Application Note

SDH and PDH stress-testing

CMA 3000

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INTRODUCTION

In an effort to keep telecom networks at peak performance network operator technicians will need to stress-test the SDH and PDH networks. Signals containing special conditions are applied to the network or network elements whereby their ability to handle abnormal signals at or beyond specified limits can be verified.

This is particular relevant when network testing or monitoring indicates problems that require advanced troubleshooting and error detection. It's also relevant when verification of error reporting mechanisms in the network is needed.

To do this special tests applying abnormal signal conditions can be made. For such tests it's very convenient for the user to be able to set up signal conditions in a flexible way while at the same time being able to inspect possible parameters that can show the reaction of the network element(s).

CMA 3000 is Anritsu's new portable, compact and user-friendly field tester. It's designed specifically for field technicians who install and maintain mobile-access and fixed-access networks, transmission networks and switching. With its very flexible Stimuli application the CMA 3000 allows user to stimulate the system under test by provoking special or abnormal conditions to a transmitted test signal and simultaneously inspect a related status or result display making SDH and PDH stress-testing fast and easy. This facilitates advanced troubleshooting and behavior verification, as well as basic transmission line testing.

1.0 Transmission line out-of-service testing

1.1. Advanced testing

A BER test with a far end loop-back is typically performed to verify that a PDH or SDH transmission line is working correctly. This can be done as a part of an installation or a commissioning procedure, or in order to troubleshoot the line. In some cases a more advanced test may also be carried to verify the system's ability to handle abnormal conditions through generation of a test signal, including:

- **Alarms:**
  - **Alarms generated in relation to framed signals will provoke responses in the signal returned to the instrument as well as on management interfaces of the network element on the line. You will find more information on this type of tests in the section on maintenance signal interaction testing**
- **Errors:**
  - **As an example: If three consecutive 2 Mbps frame alignment signal (FAS) word indicate errors, the system declares the frame alignment to be lost. By applying errors to 1, 2, 3, 4, etc. consecutive 2 Mbps frame alignment word(s) the user can verify if this happens. Other tests involving error generation may be relevant, however, depending on the specific signal**
- **FAS slips:**
  - **If one FAS word is an error so that a bit is lost (a slip) the system must first declare the frame alignment to be lost and subsequently, the frame synchronization must be recovered. This can be tested by applying a frame slip to the transmitted signal**
- **Frequency offset:**
  - **According to the specifications a 2 Mbps system must be able to handle signals deviating in frequency up to +/- 50 ppm. By e.g. applying double the frequency offset to the transmitted signal it can be verified whether the system can transport the signal error-free**

You can then monitor how the system handles the test signal on the receiver of the test instrument by inspecting maintenance consoles related to the network elements on the line.

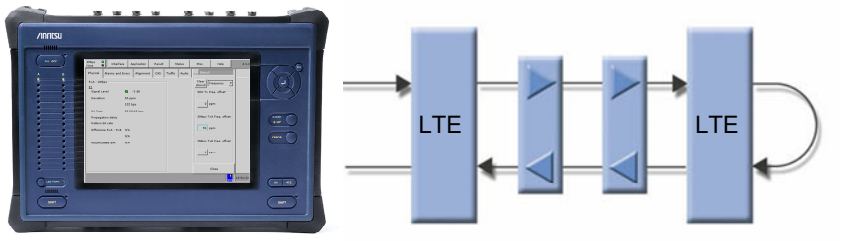

Figure 1 Out-of-service testing of a 2 Mbps line.

1.2. Basic transmission line testing

For basic out-of-service transmission line testing, generation of abnormal conditions are done simply to verify that the connections are made correctly prior to the real test:

- **A bit error may be inserted in the test signal. If a bit error is detected at the receiver in the above setup the instrument is connected to a line with a far-end loop-back rather than another test instrument sending out the same test signal**
- **By offsetting the transmitter frequency you can determine whether the frequency of the received signal follows the deviation of the transmitter frequency**
  - **The frequency of the received signal follows the transmitter frequency: The instrument controls the clocking of the signal and the test must be done using the instrument's internal clock**
  - **The frequency of the received signal does not follow the transmitter frequency: The signal is clocked to a system clock along the transmission path and the test signal must be synchronized to the same clock, e.g. by using the incoming signal as clock reference for the transmitter**

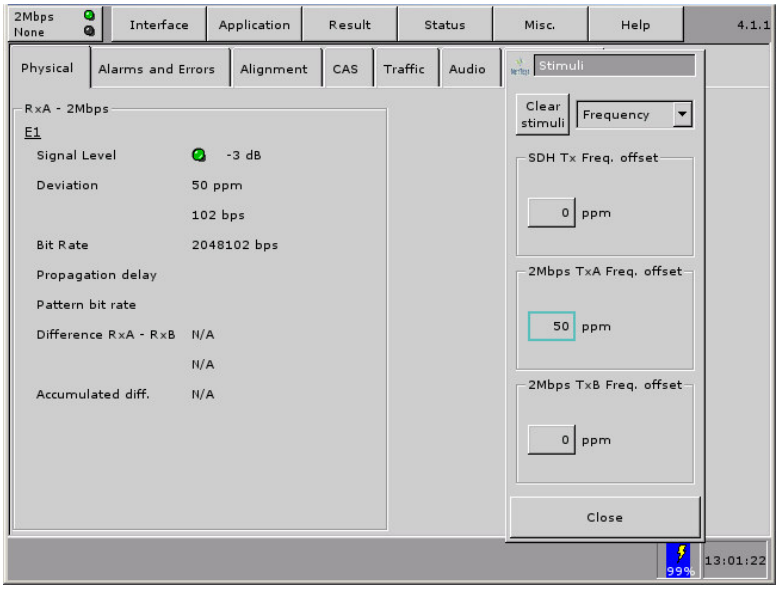

Figure 2 You can observe the frequency of the incoming signal while offsetting the frequency of the transmitted signal.

The CMA 3000 Stimuli application allows you to stimulate the network element under test by generating a test signal with special or abnormal conditions. When used the Stimuli application is on top of other CMA 3000 applications. This allows you to combine the activation of a special or abnormal condition with an immediate view of the reaction on the received signal, making the test quick and simple. You have full flexibility to combine the Stimuli application with the CMA 3000 status and result application in order to examine reactions to the anomaly in the generated test signal.

2.0 SDH network element out-of-service testing

For an out-of-service analysis of an SDH network element, the CMA 3000 with SDH option is a handy tool. The test is made by transmitting an SDH signal with an embedded 2Mbps test signal to the network element and analyzing the related 2 Mbps tributary signal with one of the instrument's receivers. Likewise a 2 Mbps test signal can be generated and the related signal, embedded in the SDH output from the network element can be analyzed.

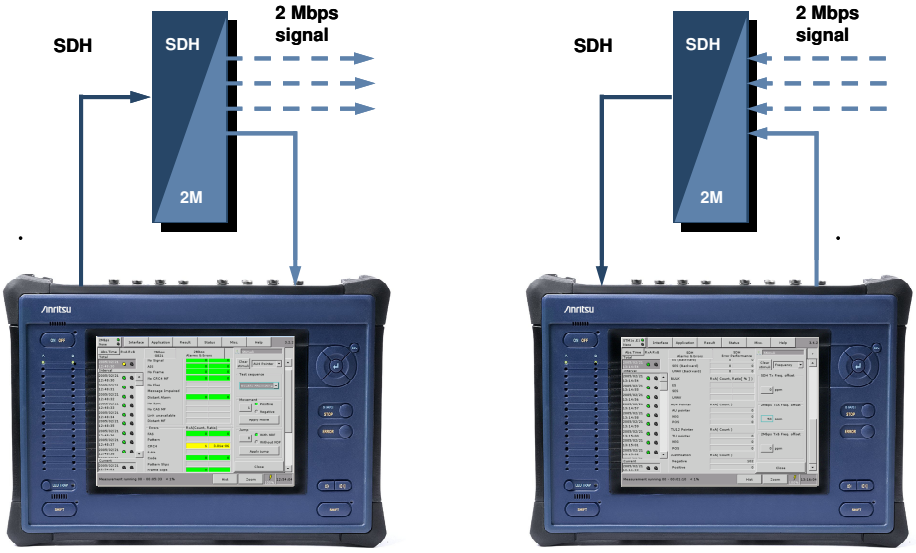

Figure 3 Out-of-service testing of SDH network elements.

Again, the Stimuli application provides a very flexible configuration activation of an abnormal condition with an immediate view of the reaction on the received signal, making the test easier and faster.

You can test several scenarios:

- **Test if pointer operations in the SDH signal causes errors in the 2 Mbps output from the network element**
- **Examine justifications in the SDH signal while offsetting the frequency of the 2 Mbps signal sent from the instrument**
- **Observe the effect on the SDH signal while offsetting the frequency of the 2 Mbps if the network element uses the 2 Mbps signal as reference**

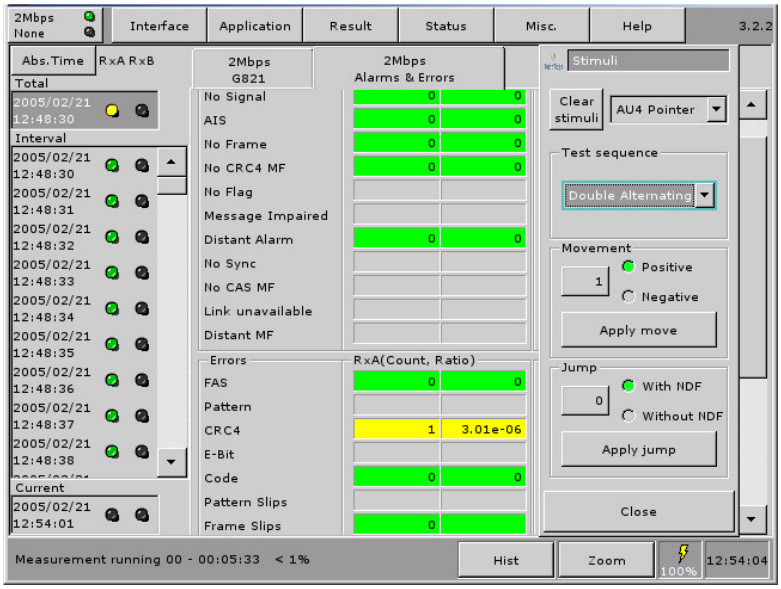

Figure 4 It's possible to observe the effect of pointer operations on a tributary 2 Mbps signal.

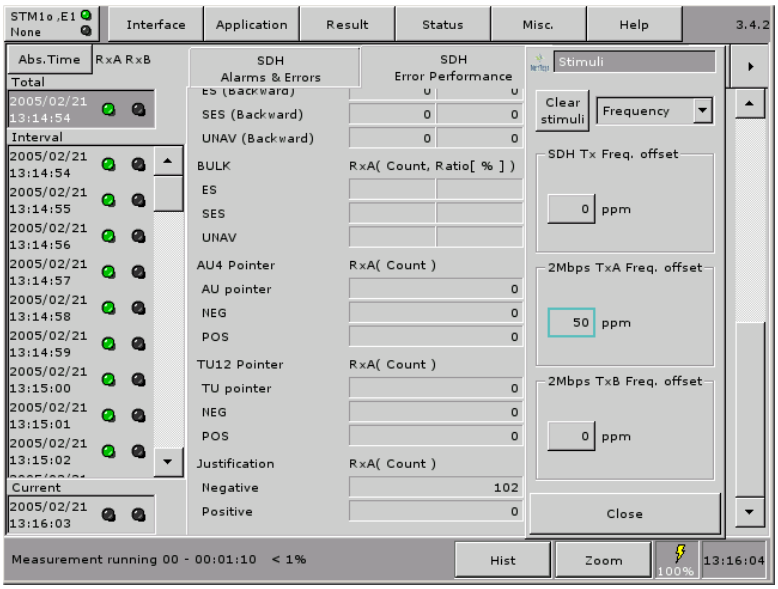

Figure 5 You may view justifications in the SDH signal while offsetting the frequency of the 2 Mbps signal sent from the instrument.

2.1. Maintenance signal interaction testing

You can also check the SDH network element for correct handling of incoming maintenance signals. The SDH signal is divided into levels: The section level, the higher order path level and the lower order path level. If a crucial condition (disrupting the traffic) occurs on one of these levels this is signaled onwards by sending out an SDH maintenance signal: “Alarm Indication Signal” (AIS) while a “Remote Defect Indication” (RDI) is signaled on the line going back to inform the transmitter of the signal that it was distorted on the way.

Likewise there are check sums at each level to detect transmission errors. In case of errors this is signaled back to the transmitter of the signal with a “Remote Error Indication” (REI). The diagram below shows the interaction between some of the SDH maintenance signals at lower order path level.

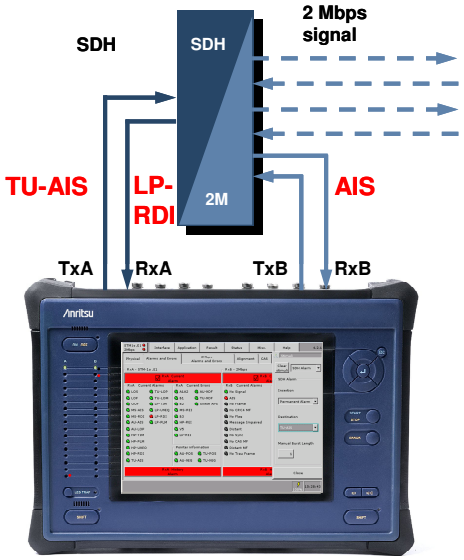

Figure 6 Test of interaction of SDH maintenance signals in a network element.

With the Stimuli application you can easily provoke the maintenance signal (in the example above a TU-AIS) and combine the insertion with the application where alarms and errors on the SDH receiver and the 2 Mbps receiver can be seen side by side. You can move the Stimuli application pop-up over the display positioning it over information not relevant for the current analysis.

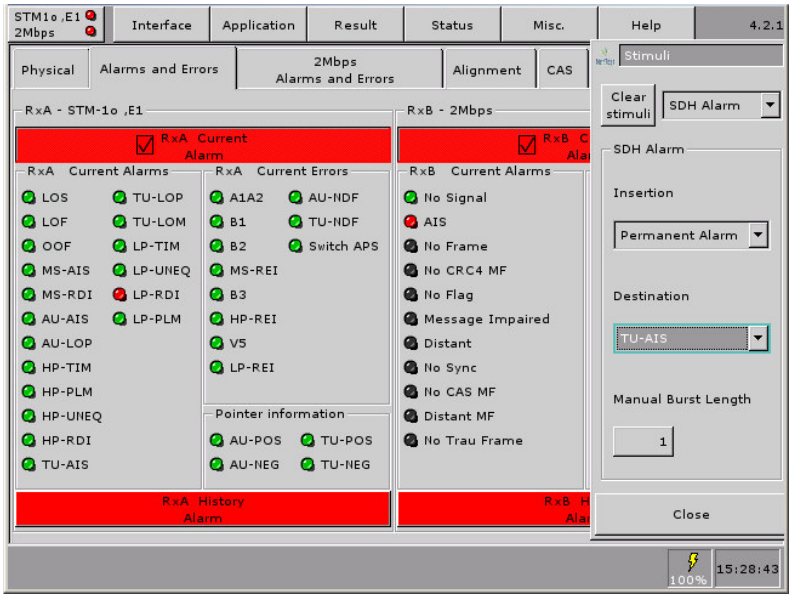

Figure 7 Check the SDH network element for correct handling of incoming maintenance signals.

The CMA 3000 allows a 2 Mbps transmitter to be active together with the SDH transmitter. In this way a valid 2 Mbps signal can be sent to the SDH network element. In turn you avoid any confusion on whether strange behavior on the SDH side of the network element could be caused by a missing PDH signal.

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