continuous testing. The example in the following chapter uses **LOOP - TIME CODE** referencing.

In order to analyze single pixels, a frame is scaled to 720x576 pixels and transformed to the Y / Cb / Cr 4:2:0 format. This assures constant speed for the following analysis and is independent from the number of input pixels. When the input pixels are filled with RGB (red/green/blue) color information, they are equivalently recalculated in brightness Y and two color difference components Cb and Cr. Then the color difference information is under sampled twice in horizontal and vertical direction

(4:2:0), because the human eye can detect brightness much better than color information. This transformation has no effect on image deviance identification.

The video output signal of a defective DUT can differ from the reference sequence in multitude manner. Each case can be reliably be detected:

- **DIFFERING PIXELS IN A FRAME**
- **UNEXPECTED SINGLE FRAME**
  - Picture Freeze
  - Black Frames
  - Dropped Frames
- **ALTERNATING AUDIO LEVEL**
- **DEVIATING SYNCHRONIZATION**
  - Fluctuating single image refresh rate (rendering rate)
  - Delay between video and audio changes

Besides deviance quantizing, R&S A/V Distortion Analysis has the capability to interpret how intense the errors are detected by humans:

- **MOS-V** (Mean Opinion Score – Video)
- **VISIBLE ERROR**
- **PICTURE FAILURE POINT**
- **AUDIO FAILURE POINT**

The capabilities above allow easy test sequence automation for specifying visible and audible errors as fail criteria.

A further feature of the VTx A/V Distortion Analysis is to recognize so called overlays during reference sequence recording. Overlays can be control panels of the playing device, status information or logos that cover part of the video content during playback. This allows the measurement to focus on the actual video content without being disturbed by unexpected overlay content.

3 Hardware Configuration

Connect the CMWrun PC to both instruments via LAN switch. Connect the mobile device to the CMW CH1 in/out connector via RF cable or OTA (Over the Air) with a CMW-Z10 shielded chamber.

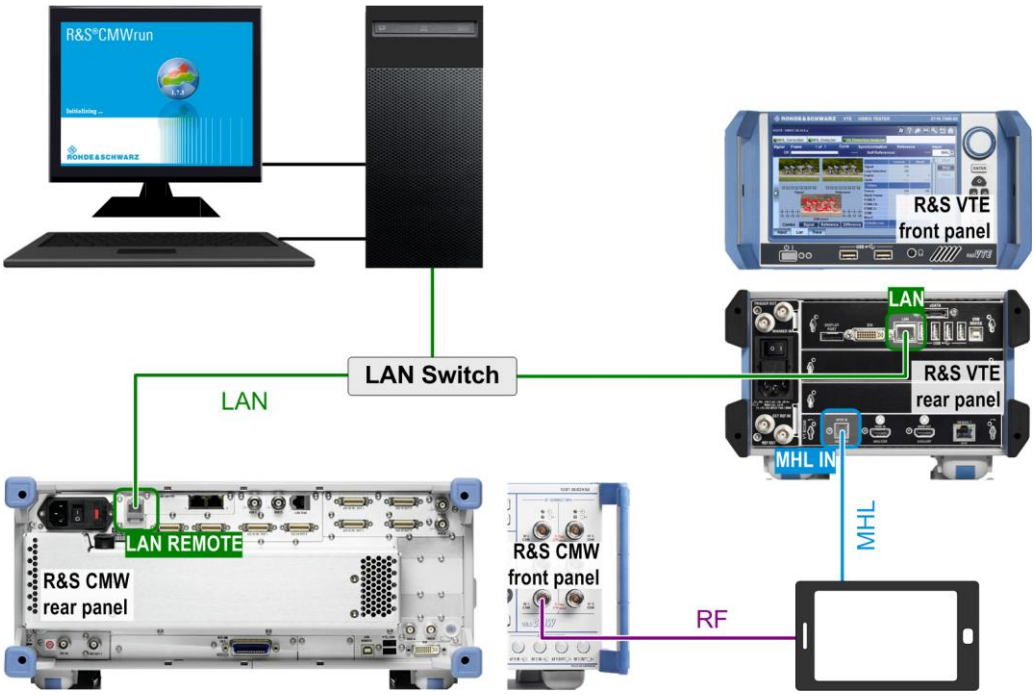


Fig. 3-1: Video Distortion Measurement Setup

To avoid conflicts, the IP addresses assigned to the computer and the two testers must use a different subnet than the Data Application Unit (DAU) installed in the CMW.

4 Software Configuration

For this application the controller PC must have CMWrun 1.7.8 or higher installed. Additionally, the CMW-KT105 VTx AV Distortion Tests and the CMW-KT051 General Purpose options need to be activated.

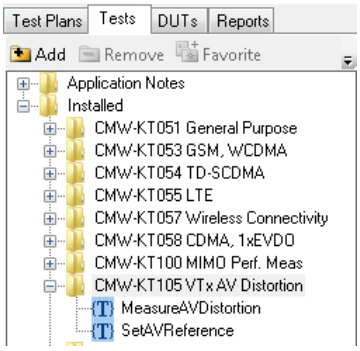


Fig. 4-1: VTx AV Distortion Functions

The CMW-KT105 VTx Distortion Tests option contains two functions:

- **SETAVREFERENCE** - Configures the referencing process of the test video. When running the test plan, the reference video is synchronized and the reference video information is evaluated. This test item needs to be performed at least once for a specific mobile & media file combination. As soon as a different media file is played or a different DUT is used, the reference file must be generated again to ensure valid and precise test results.
- **MEASUREAVDISTORTION** - Configures the settings and the execution steps for the video measurements. When running the test plan, video quality measurements by assessment between the reference video and the incoming video are performed. If a reference file already has been recorded, you can set it here and skip the preceding SetAVReference test item.

4.1 Test Results

The **REFERENCE VIDEO INFORMATION** is displayed in the **MEASUREMENT REPORT** sub tab.

4.2 Measure Video

Configure the settings and the execution steps for the video measurements. When running the test plan, video quality measurements by assessment between the reference and the incoming video are performed.

4.2.1 Test Configuration

The test case parameters for the picture failure point measurement are grouped in the **TEST PROPERTIES** dialog, see Fig. 3-7.

Reference Setup

Configure desired setup.

- **CURRENT SETUP** – Only available if the **SETREFERENCEVIDEO** test module has been executed. The reference file information is used for the VTx setup.
- **LOAD FROM FILE** – Uses a previously saved reference file for the video measurement. Select the input type. Click **LOAD** to select the reference file. In this setup the **SETREFERENCEVIDEO** test module does not have to be executed first.

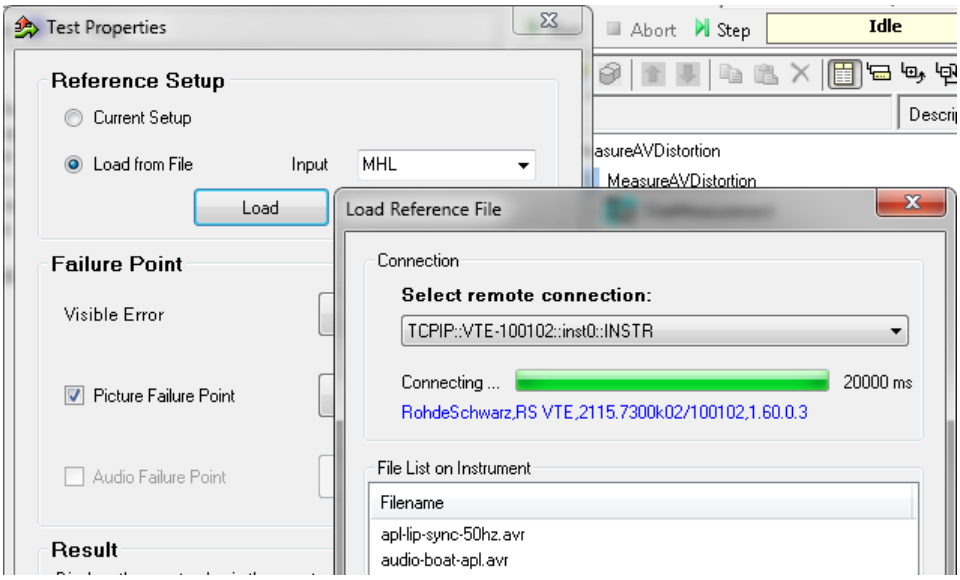


Fig. 4-2: Load Reference Setup File from instrument e.g. VTx

Failure Point

- **VISIBLE ERROR** –

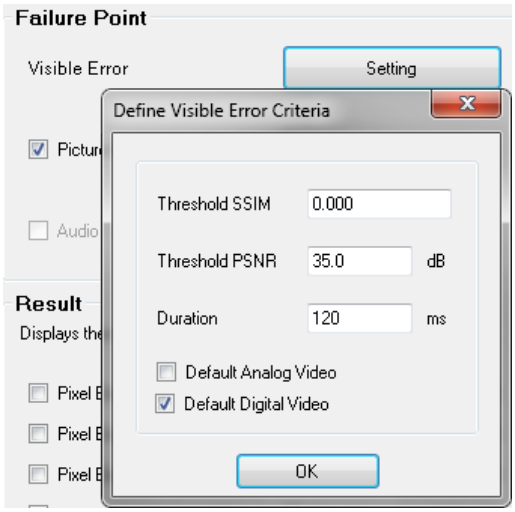


Fig. 4-3: Visible Area Failure

The following visible error criteria can be varied (see figure 4-3):

- **THRESHOLD SSIM** – Structural Similarity. Range: 0 to 100
- **THRESHOLD PSNR** – Peak Signal to Noise Ratio. Range: 0 to 100 dB
- **DURATION** – Range: 20 to 999 ms

- **PICTURE FAILURE POINT** – The picture failure point (PFP) is analyzed based on the testing conditions and the assessment criteria. The picture failure point results are determined by the number of periods with visible error. The picture failure point condition is configured with following parameters:
- **LENGTH OF PERIOD** – Range: 1 s to 60 s
- **TOTAL NUMBER OF PERIOD(S)** – Range: 1 to 99
- **GAP BETWEEN PERIODS** – Range: 0 s to 60 s
- **ALLOWED PERIODS WITH VISIBLE ERROR** – Minimum value: 0; maximum value < "Total Number of Period(s)"

Result

Configure the result items that are displayed in the test results. Select the video quality assessment criteria for testing with limit configuration. The selected items are measured during the test and the results are compared with the limit value. The selected items are displayed in the report.

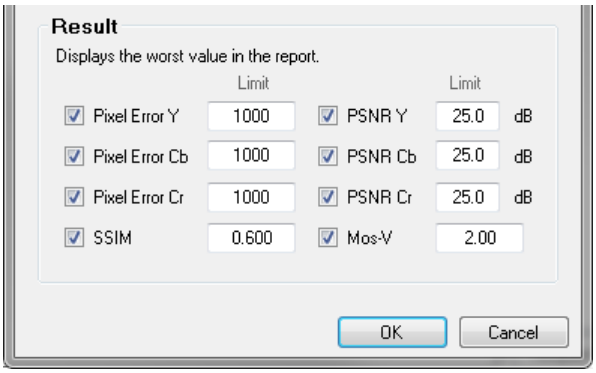


Fig. 4-4: Test Properties dialog for MeasureVideo test module

4.2.2 Test Results

The following results are displayed in the **MEASUREMENT REPORT** sub tab:

- Reference video information
- Summary of the picture failure point result
- Results selected under **RESULT** (Fig. 4-4)

MeasureVideo: Reference Video Information

Parameters			Value	Unit	Status
Reference file @ D:\VTE\UserData\Ski.avr					
Video resolution (H x V)			1920x1080		
Loop length			34.30	Sec	
Number of frames			1029		
File size			611	MB	
					Passed

MeasureVideo: Video Distortion Measurement

Test Item	Lower Limit	Upper Limit	Measured	Unit	Status
Picture Failure Point @ Length of period 10, Total Nuber of period(s) 3, Allowed periods 1					
Picture Failure					Passed
Video parameter result @ Worst value					
Pixel Error Y	---	1000	0		Passed
Pixel Error Cb	---	1000	0		Passed
Pixel Error Cr	---	1000	0		Passed
PSNR Y	25.0	---	100.0	dB	Passed
PSNR Cb	25.0	---	100.0	dB	Passed
PSNR Cr	25.0	---	100.0	dB	Passed
SSIM	0.600	---	1.000		Passed
Mos-V	2.00	---	5.00		Passed

Fig. 4-5: MeasureVideo tab, Measurement Report sub tab (test results)

5 CMWrun Test Plan

Before running a test plan, it is necessary to define the remote addresses of the involved devices CMW and VTx. Select menu **RESOURCES → SCPI CONNECTIONS …**. In SCPI Connections check the desired device and press **CONFIGURE…**.

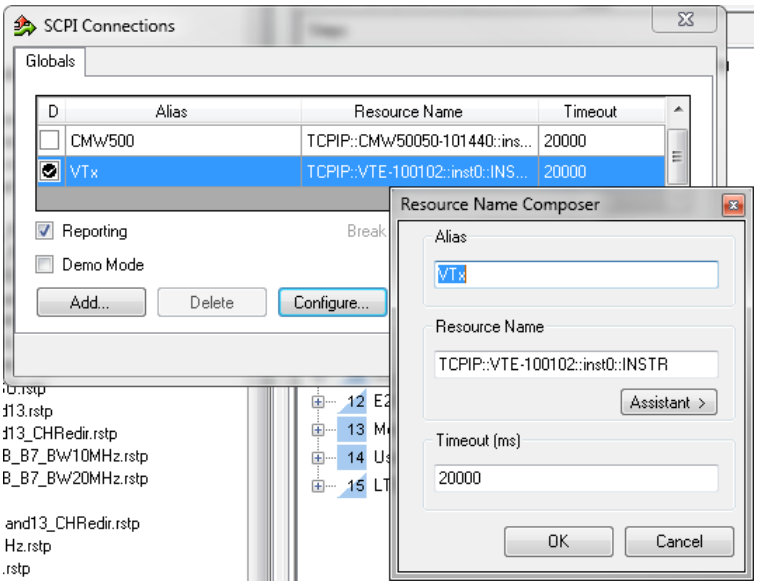


Fig. 5-1: Edit Resource Name of device

Keep the Alias default name VTx, because this is used in the demo later on. Enter the Resource Name, e.g. VTE-100102 (with correct pre- and postfix). The default Timeout (20 s) should be sufficient for most applications. Press Test Connection to check if the device is present.

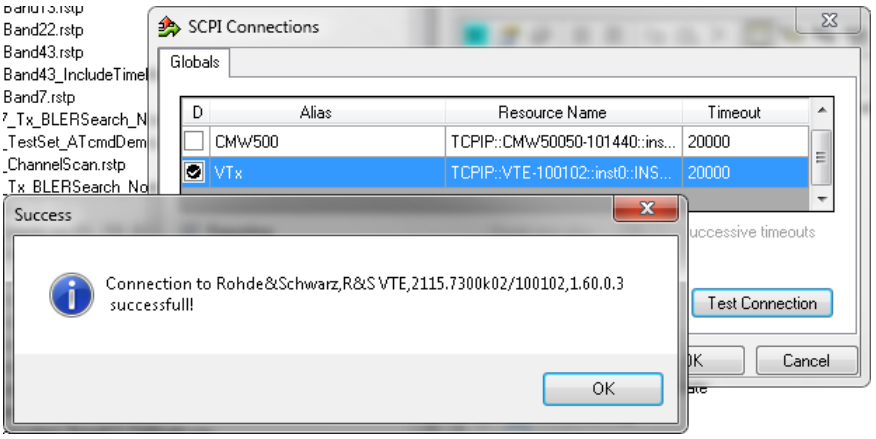


Fig. 5-2: Test Connection to device

5.1 Configuring LTE SISO Example with Fading

CMWrun version 1.7.8 and higher contains an LTE End2End example with SISO connection and fading. This example allows an easy setup and demonstrates the use of E2E (CMW-KT051 General Purpose) and video analysis (CMW-KT105 VTx AV Distortion) functions.

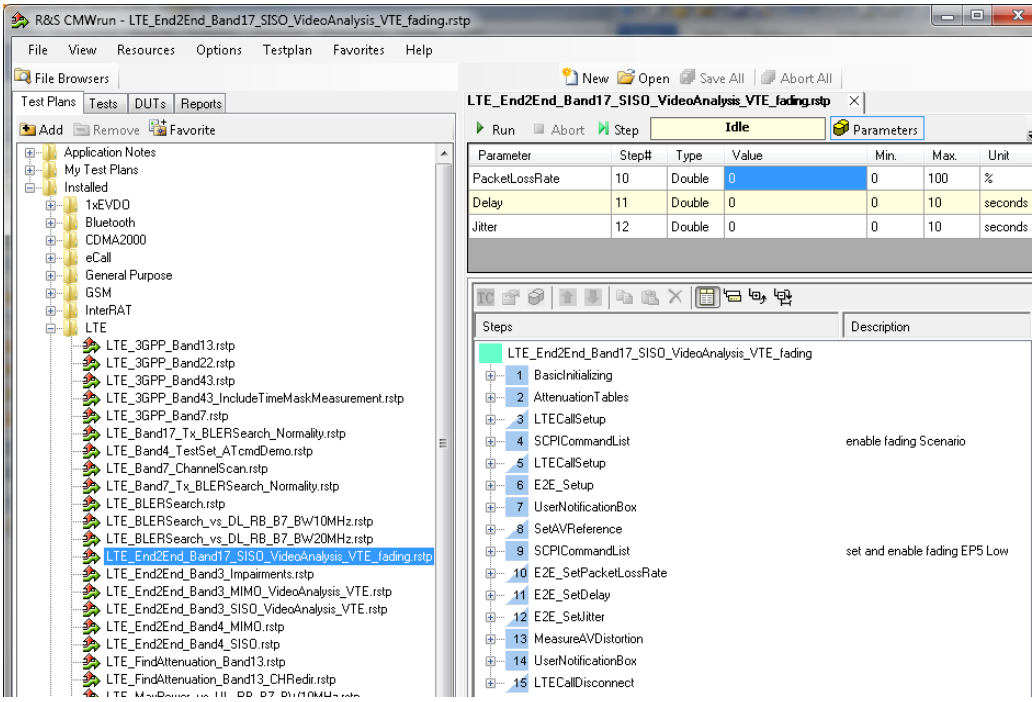


Fig. 5-3: LTE E2E SISO Fading example

In CMWrun select the menu item **TEST PLANS → INSTALLED → LTE → LTE_END2END_BAND17_SISO_VIDEOANALYSIS_VTE_FADING.RSTP** and save it as e.g. **LTE_E2E_BND13_SISO_VIDANA_VTE_FAD**.

The test steps are described below.

5.1.1 BasicInitializing

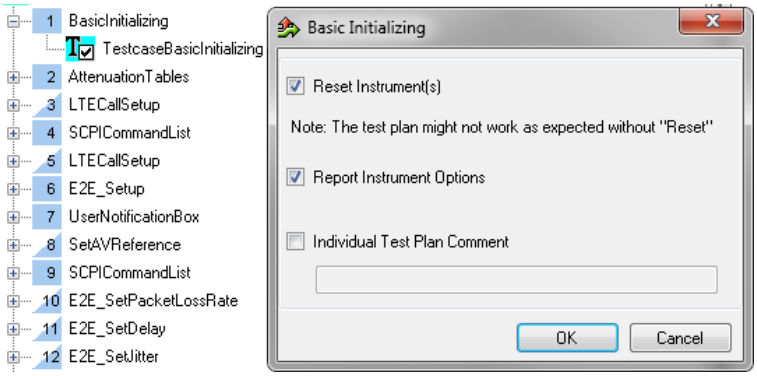


Fig. 5-4: Basic Initializing menu

- **RESET INSTRUMENTS** – If checked, all instruments in the SCPI Connections list are reset.
- **REPORT INSTRUMENT OPTIONS** – If checked, the hard- and software options of the instruments from the SCPI Connections appear in the test report.
- **INDIVIDUAL TEST PLAN COMMENT** – Allows to add a comment which appears in the test plan.

5.1.2 AttenuationTables

Compensates input and output cable losses. Only active when **APPLY** is checked. In this example setup the cable loss is 1.5 dB for downlink and uplink.

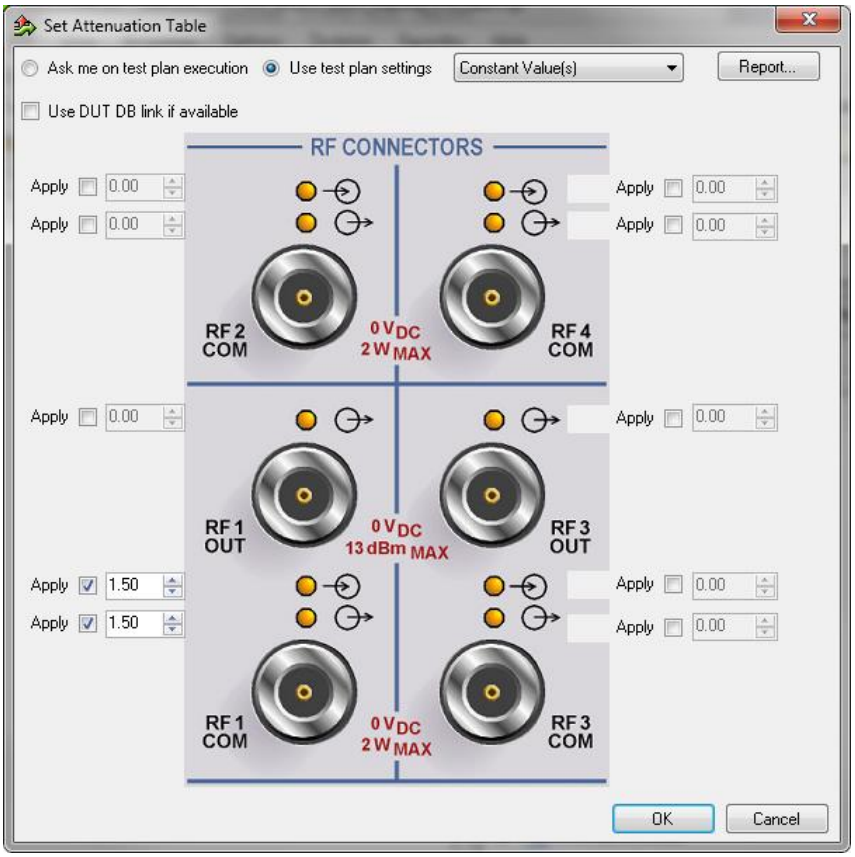


Fig. 5-5: Set Attenuation Table

5.1.3 LTE Call Setup (Configure BS)

Configures the UE (User Equipment) calling parameters. Please note that the base station is only configured in this step and will be turned ON later.

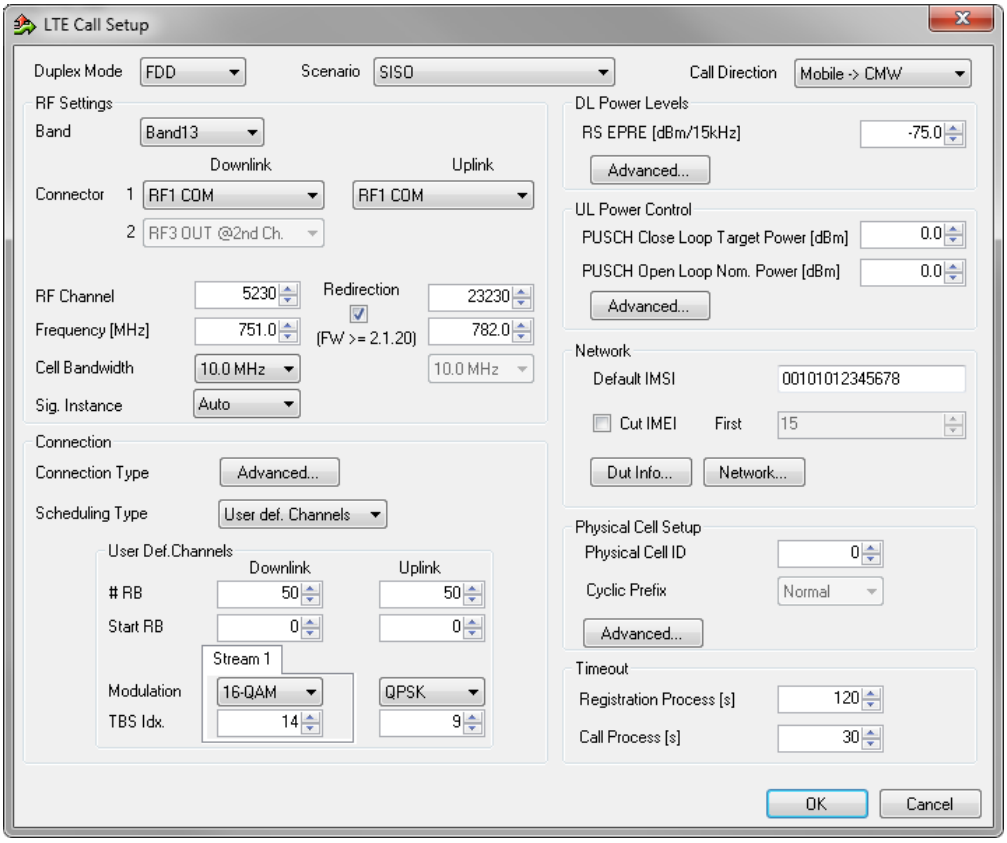


Fig. 5-6: LTE Call Setup

The connection parameters used here (Resource Blocks 50, 16-QAM, TBS Index 14) allow 14.111 Mbps maximum throughput.

5.1.4 SCPICommandList (Turn CMW Fading ON)

Contains SCPI command for turning ON the CMW500 internal fading. This must be done before the call is established or else the call may be dropped by the DUT unexpectedly.

5.1.5 LTECallSetup (Turn BS ON)

Turns on the base station and then notifies the operator to power ON the DUT, attaches to the mobile and reports the DUT info.

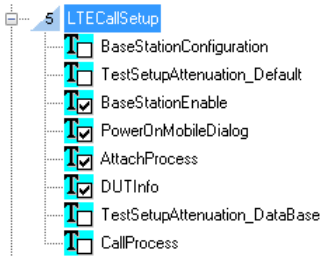


Fig. 5-7: Base station ON and mobile attach

5.1.6 E2E Setup

In this dialog the IP address of the End 2 End data application is configured. The IPv4 address is automatically determined by the CMW500 network.

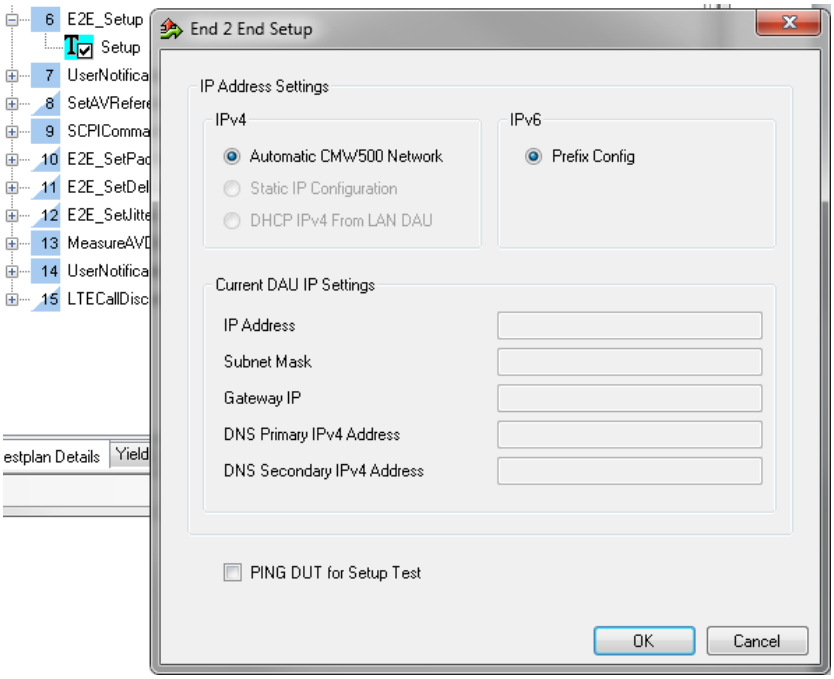


Fig. 5-8: End 2 End Setup

5.1.7 UserNotificationBox (Start Video on Mobile)

Notifies the operator to start the video player on the mobile device (select video streaming app, e.g. Daroon Player, VLC for Andriod, etc.).

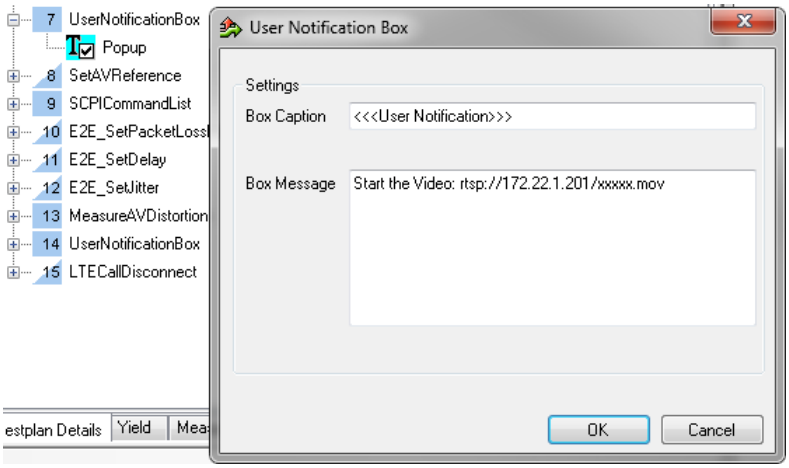


Fig. 5-9: User Notification Box

Start the video streaming player on the mobile. Select and play one of the videos from CMW500 network server **RTSP://172.22.1.201**.

Note: The video files from the CMW-KT105 option (**TALK-360P_25HZ_200KBPS.MOV**, **TALK-480P_25HZ_1MBPS.MOV**, **TALK-720P_25HZ_10MBPS.MOV** and **TALK-720P_25HZ_5MBPS.MOV**) must be copied to the CMW network drive **DAU SAMBA SERVER (Z:)\MULTIMEDIA** directory first. It is necessary that the media player on the LTE device can play the video in **LOOPED MODE** (not supported by all media players).

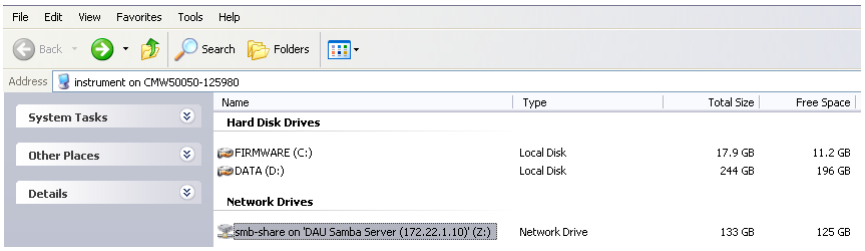


Fig. 5-10: CMW DAU network drive for multimedia files

5.1.8 SetAVReference

Configures the input, synchronization area to extract the time code from the reference frames for comparison with the corresponding target frames.

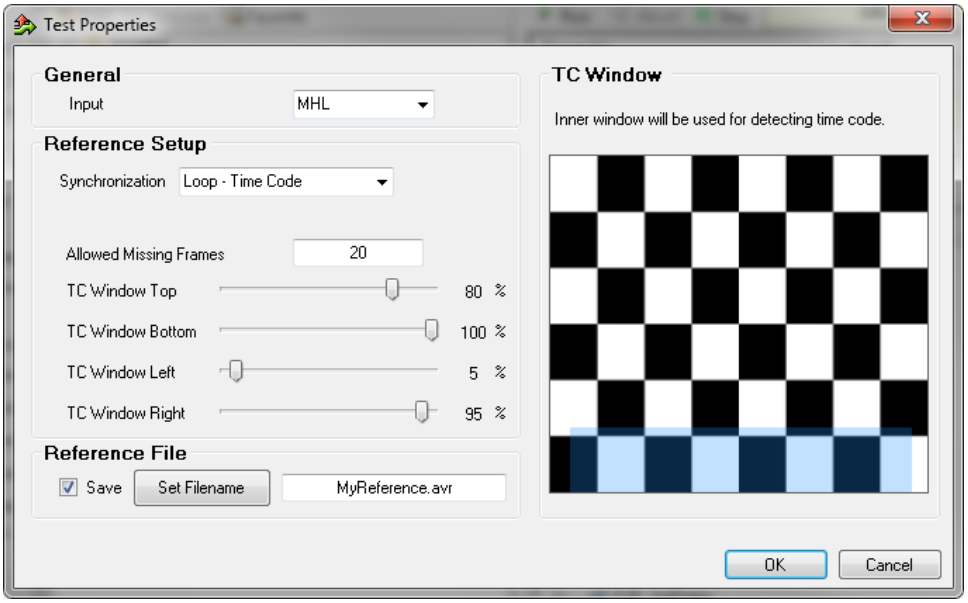


Fig. 5-11: Set AV Reference

In this example, a mobile with an MHL connector is used. It is convenient to use **LOOP – TIME CODE** synchronization with a mobile device, since frames can get lost, making the reference measurement useless. The lower 20% of a frame are usually used to insert the time code (usually invisible for the viewer).

When a particular video file is used for the first time, it is convenient to save it as reference file (*.avr). Check the **SAVE** check box and press **SET FILENAME**.

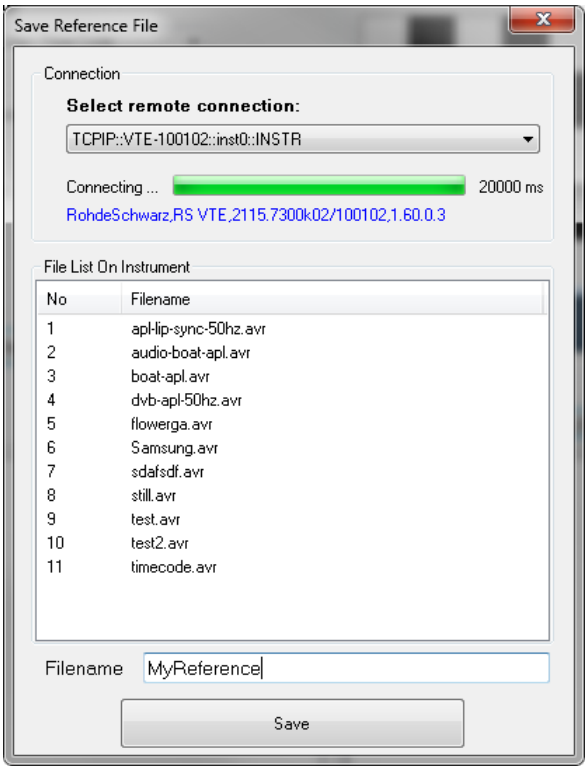


Fig. 5-12: Save Reference File

The file is saved in D:\VTE\USERDATA\ (VTE) or D:\VTC\USERDATA\ (VTC). The information about reference video also appears in the measurement report.

SetReferenceVideo: Reference Video Information

Parameters			Value	Unit	Status
Loop - Time Code					
Video resolution (H x V)			1920x1080		
Loop length			34.30	Sec	
Number of frames			1029		
File size			611	MB	
					Passed

Fig. 5-13: Reference Video Information

5.1.9 SCPICOMMANDLIST (Enables EP5Low fading on CMW)

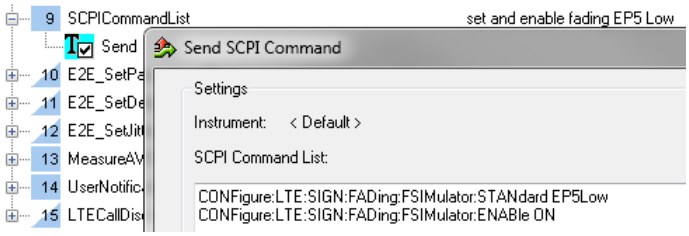


Fig. 5-14: Enables EPA 5Hz Low fading

The CMW allows numerous internal fading standards:

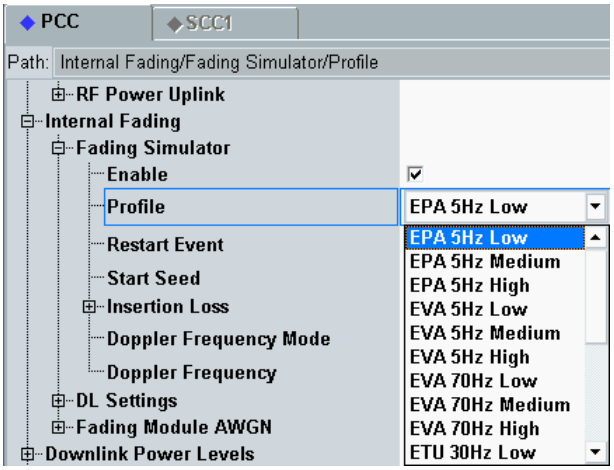


Fig. 5-15: CMW internal fading standards

Please refer to the CMW user manual for the appropriate SCPI commands.

5.1.10 E2E_SetPacketLossRate

IP impairment function that simply ‘loses’ a defined amount of data blocks.

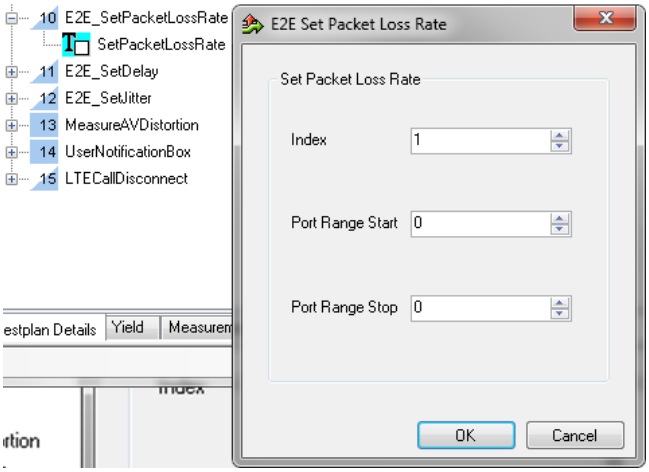


Fig. 5-16: E2E Set Packet Loss Rate

5.1.11 E2E_SetDelay

IP impairment function that delays the video data blocks by a defined duration.

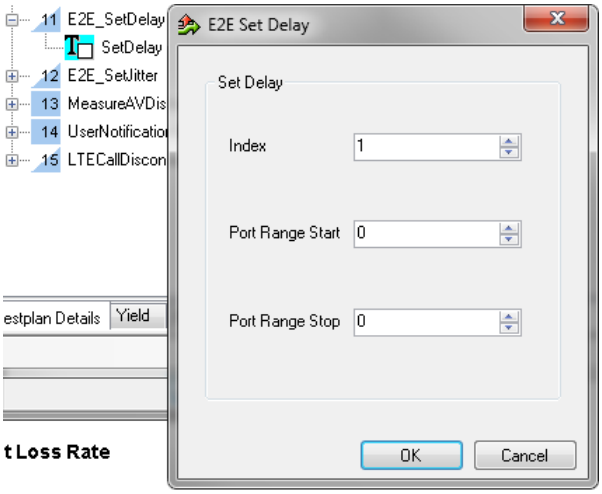


Fig. 5-17: E2E Set Delay

5.1.12 E2E_SetJitter

IP impairment function that alternates the video data block delay according to a defined sequence.

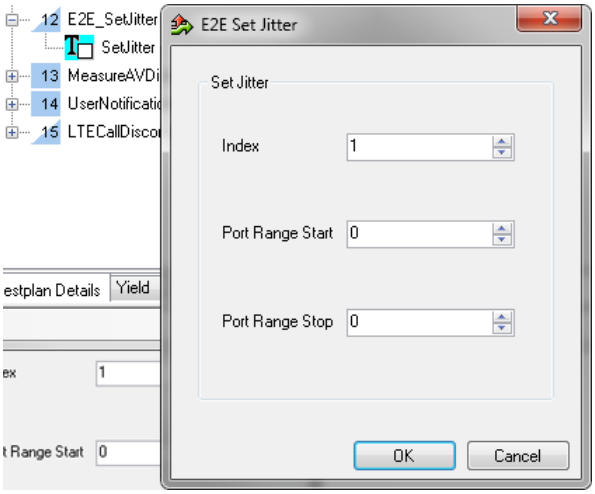
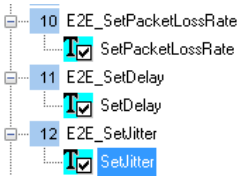


Fig. 5-18: E2E Set Jitter

The E2E functions are activated by checking SetPacketLossRate, SetDelay and SetJitter.



The corresponding parameters are set in the **PARAMETER TABLE**.

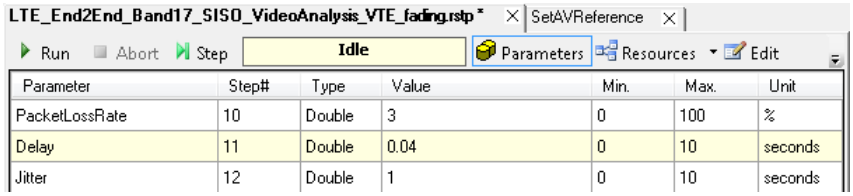


Fig. 5-19: Parameter Table

The E2E function parameter can be identified easily by adding an according comment.

Fig. 5-20: E2E Functions with Comments

5.1.13 MeasureAVDistortion

Configures the used reference, failure points and the test limits.

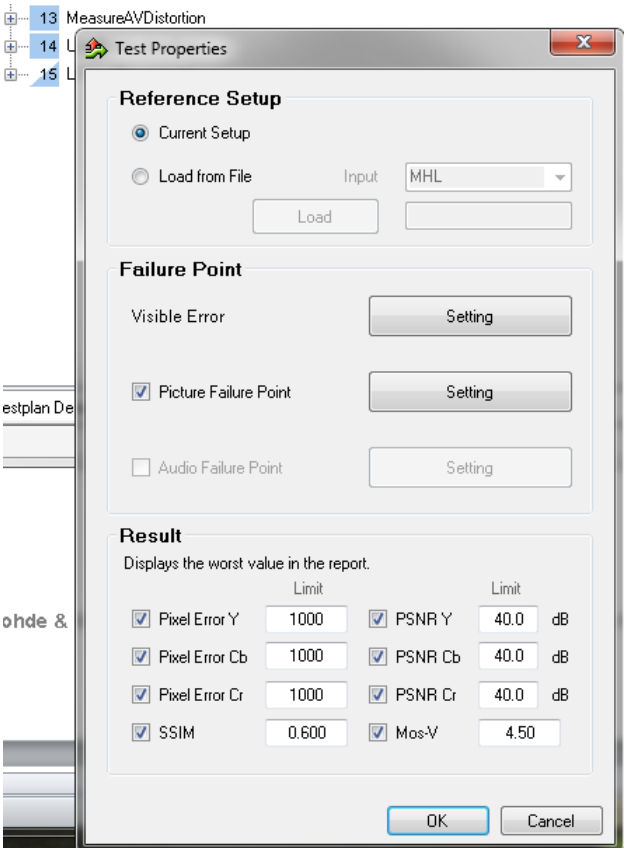


Fig. 5-21: Measure AV Distortion

5.1.13.1 Reference Setup

Determines if the current setup of the VTx is used or if a defined Reference File is loaded. If a reference file is available the preceding test SetAVReference does not need to be carried out.

5.1.13.2 Failure Point

- **VISIBLE ERROR**

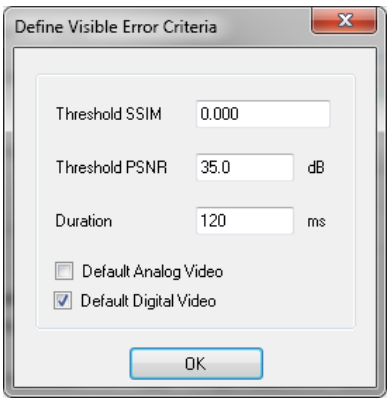


Fig. 5-22: Visible Error Failure

Following visible error criteria can be varied (see figure 5-22):

- **THRESHOLD SSIM** – Structural Similarity. Range: 0 to 100
- **THRESHOLD PSNR** – Peak Signal to Noise Ratio. Range: 0 to 100 dB
- **DURATION** – Range: 20 to 999 ms

- **PICTURE FAILURE POINT** – The picture failure point (PFP) is analyzed based on the testing conditions and the assessment criteria. The PFP results are determined by the number of periods with visible error.

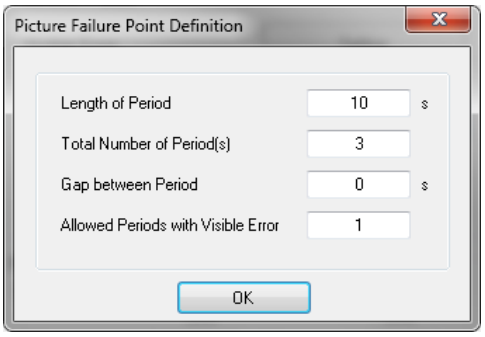


Fig. 5-23: Picture Failure Point

The PFP condition is configured with following parameters:

- **LENGTH OF PERIOD** – Range: 1 s to 60 s
- **TOTAL NUMBER OF PERIOD(S)** – Range: 1 to 99
- **GAP BETWEEN PERIODS** – Range: 0 s to 60 s
- **ALLOWED PERIODS WITH VISIBLE ERROR** – Minimum value: 0; maximum value < "Total Number of Period(s)"

5.1.13.3 Result

The checked items are measured during the test and the results compared to the limit values.

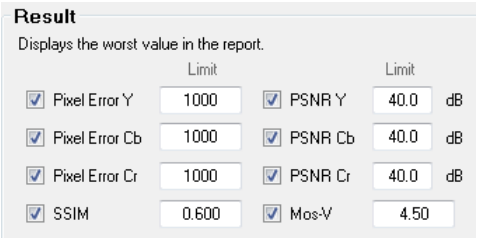


Fig. 5-24: Result Items

5.1.14 USERNOTIFICATIONBOX (Stop video playback on DUT)

This notifies the user to stop the video player on the mobile phone.

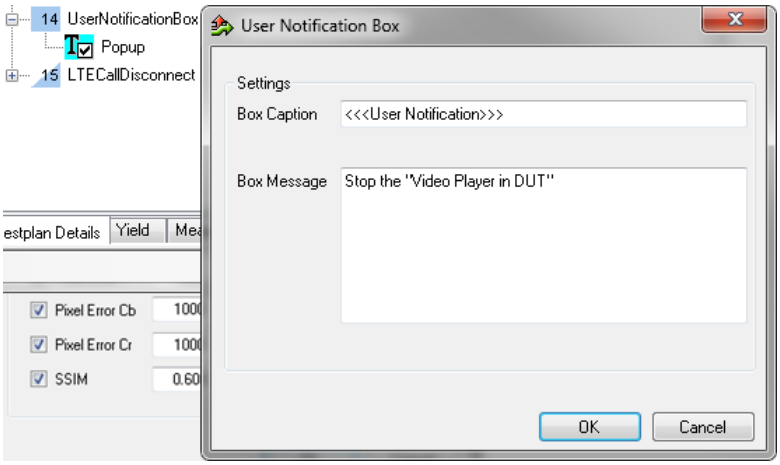


Fig. 5-25: User Notification Box

5.1.15 LTECallDisconnect

CMW terminates the call and turns OFF the base station emulation.

Fig. 5-26: LTE Call Disconnect

5.2 Running the Test

The test can be started either by clicking on the **RUN** button or pressing **F5**.

Fig. 5-27: Run Test

After the instruments have been reset and configured, a message appears, telling you to power OFF and the ON again the DUT. This ensures that the LTE call procedure always starts from a defined point.

Fig. 5-28: Power mobile OFF and ON

A message appears to inform you that the appropriate video for the test can now be started / streamed for playback.

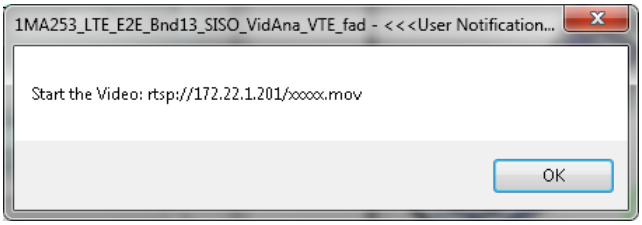


Fig. 5-29: Start video

For this example the **DAROON** player was used. Select Streams and add the full path and name to the favorites list, e.g. **RTSP://172.22.1.201/TALK-720P_25HZ_5MBPS.MOV** and start the video.

Now the video is referenced under ideal conditions (no fading or ip impairment) which is also stated with the following message:

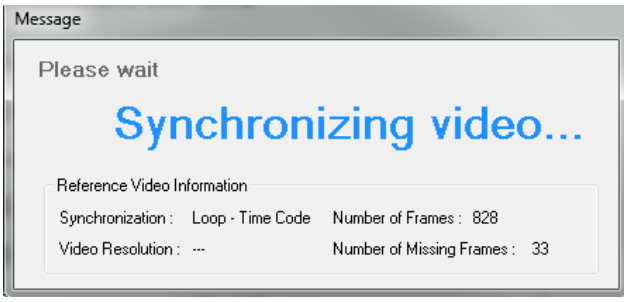


Fig. 5-30: Synchronizing video for reference measurement

After the reference video has been recorded, the disturbing effects, like fading, IP packet loss rate, delay and jitter are turned ON. In this example all effects run simultaneously. Other test cases might vary only one effect for obtaining the correlation between video quality and e.g. delay.

During the A/V distortion measurement a timer display the current time remaining.

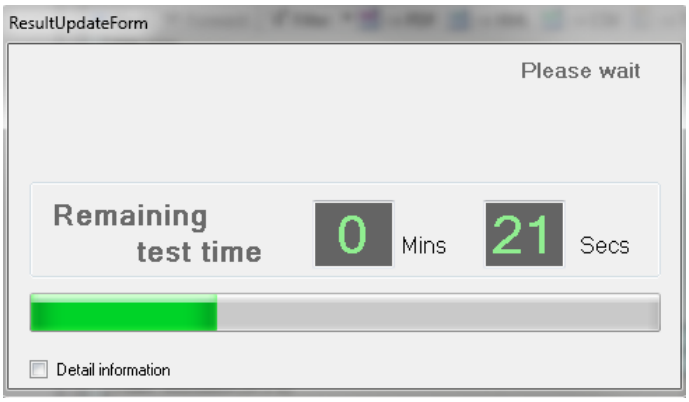


Fig. 5-31: Remaining test time

After the test, please stop the video player on the mobile phone.

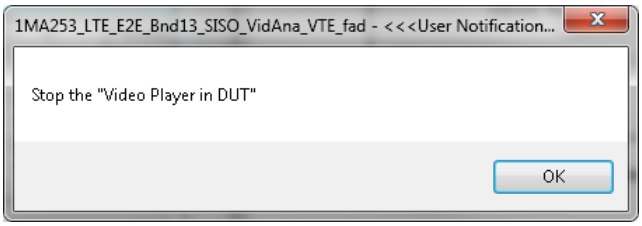


Fig. 5-32: Stop video player on mobile phone

As was shown with this example, it is very straight forward to run even complex video test scenarios using a CMWrun test plan.

In the last step a measurement report (similar to this one) is generated.

Measurement Report

ROHDE&SCHWARZ

Report Info:

Date: 8/5/2014 12:30:57 PM

Device Under Test:	*n/a*
Serial No. (Dec. IMEI):	*990003358866818*
Testplan:	*C:\Users\gerlac_o\Documents\CMWrun Files\My Test Plans\1MA253_LTE_E2E_Bnd13_SISO_VidAna_VTE_fad.rstp*
User:	*gerlac_o*
Comment:	
Test Executive:	*R&S CMWrun 1.7.8*
Instrument ID 1:	*Rohde&Schwarz,CMW,1201.0002k50/124980,3.2.50*
Options:	*H051F, H052F, H054B, H055H, H090A, H100A, H110A, H200A, H200A, H210A, H210A, H220A, H220A, H230A, H270A, H300B, H300B, H400B, H405A, H450B, H510F, H550M, H570B, H570B, H590D, H600B, H605A, H612B, H660A, H661A, H690B, KB036, KB036, K0, K998, K998, K998, K998, KA100, KA150, KA700, KAA10, KAA20, KC001, KC002, KC003, KC004, KC005, KC006, KC007, KC008, KC009, KC010, KC011, KC012, KC013, KC015, KC016, KC017, KC018, KC020, KC021, KC023, KC024, KC025, KC026, KC027, KC031, KC033, KC036, KC050, KC051, KC052, KC060, KC061, KC065, KC066, KC070, KC071, KC075, KC201, KC202, KC203, KC204, KC205, KC206, KC207, KC208, KC209, KC210, KC211, KC212, KC213, KC214, KC215, KC221, KC222, KC223, KC231, KC232, KC233, KC241, KC280, KC290, KC401, KC402, KC403, KC404, KC405, KC406, KC407, KC408, KC420, KC421, KC422, KC423, KC424, KC425, KC426, KC427, KC428, KC429, KC430, KC431, KC432, KC433, KC434, KC435, KC436, KC437, KC501, KC502, KC503, KC504, KC505, KC506, KC507, KC508, KC509, KC510, KC511, KC512, 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KW751, KW800, KW800, KW800, KW800, KW880, KW880, KW880, KW880,*
Instrument ID 2:	*R&S VTE 1.60.0.3*
Options:	*"VT-B2350, VT-B2351, VT-B2360, VT-B2361, VT-B360, VTE_DEMO_OPTION-K0, VTE_DEMO_OPTION-K0, VTE_DEMO_OPTION-K0, VT-K2100, VT-K2101, VT-K2110, VT-K2111, VT-K2150, VT-K2355, VT-K2356, VT-K2366, VT-K355, VT-K362, VTE, RsVte, FWA AudioAnalyzer, FWA BroadcastModulator, FWA DistortionAnalyzer, FWA HDMIAnalyzer, FWA HDMIGenerator, FWA MHLAnalyzer, FWA MHLGenerator, FWA VideoAnalyzer"*

Summary:

Test Start Time:	*8/5/2014 12:30:57 PM*
Test End Time:	*8/5/2014 1:44:54 PM*
Total Test Time:	*01:13:57*
Weighted Test Time:	*01:13:57*
Test Items Passed:	*13*
Test Items Failed:	*0*
Number of Test Items:	*13*

Basic Initiation: Initialization of Instrument.

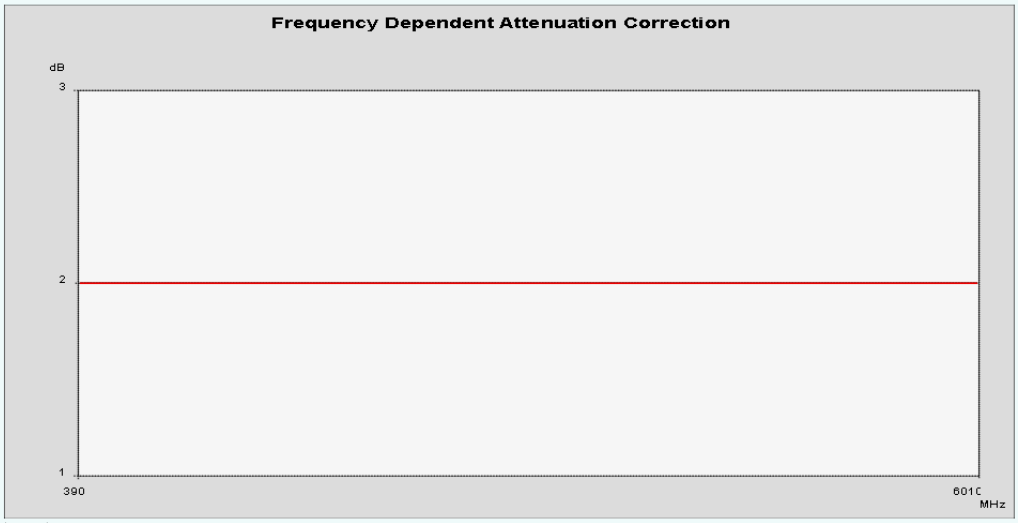
Instrument reset:
CMW - Done !

Attenuation Tables: Read Tables

Frequency Dependent Attenuation Correction			Table		
Connector (Read)					
RF1 COM *IN*			""		
RF1 COM *OUT*			""		
RF1 OUT			""		
RF2 COM *IN*			""		
RF2 COM *OUT*			""		

Attenuation Tables: Set Tables

Frequency Dependent Attenuation Correction			Table		
Connector (Set)					
RF1 COM *IN*			"Const_1p50dB"		
RF1 COM *OUT*			"Const_1p50dB"		
RF1 OUT			""		
RF2 COM *IN*			""		
RF2 COM *OUT*			""		



LTE Call Setup: Base Station Configuration

LTE FDD, Band13
DL Channel 5230, DL Frequency 751, DL Cell Bandwidth 10.0 MHz
UL Channel 23230, UL Frequency 782, UL Cell Bandwidth 10.0 MHz
Connection Type: Data Application
Call Direction: Mobile -> CMW

SCPI Command List: Send

--> ROUTe:LTE:SIGN1:SCENario:SCFading:INTernal:FFADer RF1C,RX1,RF1C,TX1

LTE Call Setup: Base Station Enable

Base Station Enabled in 24.9s

LTE Call Setup: Power On Mobile Box

LTE Call Setup: Attach Process

Attach Process		Timeout	Elapsed Time	Unit	Status
Attached		120	38.1	s	Passed

LTE Call Setup: DUT Info

Test Item	Lower Limit	Upper Limit	Measured	Unit	Status
DUT Info					
IMEI	---	---	990003358866818	---	Passed

End2EndSetup: End 2 End Setup

DAU data connection process			Elapsed Time	Unit	Status
Mobile IP address: 172.22.1.100; RAN: LTE @ Band 13 / UL ch.: 23230 - DL ch.: 5230					
PING check to mobile IP address:	---	---	0.2200748	s	

SetAVReference: Reference Video Information

Parameters			Value	Unit	Status
Loop - Time Code					
Video resolution (H x V)			---		
Loop length			---	Sec	
Number of frames			1185		
File size			703	MB	
					Passed

Reference file is saved. - D:\VTE\UserData\MyReference.avr

SCPI Command List: Send

–> CONFigure:LTE:SIGN:FADing:FSIMulator:STANdard EP5Low
–> CONFigure:LTE:SIGN:FADing:FSIMulator:ENABle ON

MeasureAVDistortion: Reference Video Information

Parameters			Value	Unit	Status
Reference file @ D:\VTE\UserData\MyReference.avr					
Video resolution (H x V)			0x0		
Loop length			39.50	Sec	
Number of frames			1185		
File size			703	MB	
					Passed

MeasureAVDistortion: Video Distortion Measurement

Test Item	Lower Limit	Upper Limit	Measured	Unit	Status
Picture Failure Point @ Length of period 10 sec, Total Nuber of period(s) 3, Allowed periods 1					
Picture Failure					Passed
Video parameter result @ Worst value					
Pixel Error Y	---	1000	0		Passed
Pixel Error Cb	---	1000	0		Passed
Pixel Error Cr	---	1000	0		Passed
PSNR Y	40.0	---	100.0	dB	Passed
PSNR Cb	40.0	---	100.0	dB	Passed
PSNR Cr	40.0	---	100.0	dB	Passed
SSIM	0.600	---	1.000		Passed
Mos-V	4.50	---	5.00		Passed

LTE Call Disconnect: Base Station disable

Base Station disabled in 1.1s

6 Literature

[1] Application Note 7BM84, “R&S®Time Code Inserter: AV Distortion Analysis of Every Video Format”

[2] Application Note 7BM87, “R&S A/V Distortion Analysis – Inspecting Output Quality of Audio and Video Devices”

[3] Application Note 1MA119 "R&S VTx Manual"

7 Ordering Information

Ordering Information		
Wideband Radio Communication Tester		
R&S®CMW500	**Wideband Radio Communication Tester**	**1201.0002K50**
CMW-PS503	Basic Assembly (mainframe), 70 MHz to 3.3 GHz	1208.7154.02
CMW-S550B	Basic Interconnection, flexible link, for non-signaling, signaling and IQ access	1202.4801.03
CMW-S590A	RF front end, advanced functionality	1202.5108.02
CMW-S600B	CMW500 front panel with display/keypad	1202.0102.03
CMW-B570B	RF Converter (TRX)	1202.5008.03
CMW-S100A	Baseband Measurement Unit, 1 GB memory	1202.4701.02
CMW-B300B	Signaling Unit Wideband (SUW), for WCDMA / LTE	1202.6304.02
CMW-B450D	Data Application Unit, H450A	1202.8759.05
CMW-B660A	Option Carrier	1202.7000.02
CMW-B661A	Ethernet Switch Board	1202.7100.02
CMW-B690B	OCXO, high stability	1202.6004.02
CMW-PK45	E2E Bundle including IP Enabler, IMS, and IP Measurements and Analysis	1207.6354.03
CMW-KS500	LTE FDD Release 8, SISO, signaling/network emulation	1203.6108.02
CMW-KS510	LTE Release 8, SISO, signaling / network emulation, advanced functionality	1203.9859.02
Video Analyzer		
R&S®VTE	Video Test Center	2115.7400.02
R&S®VTC	Video Tester	2115.7300.02
R&S®VT-B2350	MHL Analyzer/Generator Module	2115.7622.06
R&S®VT-B2360	HDMI Analyzer Module 225 MHz (optional)	2115.7616.06
R&S®VT-B2361	HDMI Analyzer Module 300 MHz (optional)	2115.7639.06
R&S®VT-B360	HDMI Generator Module (optional)	2115.7500.06
Measurement Software		
CMWPC	PC based CMW applications	1201.0002.90
CMW-KT051	R&S®CMWrun sequencer tool, CMWrun generic proposal	1203.4157.02
CMW-KT055	R&S®CMWrun sequencer tool, LTE applications	1207.2107.02

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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