

Cellular

Analog FXS & FXO

Acoustic

VoIP

ISDN PRI

xDSL

T1/E1

Using TCA for Testing Through Transmission Equipment

Application Note



version 1.3
November 2009



HERMON LABORATORIES

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Overview

The tests for Through Transmission Equipment, defined in telecommunication standards, are applicable to the equipment that provides a transmission path connecting two or more network facilities. Through Transmission Equipment usually has at least two different interfaces, for example, analog, digital, or VoIP interfaces. Examples of this kind of equipment are channel banks (T1/E1 to FXS converters), PBXs (Private Branch Exchanges), IP-PBXs, VoIP gateways and small VoIP gateways with one or two FXS ports known as ATAs (Analog Telephone Adapter).

In this document, tests of Through Transmission Equipment are called ***Through Transmission Tests***.

Examples of through transmission tests include:

- through-transmission gain test
- through-transmission level test
- through-transmission SF (Single Frequency) cutoff test
- loss plan,
- idle channel noise measurements

To carry out through transmission tests, the testing equipment must be able to set-up the appropriate voice transmission path through the Equipment Under Test (EUT). The Telecom Conformance Analyzer 8200 (TCA) provides several different interfaces and a powerful signaling configuration feature which enables creation of voice transmission paths.

The purpose of current document is to explain how to configure the TCA and connect it to the EUT in order to perform through transmission tests.

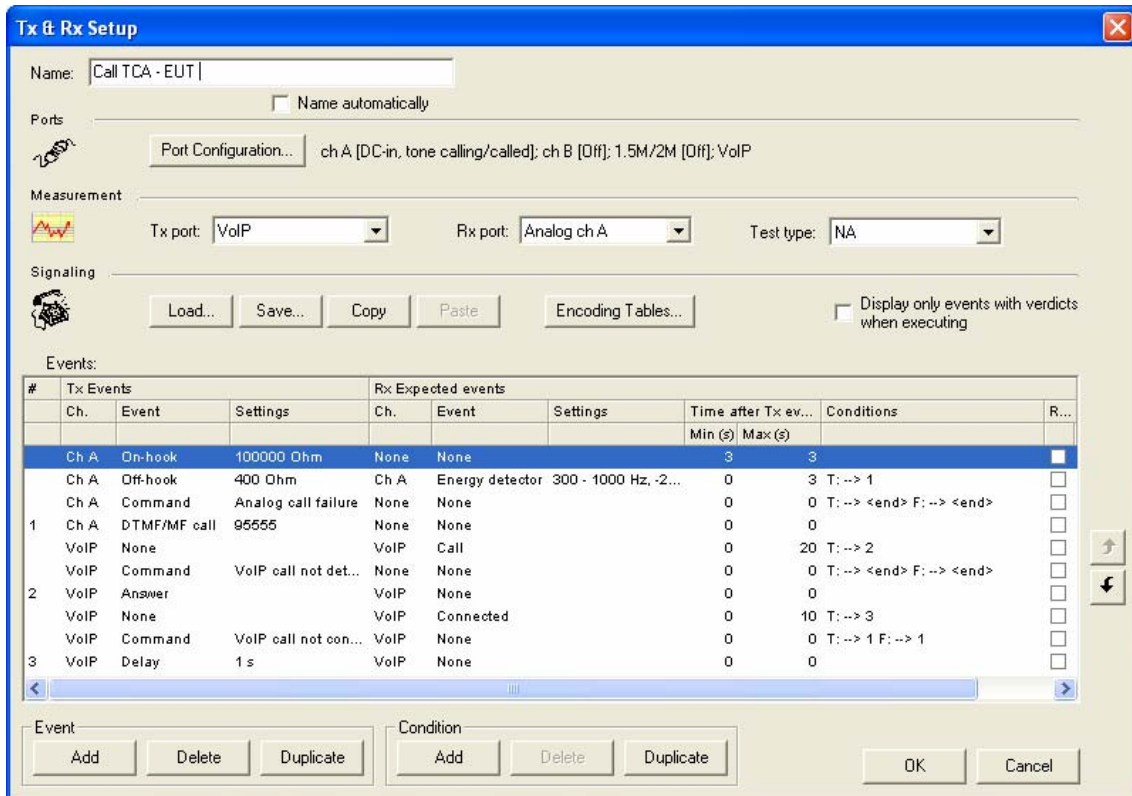
Tx and Rx Ports

To carry out through transmission tests, first establish a transmission path between two interfaces of the EUT. For this purpose, connect the TCA's Tx and Rx ports to the EUT and configure the EUT according to the product specifications.

- The Tx port is used as the source of the stimulus signal (i.e. transmitted to the "input" of the EUT).
- The Rx port is where the measurement signal is received by TCA (i.e. received from the "output" of the EUT).

Use the Tx & Rx Setup screen to configure the voice transmission path.





Tx Rx Setup Screen

To begin configuration:

1. Open **Test Properties**.
2. Select the **Conditions** tab.
3. Click **Tx & Rx Setup**.
4. Click **Settings Field**.

The two most relevant controls are:

- **Port Configuration**
Defines input/output ports for the test measurements.
- **Signaling**
Defines how the voice path is established on the EUT.

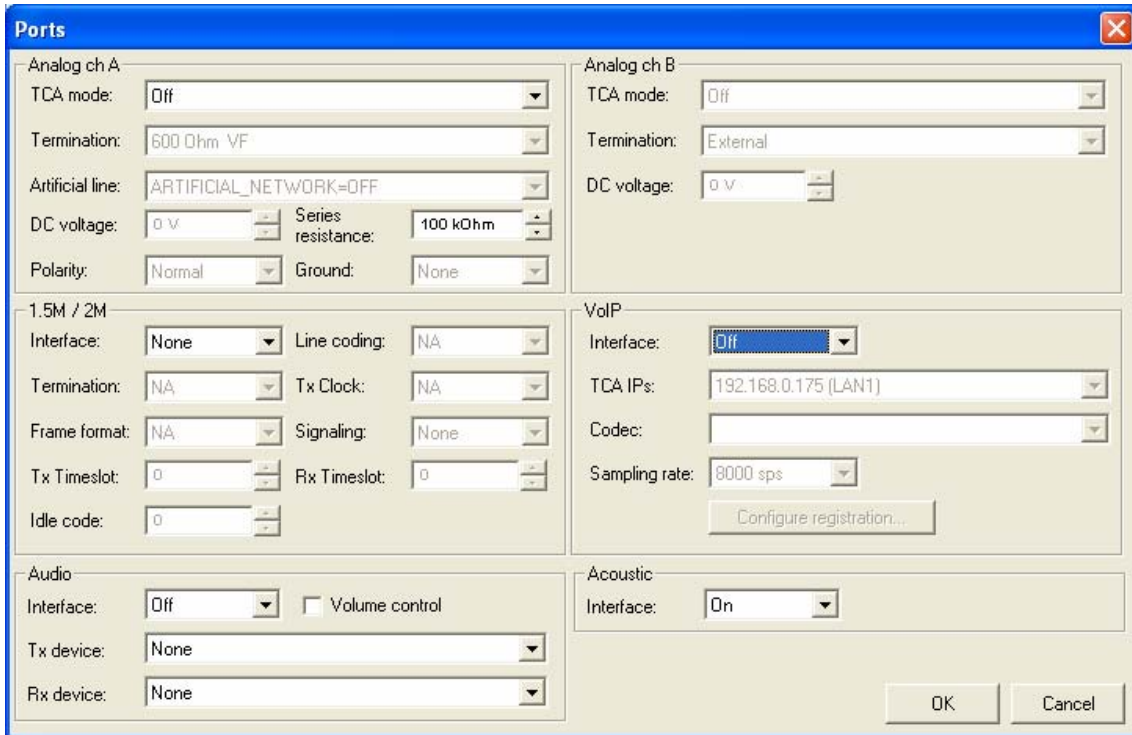
Configuring Ports

Use the Ports Configuration screen to configure the settings for each port used in the test signaling procedure. Access the Ports Configuration screen by clicking **Port Configuration** in the Tx & Rx Setup screen.

Alternately, access the Ports Configuration screen through the Signaling procedure. Use System branch in the main tree – Signaling , select Standard or User signaling, then Properties, – and click Port configuration in the Signaling procedure. In that case,

when signaling procedure is copied or loaded, the Port Configuration can be changed to match the port configuration of the source signaling procedure.

NOTE: A detailed list of possible EUT interfaces and corresponding TCA port selection and/or configuration is provided in Appendix A and in the TCA online Help.



Ports Dialog Box

Port Types and Options

The following port types are supported by the TCA:

- Analog, either one or two ports, depending on the TCA configuration
- Digital (1544 kbit/s or 2048 kbit/s)
- Acoustic
- Audio
- VoIP

Following is a detailed explanation of the port options and configuration:

Channel A, Channel B Options

These options configure channel A and channel B.

TCA mode

Sets the channel operation mode throughout the test execution.

Termination

Sets the channel termination

Initial channel loop conditions

Note that initial channel loop conditions can be changed by some Tx events.

DC Voltage

Sets channel output DC voltage.

Series resistance

Sets channel internal series resistance.

Polarity (Channel A only)

Sets channel normal (positive) / reverse (negative) polarity of the output DC voltage with regards to the Tip and Ring pins of the channel connector.

Ground (Channel B only)

Selects if the ground is not connected (None) or connected internally to Tip or to Ring.

1.5M / 2M Options

These options configure the digital port (1544 kbit/s or 2048 kbit/s interface):

Interface

Selects 1544 kbit/s or 2048 kbit/s interface.

Termination

Selects 120 ohm or 75 ohm termination for 2048 kbit/s interface. If 1544 kbit/s interface is selected the termination is 100 ohm.

Frame format

Selects ESF or D4 (SF) frame format for 1544 kbit/s interface or selects CCS / CCS & CRC / CAS / CAS & CRC format for 2048 kbit/s interface. CCS and CCS & CRC frame formats are not available if Signaling (mode) is set to CAS.

Line coding

Selects AMI or B8ZS line coding for for 1544 kbit/s interface or selects AMI / HDB3 line coding for 2048 kbit/s interface.

Tx Clock

Selects Internal or Recovered clock for the digital (1.5M/2M) transmitter.

Signaling

Selects signaling mode. Available options: None or CAS. If CAS is selected, ABCD signaling bits are transmitted and received according to Tx and Rx Events defined in the signaling procedure. If Measurement is run after the signaling procedure has executed, the last Tx ABCD bit state defined in the signaling procedure is transmitted during the measurement. The ABCD bits are transmitted and received in timeslot 16 (per ITU-T G.704) for 2048 kbit/s interface. For 1544 kbit/s interface the ABCD bits are transmitted and received as robbed bits (per ITU-T G.704).

Tx and Rx timeslots

Selects Transmit and Receive payload timeslot (voice channel). The VF PCM-encoded signals are transmitted and received in these timeslots when Measurement is performed. Different Tx and Rx timeslots can be selected for each Tx and Rx signaling event.

Idle code

Sets initial idle code that is transmitted in all payload channels of the 1.5/2M Tx port.



Acoustic Options

This option is available in some acoustic tests. When the acoustic interface is on, the acoustic interface output (voice simulator) and input (hearing simulator) can be selected as the measurement Tx and Rx ports for the test. The Acoustic port is not available for Signaling Tx and Rx events.

Interface

Turns on / off acoustic interface

Audio Options

These options configure the audio port.

Interface

Turns on/off Audio interface

Volume control

Enable automatic volume control (set system sound volume to maximum before test)

Tx Device

Audio device to transmit signal

Rx Device

Audio device to capture signal

VoIP Options

These options configure the VoIP port.

Interface

Turns on/off VoIP interface

Sampling rate

Audio sampling rate

Codec

VoIP codec that will be supported during the VoIP call

TCA IP

Network interface TCA should use (it may have more than one LAN interface, so it is necessary to define, which LAN interface should be attached to VoIP).

Configure VoIP Registration -



VoIP Registration Dialog Box

Elements on the VoIP Registration dialog box include:

Host: registrar host

User name: user to register as

Password: password, used for authentication in the registrar.

Signaling Procedure

To complete the test measurements after the Signaling procedure is executed, ensure that the **Run** parameter (in the **Test properties > Conditions**) is set to **Signaling & Meas.**

To complete only one or the other, ensure that the **Run** parameter is set to either Signaling only or to Meas. only.

Use the Signaling procedure to simulate and analyze various PSTN analog or digital (2M/1.5M) signals and conditions such as DTMF, MF, MFC, pulse dialing, progress tones, rings, on-hook, off-hook and ABCD-bits CAS. The Signaling procedure also supports basic VoIP commands and events required to establish the SIP or H.323 call on one of the interfaces.

Two sets of the procedures exist in TCA:

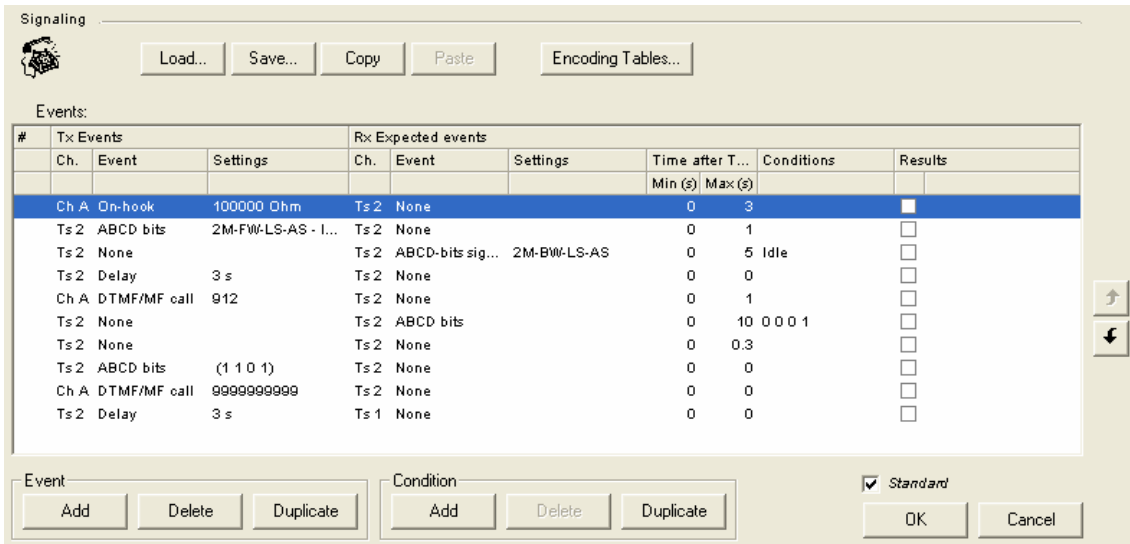
- **Predefined**
Signaling procedures that appear in System - Standard signaling (Read-only) list.
- **User-defined**
Signaling procedures that were created by user and saved in System - User signaling list.

To use a predefined signaling procedure, load it from **System > Standard / User signaling list**. It is possible to save a Signaling procedure to System - User signaling list. Signaling procedures can be also copied and pasted.

In through transmission tests, the signaling procedure is accessed through the Tx & Rx setup parameter in the **Test properties > Conditions**.

The Signaling procedure is defined by the Events table. Events are tests.





The Events Table

Multiple combinations of the simulations, detection and measurements together with time criteria, programmable user messages, remote device commands and user verdicts can be defined in the Signaling procedure.

When a test that includes a Signaling procedure runs, the events are executed one after the other. Signals are sent (Tx events) and monitored (Rx) according to the events defined in each test case row in the Events table.

Events Table

The Events table comprises test case definitions listed as rows.

Each test case definition includes none or one Tx event definition, none or one Rx event definition, and the Results selection.

Each Rx event definition can optionally include multiple conditions.

Event Operations

Add

Adds a new test case at the bottom of the test case table.

Ordering events

To change the order of the test cases, click the Up/Down buttons at the right side of the table.

Delete

Deletes the selected test cases. Use Shift or Ctrl keys to select multiple test cases.

Duplicate

Duplicates the selected test cases.

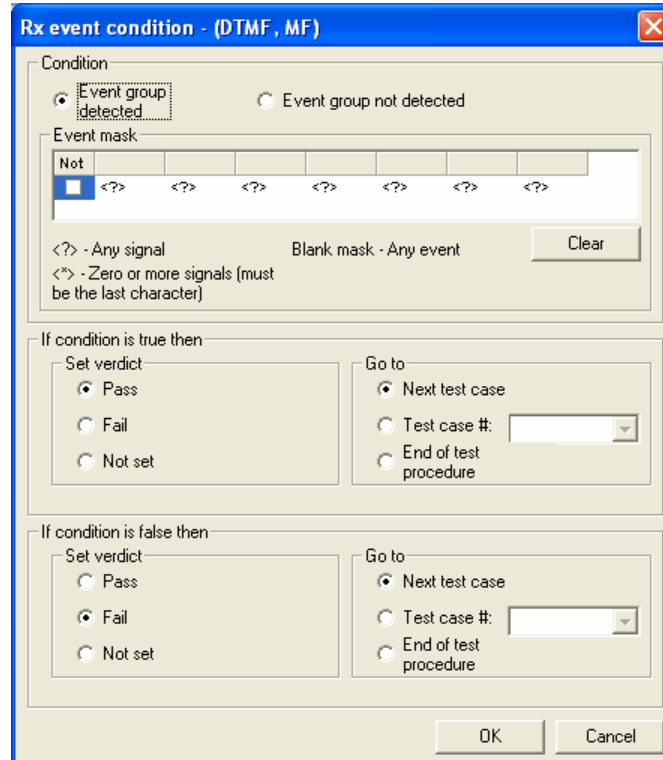
NOTE: The complete list of possible Tx and Rx events is provided in Appendix B and in the TCA online help.

Conditions

Conditions serve two purposes:



- Define additional criteria for verdict setting (additional to the Rx event settings and Min, Max time limits)
- Branch the test execution flow to a test case other than the next one. Thus protocol state machine simulation can be implemented.



Rx Event Condition Screen

Condition Options

There are two Event group options:

- **Event group not detected**
Select if you want the condition be true when no signal of the specified type or encoding group is received.
- **Event group detected**
In all other cases, select this options.

Event mask

Sets additional criteria for the received events. If the received event matches the event mask, the condition is set to true.

Example: 0 3 <?> <?> <*> mask for DTMF number < means that the numbers starting with 0 3 and having at least 4 digits must be received in order for the condition to be true.

If the condition is true then additional options are:

Set verdict

Sets the test case verdict to Pass, Fail or leaves the verdict not set.

Go to

Sets the next test case to be executed.

Type a label in the # column of the Test cases table for the test case you want to reference in **Go to Test case #**.

If a condition is found to be true, other conditions in the test case are not checked and the test case set by the **Go to** is executed.

If the condition is not true, the next condition is checked if it exists. If it does not exist, the next test case is executed.

Condition operations

Add

Adds a new condition to the test case.

Delete

Deletes the selected condition from the test case.

Duplicate

Duplicates the selected condition.

Signaling Procedure Execution

As the Signaling procedure is running, the test cases are executed one by one, starting with the first test case.

In each test case, if a Tx event exists, it is generated with its specified settings at the selected (Tx event) channel.

The Rx expected event is monitored at the Rx Expected event channel.

If the Rx Expected event was detected within the time between Min and Max limits from the beginning * of the Tx event (Stimulus), the test case passes. Then, if the test case includes conditions, the detected Rx event characteristics are compared to the criteria defined in the conditions. The condition criteria may optionally set the test case Pass/Fail verdict and direct the test execution flow to another test case, if the Results option was selected for the test case.

The selected results are measured and compared with the limits as defined in **Test properties > Limits**.

Thus, the overall test case verdict is set by the combined result (logical AND) of the following three criteria:

- Rx Expected event was detected according to the specified settings (if exists).
- According to the criteria defined in the event's conditions (if exists).
- According to the selected measurement Results vs corresponding limits (if exists).

If one of the criteria fails, the test case fails.

If none of the criteria fails and at least one criterion passes, the test case passes.



NOTE: In some Tx event/Tx event settings, the Rx event time is measured from the end of the Tx event.

- Tx and Rx event selection depends on the selected TCA channels modes.
- Selection of the test case Results depends on the selected Rx event.
- Multiple conditions can be optionally defined for a Rx event.

Example of Configuration for Tests

In this example, we demonstrate how to configure test properties, both ports and signaling procedures, according to the standard for which the suite of through transmission tests is created.

Analyzing Test Requirements and Selecting Interfaces

For example, we have to test the analog extensions of the IP-PBX according to the standard ETSI ES 201 168 V1.2.1 “Speech processing, Transmission and Quality aspects (STQ); Transmission characteristics of digital Private Branch eXchanges PBXs) for interconnection to private networks, to the public switched network or to IP gateways”.

The standard defines the half connections used in the tests as follows:

- Input connection: a unidirectional path from an input of a digital PBX to an output test point.
- Output connection: a unidirectional path from an input test point to an output of a digital PBX.
- Half connection: a bi-directional path comprised of an input connection and an output connection, both having the same interface.

We have to figure out which interfaces of the IP-PBX should be used for the test purposes as

- Input/output of the IP-PBX
- Input/output test point.

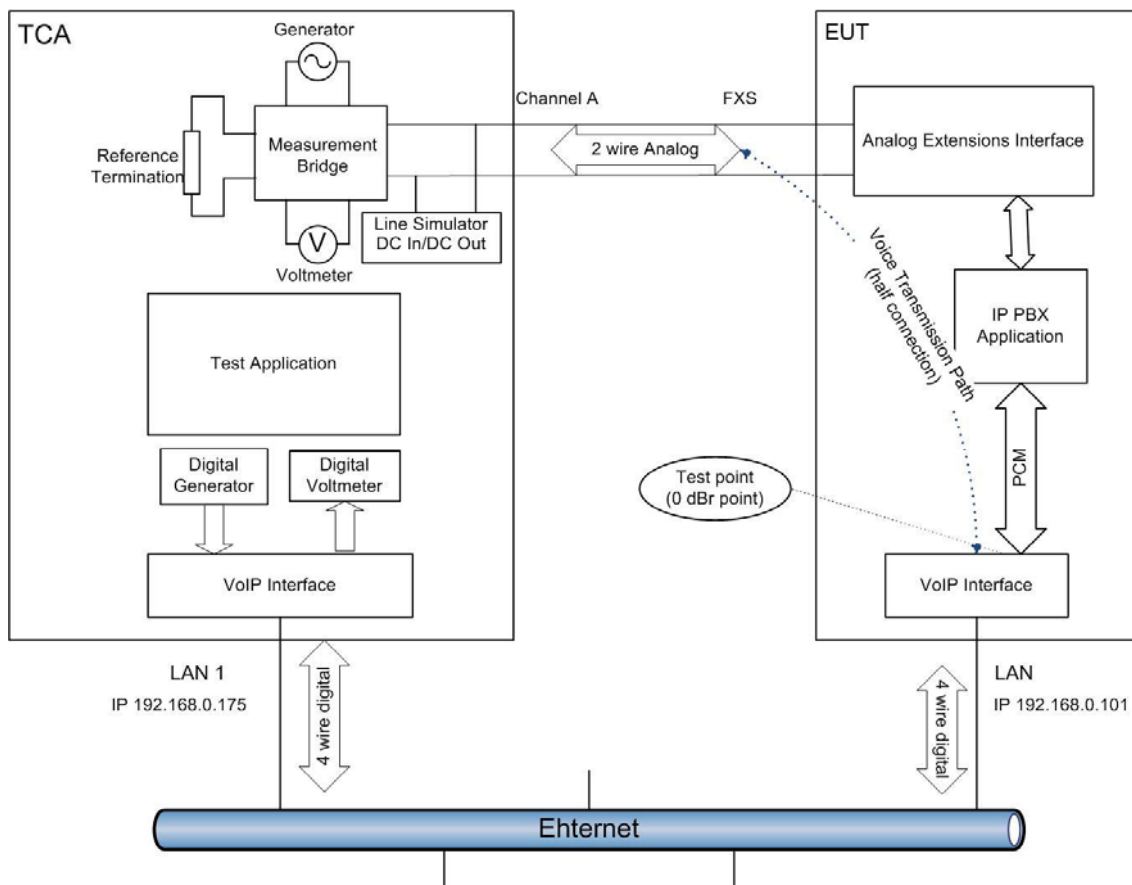
In this case, the input/output of the PBX are the analog extensions (FXS ports).

Next, we clarify the requirements to the test points. According to the standard, an access to the (input/output) test points (Access Point – AP) should be “for measurement purposes, an AP shall be digital in its nature. To avoid additional adaptation equipment between AP and test instrument, the following interface types shall be used with the test access: - 64 kbit/s co-directional ... The coding law of the test point shall be either A-law or μ -law”. Another requirement of the standard to the test point is the Relative signal level: “The input and output test points are defined as 0 dBr points for the equipment under test”.

The VoIP interface of the IP-PBX fits both requirements (when codec G.711 is used and no attenuation is done on vocoder) and can be used as an Access Point to the EUT.



So, in order to follow the standard, we are going to configure test properties for the through transmission tests between the analog (FXS) and digital (VoIP) interfaces. Such test properties will be applicable for all through transmission tests incorporating the test suite corresponding to this standard. That suite also will be applicable for testing other equipment that has same type of interface, for example, VoIP gateways and ATA (Analog Telephone Adapters).



Picture 1. TCA and ETU Connected According to the Standard for Half-connection Measurements (Analog and VoIP interfaces)

Preparing Correct EUT Configuration

After having decided which EUT interfaces should be used, we should figure out how this EUT should be manipulated in order to create (as required for the tests) a voice path between the FXS and VoIP ports. There are two possibilities of the call-setup going through the EUT: from FXS to VoIP or vice versa. The standard usually doesn't define the direction in which call setup was done, but just requires an internal connection between two interfaces. Usually the EUT has to be configured appropriately in order to allow creating of the connection.

It is necessary to configure the VoIP trunk. At the very least, you must configure the destination IP address, that is, the IP address of the remote VoIP device which will receive the VoIP call. This IP address should be the IP address of the TCA LAN interface which is planned to be connected via VoIP to the EUT (see picture above). The required VoIP protocol, SIP or H.323, should be selected. Another important parameter is the codec what will be used. It should correspond to the standard requirements, which in our case (see above) should be G.711 A-law

It is also important to define/configure which number should be dialed from the analog extension. That will cause the IP-PBX to route this call to the VoIP trunk.

Scenario 1: Calling from FXS to VoIP Interface of the EUT

In our case, in order to establish a call from the analog extension (FXS port) to the VoIP trunk through the IP-PBX, it is necessary to dial from the phone connected to the FXS extension number consisting of 5 or more digits, where the first digit should be “9”. When such a number is dialed from the phone, then the IP-PBX sends a SIP message INVITE to the ip address 192.168.0.175 which corresponds TCA “LAN1” network interface. Routing functionality is determined by the internal IP-PBX configuration.

Here is the sequence of signals events that represents establishing of the voice path in that direction:

1. TCA start SIP listener on port 5060 of the LAN1, which has IP address 192.168.0.175
2. TCA generates Off-hook on FXS port - EUT plays “dial tone”
3. TCA dials 95555 on FXS port
4. The EUT routes this call from the FXS to the VoIP interface (according to its configuration) and sends the SIP message “INVITE” to the IP 192.168.0.175 and starts playing ring-back tones to the FXS port
5. TCA receives SIP message INVITE and proceeds according to the SIP protocol, eventually answering to the SIP call by sending SIP message “OK”
6. EUT stops playing the ring-back tone. The connection established, the voice path – created!

Scenario 2: Calling from VoIP to FXS Interface of the EUT

If we want to establish a call to the opposite direction, we have to configure the EUT such that it will route the incoming SIP call from the VoIP interface (that has IP address 192.168.0.101) to the appropriate extension (FXS port connected to the TCA). Let’s say that for that purpose the phone number that arrives in the INVITE should 1000.

Here is the sequence of signals events that represents establishing of the voice path in that direction:

1. TCA initiates the SIP interface (internal action)
2. TCA sends SIP “INVITE” message with URI number 1000 to the IP address 192.168.0.101
3. EUT receives “INVITE”, decodes it and routes the call to the appropriate extension according to its configuration. This extension, an FXS port, generates the ring signal.



4. TCA detects ring on its analog port, and generates Off-hook .
5. EUT detects Off-hook and answer the call, using the VoIP interface, by sending the SIP message “OK”
6. TCA detects SIP “OK”. The connection established, the voice path – created.

Now, when we know which signals and events should be sent/received to/from the EUT interfaces connected to TCA ports, we may create appropriate signaling procedures. It should be created according to one of the two scenarios we’ve described above.

Appropriate Port Definitions

The first step is appropriate port definition. As discussed earlier, two ports should be enabled/configured in the TCA: Analog Channel A and VoIP. According to that design, the Channel A which is connected to the FXS port of the EUT should be configured as DC-In, with appropriate Termination and other parameters that are corresponding to the EUT and standard requirements.

Channel A Configuration

Another port should be VoIP, where it is important to select the correct LAN interface (TCA has two – LAN1 and LAN2) and codec G.711 A-law, according to ITU-T recommendations.

Channel B Configuration

If EUT required using a SIP Registrar server for issuing VoIP SIP calls, then it is necessary to configure the registration parameters of the TCA using Configure Registration dialog.

Once both ports are configured, it is possible to actually define the Signaling procedure itself.

Creating the New Signaling Procedure

The signaling procedure has to be created according to the selected calling scenario (1 or 2, see above), and will consist of the events and test cases (as were described in appropriate chapter earlier) that apply to the selected ports. Let's how the scenario 1 is translated to the events:

Signaling procedure for Scenario 1

Events:										
#	Tx Events			Rx Expected events						Results
	Ch.	Event	Settings	Ch.	Event	Settings	Time after T...		Conditions	
							Min (s)	Max (s)		
	Ch A	On-hook	100000 Ohm	None	None		3	3		
	Ch A	Off-hook	400 Ohm	Ch A	Energy detector	300 - 1000 Hz, -20 dBV	0	3	T:--> 1	
	Ch A	Command	Analog call failure	None	None		0	0	T:--> <end> F: --> <end>	
1	Ch A	DTMF/MF call	95555	None	None		0	0		
	VoIP	None		VoIP	Call		0	20	T:--> 2	
	VoIP	Command	VoIP call not detected	None	None		0	0	T:--> <end> F: --> <end>	
2	VoIP	Answer		VoIP	None		0	0		
	VoIP	None		VoIP	Connected		0	10	T:--> 3	
	VoIP	Command	VoIP call not connec...	VoIP	None		0	0	T:--> 1 F: --> 1	
3	VoIP	Delay	1 s	VoIP	None		0	0		

Scenario 1 Signaling Procedure

Each row represents an item in Scenario 1:

1. Channel A goes to the initial state – i.e. On-hook, plus delay 3 sec
2. Channel A makes Off-hook and expects event – incoming dial-tone (uses energy detector for detection), and if it is received (during configured 3 seconds period) , the procedure “jump” the “test-case #1”, which means continue with the signaling. If the dial-tone is not detected, in the next step the appropriate error message appears and signaling procedure fails.
3. Channel A makes phone call (sends DTMFs to the line) to the predefined number 95555
4. Channel VoIP - expects to get the “incoming call” event (SIP “INVITE” message), and if received during 20 seconds – the procedure “jump” the “test-case #2”, which means continue with the. If SIP call was not received, in the next step the appropriate error message appears and signaling procedure fails.
5. Channel VoIP answers the incoming call (sends SIP “OK” messages and expects to get event “Connected” (SIP “Ack” message). When the “Connected” event arrives, the procedure “jumps” the “test-case #3”, which is actually a last step of the procedure. If not, the appropriate error message appears and signaling procedure fails.
6. 1 sec delay just before the actual measurement starts.



Signaling procedure for Scenario 2

Events:										
#	Tx Events			Rx Expected events						Results
	Ch.	Event	Settings	Ch.	Event	Settings	Time after T...		Conditions	
							Min (s)	Max (s)		
	VoIP	Command	Start of signaling	VoIP	None		0	0		<input checked="" type="checkbox"/>
	VoIP	Call	sip:1000@192.168.0.101	VoIP	None		0	0		<input type="checkbox"/>
	None	None		Ch A	Energy detector	10 - 100 Hz, 15 V	0	10	F:--> 1	<input type="checkbox"/>
	Ch A	Off-hook	400 Ohm	None	None		0	0		<input type="checkbox"/>
	None	None		VoIP	Connected		0	10	T:--> 2 F:--> 1	<input type="checkbox"/>
1	VoIP	Command	Call failure	None	None		0	0	T:--> <end> F:--> <end>	<input type="checkbox"/>
2	VoIP	Delay	1 s	None	None		0	0		<input type="checkbox"/>

Scenario 2 Signaling Procedure

Each row represents an item in Scenario 2:

1. Channel VoIP initializes of the SIP sub-system and showing initial dialog
2. Channel VoIP issues the SIP call – to the earlier defined phone number and IP address.
3. Channel A expects event – incoming ring (uses energy detector for detection), and if it is not received (during configured 10 seconds period) , the procedure “jumps” to the “test-case #1” – where error message and request to check configuration appears . If the ring is detected . next step is proceed
4. Channel A proceeds off-hook.
5. Channel VoIP - expects to get the “Connected” event (SIP “OK” response) , and if not received – procedure “jumps” to the “test-case #1” – where error message and request to check configuration appears . If received – the procedure goes to the last step (test-case #2)
6. Last step - 1 sec delay just before the actual measurement starts.

Conclusions

TCA provides very powerful and feature rich mechanism for creating and performing through transmission tests required by many telecommunications standards for a different EUT types. But, in order to correctly configure and run such test it is necessary to have good understanding of the signaling capabilities of the EUT and use appropriate ports and interfaces of both TCA and the EUT.

Appendix A: Port Configuration Table

TCA Mode	Supported channels	Description
Analog PSTN interface		
Loop-in (DC-out) - Calling party	A	TCA simulates Central Office (CO) providing the loop feed and originating calls (rings).
Loop-in (DC-out) - Called party (tone)	A and B	TCA simulates CO providing the loop feed. EUT originates tone-dialed calls.
Loop-in (DC-out) - Called party (pulse)	A and B	TCA simulates CO providing the loop feed. EUT originates pulse-dialed calls.
Loop-out (DC-in) - tone calling / called	A and B	TCA simulates Customer Equipment (CE). EUT provides loop feed. TCA or EUT can originate tone-dialed calls.
Loop-out (DC-in) - Pulse calling	A	TCA simulates Customer Equipment (CE). EUT provides loop feed. TCA originates pulse-dialed calls.
GND-start (DC-out) - Calling party	A	Ground-start mode. TCA simulates Central Office (CO) providing the loop feed and originating calls (rings).
GND-start (DC-out) - Called party (tone)	A	Ground-start mode. TCA simulates CO providing the loop feed. EUT originates tone-dialed calls.
GND-start (DC-out) - Called party (pulse)	A	Ground-start mode. TCA simulates CO providing the loop feed. EUT originates pulse-dialed calls.
GND-start (DC-in) - tone calling / called	A	Ground-start mode. TCA simulates Customer Equipment (CE). EUT provides loop feed. TCA or EUT can originate tone-dialed calls.
GND-start (DC-in) - Pulse calling	A	Ground-start mode. TCA simulates Customer Equipment (CE). EUT provides loop feed. TCA originates pulse-dialed calls.
1.544 Mbps / 2.048 Mbps interfaces	1.544 Mbps interface: Timeslots 0 - 23, 2.048 Mbps interface: Timeslots 1-15, 17-31	
VoIP interface	VoIP	
Audio interface	None	



Appendix B: Tx Events and Rx Events Table

Tx Events

Event	Interfaces	Settings	Description
None	Any		No Tx event is executed.
Command	Any	Messages and Remote commands properties	Displays a user message or sends ASCII commands to a remote device. Latest received command will be stored and may be processed by Rx Response Processor event.
Delay	Any	Delay duration	Delays test execution. Rx events can be detected during the delay time.
Wink	Analog	Duration	TCA channel is set off-hook for the specified duration and then returns to on-hook.
Polarity reversal	Analog		Reverses the polarity of the DC feed voltage.
Polarity	Analog	Normal / Reverse	Sets Normal (positive) or Reverse (negative) DC feed voltage polarity with regards to the channel Tip and Ring terminal.
Ring	Analog	Analog PSTN signals - Ring signal properties	Sends ring signal.
DTMF/MF call	Analog, 1.544 Mbps, 2.048 Mbps	Dialed number, with DTMF, MF signal properties, optional line seizure with resistance/current value and delay after line seizure	Optionally goes off-hook and sends the specified DTMF/MF number.
MFC	Analog, 1.544 Mbps, 2.048 Mbps	MFC signal properties	Sends MFC signal
Progress tone	Analog	Analog PSTN signals - Progress tone signal properties	Sends progress tone
On-hook	Analog	Resistance / Current value	The channel is set on-hook with the specified resistance or current value.
Off-hook	Analog	Resistance / Current value	The channel is set off-hook with the specified resistance or current value.
Set leakage resistance	Analog	Tip-Ring / Tip - GND / Ring - GND	50 kohm resistor is connected between the specified terminals.
Set feed voltage	Analog	Voltage	Sets the DC feed voltage.
Disconnect line	Analog	Tip / Ring	Disconnects channel's Tip or Ring line.
Play file	Analog	file name	Plays up to 20 sec. of .wav format data from the specified file.
Pulse call	Analog	Dialed number, N/N+1 encoding, pulse signal properties, optional line seizure with resistance/current value and delay after line seizure	Optionally goes off-hook and sends the specified pulse number.
Hook flash	Analog	Loop break duration	Breaks the loop (goes on-hook) for the specified duration and returns to off-hook.

Event	Interfaces	Settings	Description
Remove signal	Analog		Turns-off the last generated signal.
Timed off-hook	Analog	Off-hook duration	Goes off-hook for the specified duration and returns to on-hook.
Idle state	Analog		Sets 20 kohm resistance across Tip and Ring.
Tip - GND	Analog		Connects channel's Tip to the ground.
Tip - open	Analog		Disconnects channel's Tip.
Tip - floating	Analog		Disconnects channel's Tip from the ground.
CID/SMS	Analog (SMS option)	Message properties	Sets properties of the transmitted CID/SMS message.
Wink	2.048 Mbps / 1.544 Mbps interface	Duration	Sets ABCD bits corresponding to the off-hook state for the specified duration, then sets on-hook state ABCD bits as defined in the Encoding tables - ABCD bits signals.
ABCD bits	2.048 Mbps / 1.544 Mbps interface		Sets ABCD signaling bits at the 2.048 Mbps / 1.544 Mbps interface Tx port.
Call	VoIP	EUT user name, EUT address	Places a call to the specified EUT address and/or user name.
Answer	VoIP		"Answers" a call regardless of whether a call was received or not. Normally the Answer Tx event should be preceded by the Call Rx event in the Signalling procedure.
Disconnect	VoIP		Terminates the call.

Rx Events

Event	Interfaces	Settings	Description
None	Any		No Rx event is detected.
User verdict	Any	User question	Verdict and the next executed test case can be set in conditions according to the user Yes/No answer.
Response processor	Any	Number of response comparisons	This event may be used after Tx Command event to process its response.
Wink	Analog	Min and Max off-hook duration	Detects on-hook to off-hook to on-hook transition
Polarity reversal	Analog		Detects a change of the DC voltage polarity
DTMF, MF	Analog, 1.544 Mbps, 2.048 Mbps	Encoding (group), Max number length, Remove dial tone	Detects DTMF/MF number from the Encoding group defined in the Encoding tables - DTMF, MF and using the level and time tolerances defined in the Encoding table - DTMF, MF. The groups appear as expandable

Event	Interfaces	Settings	Description
			nodes in the Encoding tables. If Remove dial tone is selected in the Settings, the dial tone is removed when the first digit is detected.
MFC	Analog, 1.544 Mbps, 2.048 Mbps	Encoding (group)	Detects MFC signal from the Encoding group defined in the Encoding tables - DTMF, MF and using the level tolerance defined in the Encoding table - DTMF, MF.
Pulse	Analog	Encoding (N/N+1), Max number length	Detects pulse number
Automatic seizure	Analog		When the Automatic seizure Rx event is selected, the minimum duration between line seizures (by the EUT) is displayed in the Signal duration result.
On-hook	Analog	Min EUT resistance / Max EUT current	Detects on-hook state either according to the minimum EUT resistance or the maximum EUT current defined in the settings.
Off-hook	Analog	Max EUT resistance / Min EUT current Fast detection	Detects off-hook state either according to the maximum EUT resistance or the minimum EUT current defined in the settings. If Fast detection is selected the off-hook is detected using a faster algorithm which is preferred for timing measurements. Results for the Off-hook received event cannot be displayed, if Fast detection is selected.
Line voltage	Analog	Threshold above/below, Threshold value	Detects minimum/maximum line DC voltage.
Energy detector	Analog	Start frequency, Stop frequency, Minimum level	Detects if the Minimum level is exceeded in the Start to Stop frequency range.
Disconnect line	Analog	Tip / Ring	Disconnects channel's Tip or Ring line.
Tip open	Analog		Detects if Tip is open.
Ring - GND	Analog		Detects if Ring is grounded.
Ring-floating	Analog		Detects if Ring is disconnected from the ground.
Hook flash	Analog	Minimum, Maximum loop break (on hook) duration	Detects hook flash (loop break).
Line monitor	Analog	File name to save the recorded voltage waveform	Records the voltage waveform at the Rx channel displays the waveform result on the graph and saves the waveform to the file specified in the event settings.
Start async. line monitor	Analog	Vertical range, Sampling rate	Measures signals at the Rx port symphoniously (in parallel with the following events) until Stop async. line monitor Rx event is encountered.
Stop async. line monitor	Analog	Last signal duration, Last silence duration, Last signal + silence	Stops the asynchronous line monitor measurement and displays the results

Event	Interfaces	Settings	Description
		duration - selects what duration is measured (signal/silence/signal + duration) and recorded in the results. Threshold - sets the threshold voltage level above which the waveform is regarded as Signal. The voltages below the the threshold level are regarded as Silence.	according the event settings.
Wink	1.544 Mbps, 2.048 Mbps	Minimum duration, Maximum duration, Signaling bits	Detects the ABCD bits specified by the Signaling bits that are received continuously for the time limited between Minimum duration and Maximum duration.
ABCD bits	1.544 Mbps, 2.048 Mbps		Detects ABCD bits state at the 2.048 Mbps / 1.544 Mbps interface Rx port.
ABCD bits signal	1.544 Mbps, 2.048 Mbps	Group (Encoding tables)	Detects ABCD bits state from the selected group as defined in the Encoding tables - ABCD bits signals at the 2.048 Mbps / 1.544 Mbps interface Rx port.
CID/SMS message	Analog (SMS option)	Group (Encoding tables)	Sets properties of the detected CID/SMS messages.
Call	VoIP		Detects an invitation for a session (call) from the EUT.
Connected	VoIP		Detects if the EUT has accepted the call.
Disconnect	VoIP		Detects if the EUT has terminated the session (call).

Cellular Analog FXS & FXO VoIP xDSL
Acoustic ISDN PRI T1/E1



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