

Advanced Network Testing

The magazine for
ANT-20 users –
The standard test
platform for PDH,
SDH, SONET
and ATM PVC/SVC
networks

Dear Reader,

Issue no. 4 of Advanced Network Testing takes an up-close look at software version 6.6. The new DSx/SONET features in particular are relevant to users everywhere and not just in the US and Canada. Why? As globalization progresses, the SDH and SONET worlds are seeing more and more inter-connections. Wandel & Goltermann recognized this trend early on: The ANT-20 was the first instrument to incorporate DSx/SONET and PDH/SDH test functions in a single unit.

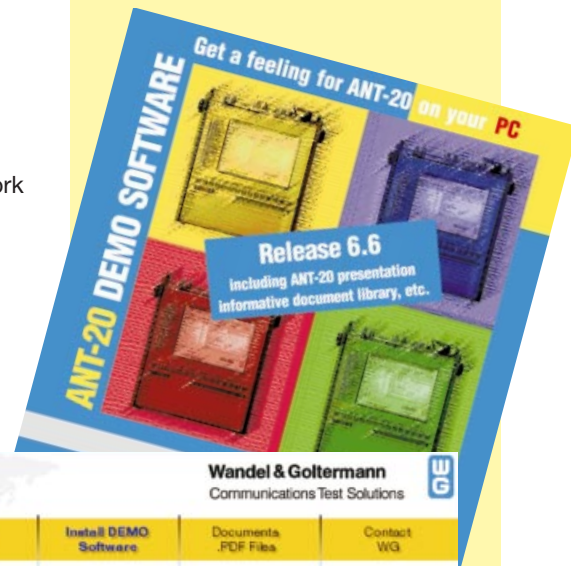
Jochen Hirschinger

New ANT-20 demo CD available

The new ANT-20 demo CD will give you a feel for what "advanced network testing" really means:

- Features of the latest ANT-20 software release (version 6.6)
- Offline analysis on your PC
- Automation with the CATS (CVI Applications Test Sequences) option

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ANT-20 Presentation	Company Overview	Related Products	Install DEMO Software	Documents .PDF Files	Contact WG
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- ANT-20 presentation: A quick overview of our test solution
- Related products for ATM, DWDM, fiber testing and network management
- Background information in a document library

Available free of charge from our sales offices, or use the reply fax on the back.

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Wandel & Goltermann
Communications Test Solutions



In May 1999, new WG-CATS family software will be released, making it easy to verify the quality of a complete DWDM signal.

New CATS software package facilitates DWDM measurements

Unlike conventional fiber transmission technology where a single SDH or SONET signal is carried per fiber, DWDM (Dense Wavelength Division Multiplex) enables simultaneous transport of multiple signals ("channels") with defined wavelengths ("colors"). When attempting to measure SDH or SONET parameters in such systems, classic testers with a broadband optical input are unable to handle the composite signal present at the analyzer input. The solution involves switching in an optical filter that selects a wavelength from the DWDM signal and feeds it alone to the tester.

The OSA-155 DWDM System Analyzer is an optical spectrum analyzer that in addition to measuring purely optical parameters (wavelengths and levels of individual channels, optical signal-to-noise ratio) also provides a filter function. The currently selected channel is available at the OSA-155's monitor output and can be fed to the ANT-20's optical receiver, which then performs typical SDH/SONET tests (alarms, error ratios, jitter, etc.).

We recommend automating this procedure since it can be very time-consuming to manually set all the parameters on the two testers, start the measurement and evaluate the results. Once loaded on the ANT-20, the CATS DWDM test automation software controls the complete procedure:

- Measurement of the optical parameters for all channels
- Filter setting for an optical channel
- Measurement of SDH/SONET signal quality for this channel
- Filter setting for the next channel and so on.

The user can preset the parameters for the individual measurements and create a customized test sequence for a given scenario without any programming experience whatsoever. Long-term measurements of optical and SDH/SONET parameters are possible, jitter measurements can be made, or a complete analysis of the paths embedded in the SDH/SONET signal performed.

Once the test sequence terminates, a complete test report (ASCII format) is generated along with a clear PASS/FAIL statement.

Design of the test system

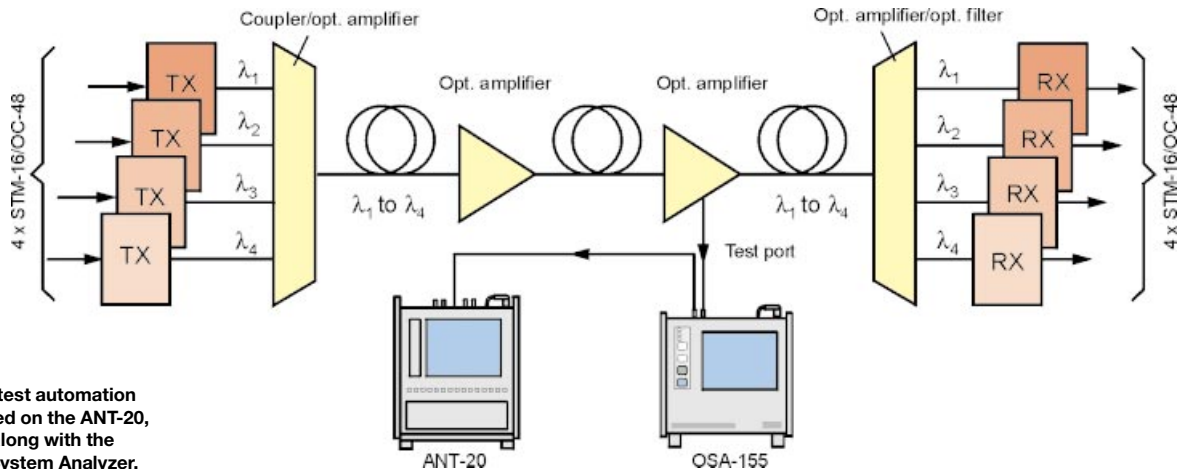
The CATS DWDM software runs directly on the ANT-20's built-in PC and controls all of the relevant ANT-20 functions. The OSA-155 is controlled via the ANT-20's RS232 or GPIB interface.

The CATS DWDM software includes all of the features of the ANT-20 CATS Test Sequencer and adds some typical OSA-155 tests.

Components of the test system

- OSA-155 with monitor output (1450 to 1650 nm) BN 2260/04
- ANT-20/E Advanced Network Tester with optical interfaces BN 3035/xx
- CATS DWDM Test Automation Software running on the ANT-20 BN 3045/93.43

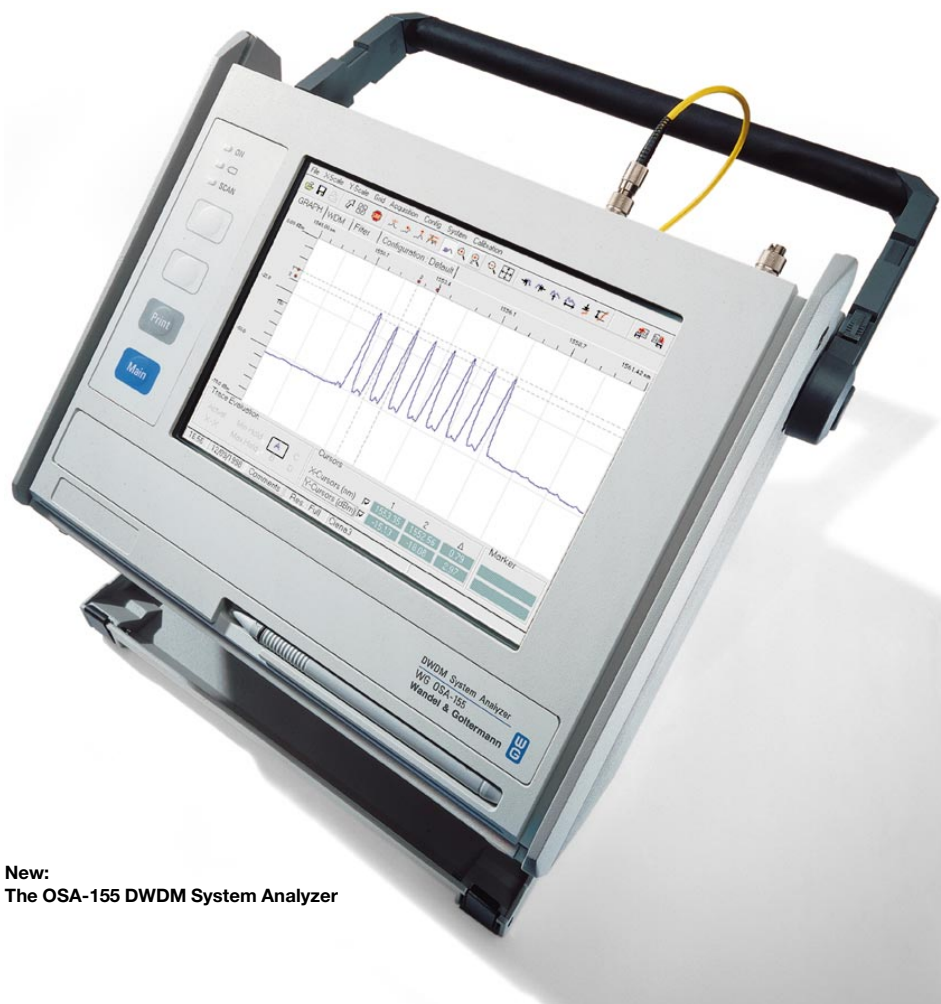
Walter Besse



The CATS DWDM test automation software is installed on the ANT-20, which it controls along with the OSA-155 DWDM System Analyzer.

The OSA-155 DWDM System Analyzer belongs to Wandel & Goltermann's 2nd generation of field-ready test sets for DWDM communications technology. Compared to its predecessor (the OSP-102A), the new instrument has a wider wavelength tuning range, better measurement accuracy, and improved selectivity and dynamic range. Of course, the OSA-155 includes popular features of the OSP-102A, such as the monitor output and rugged, portable design. Battery and DC powering options, combined with all the memory and remote control features of a PC-based test set, make the OSA-155 ideal for field use.

The OSA-155 uses a grating monochromator. This enables analysis of DWDM signals in the wavelength range 1450 to 1650 nm, with optimum results for the optical signal-to-noise ratio (OSNR) measurement being obtained with channel spacings of 100 GHz or higher. However, the OSA-155 is also capable of handling a 50 GHz channel spacing. The OSA-155's wavelength range covers, besides the actual carriers in the range 1530 to 1565 nm (later also 1560 to 1600 nm), the optical supervisory channels (OSC) at 1480, 1510 and 1625 nm.



New:
The OSA-155 DWDM System Analyzer

Stress element sensors with byte sequences

For use in stress testing network elements, the ANT-20 can insert a sequence into specific bytes*) of the SOH and POH. The sequence is user-defined and can be programmed as follows:

- Select the overhead byte*)
- Press the "SQ" button
- Enter the desired value for the overhead byte
- Enter the number of times this value is to be repeated
- Enter the number of repetitions for the complete sequence

Werner Habisreiterger

*) STM-1 mapping,
SOH: all except B1, B2, H1, H2, H3
POH: J1, C2, G1, F2, F3, K3, N1, J2, N2, K4
STS-1 mapping,
TOH: all except B1, B2, H1, H2, H3
POH: J1, C2, G1, F2, F3, Z4, J2, N2, K4
Optical interface:
all except B1, B2, H1, H2, H3

SOH												POH									
A1	A1	A1	A2	A2	A2	J0	--	--	J1	V5	F6	F6	F6	28	28	28	01	AA	AA	T1	04
B1	--	--	E1	--	--	F1	--	--	B3	J2	xx	00	00	00	00	00	00	00	00	xx	TI
D1	--	--	D2	--	--	D3	--	--	C2	N2	00	00	00	00	00	00	00	00	00	02	00
H1	Y	Y	H2	--	--	H3	H3	H3	G1	00	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	00
B2	B2	B2	K1	--	--	K2	--	--	F2	00	xx	xx	xx	00	00	00	00	00	00	00	00
D4	--	--	D5	--	--	D6	--	--	H4	SQ	00	00	00	00	00	00	00	00	00	00	00
D7	00	00	D8	--	--	D9	--	--	F3	00	00	00	00	00	00	00	00	00	00	00	00
D10	--	--	D11	--	--	D12	--	--	K3	00	00	00	00	00	00	00	00	00	00	00	00
S1	Z1	Z1	Z2	Z2	M1	E2	--	--	N1	00	00	00	00	00	00	00	00	00	00	00	00

Example:
Send 2 times value AA
Send 5 times value 55
Repeat 2 times
results in:
AAAA5555555555AAAA5555555555

Tandem connection monitoring (TCM) is a way to monitor the performance of part of an SDH path. This is a continuation of our article from Issue no. 3 on page 2.

Tandem connection monitoring: Alarm and error handling in defined subpaths

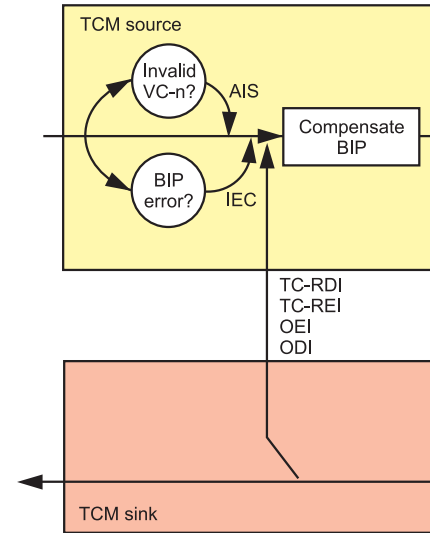
In the last issue of Advanced Network Testing, we focused on the error monitoring mechanism. Now we will consider the following:

- The concept of TCM sources and sinks
- The alarm structure of TCM
- Alarm display with the ANT-20.

Fig. 1 shows a typical configuration: Provider 1 connects a VC-n path in the forward and backward directions via Provider 2's network. The entire path is monitored using the facilities provided by the POH. The subpath within Provider 2's network is known as the TCM sublayer. The transfer points are referred to as the TCM source and TCM sink. A complete

alarm protocol flows between them in both directions (Fig. 2). Events in the path cause the following responses in the source and sink:

Fig. 2: Alarm and error handling in the TCM sublayer



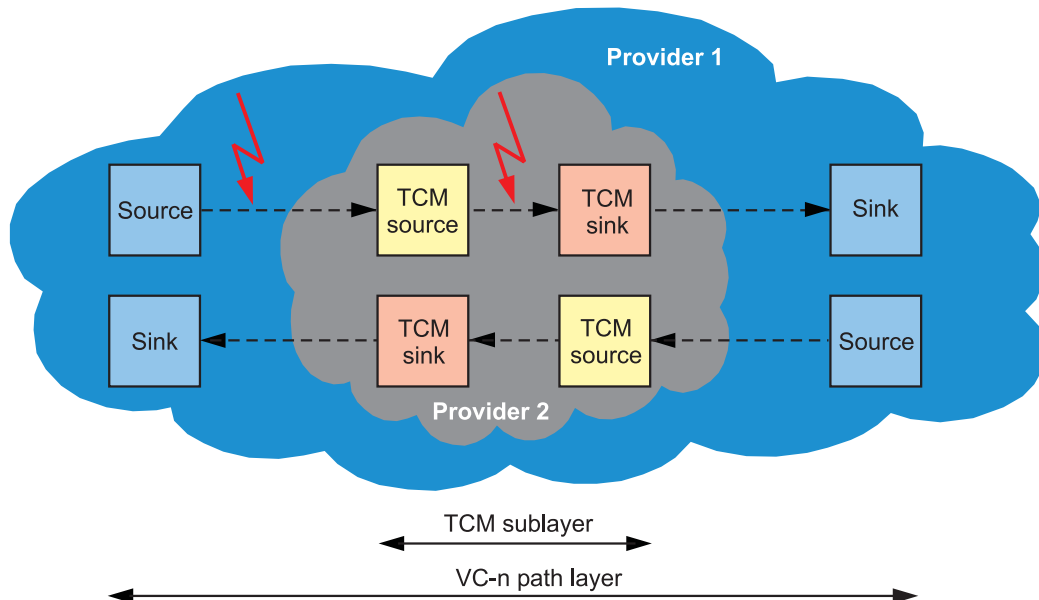
TCM source

Event	Response
Invalid VC-n?	Insert AIS (Alarm Indication Signal)
BIP errors detected?	Insert error information into IEC (Incoming Error Count)
Alarms received from TCM sink	Set TC-RDI (Tandem Connection Remote Defect Indication) Set TC-REI (Tandem Connection Remote Error Indication) Set ODI (Outgoing Defect Indication) Set OEI (Outgoing Error Indication)

TCM sink

Event	Response
TC alarms detected?	Set TC-RDI (Tandem Connection Remote Defect Indication)
AIS detected?	Set ODI (Outgoing Defect Indication)
BIP errors detected?	Insert error information into OEI (Outgoing Error Indication)
BIP not equal IEC?	Insert difference into TC-REI (Remote Error Indication)

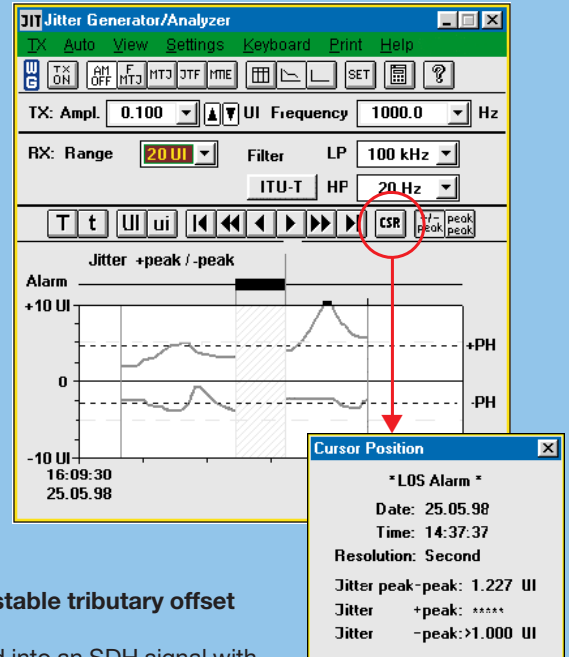
Fig. 1: TCM enables monitoring of the performance of part of an SDH path. This becomes critical when the path is routed via networks operated by different providers. The subpath to be monitored is defined as a "TCM sublayer". The N1/N2 bytes of the POH are used for error monitoring and for alarm handling (only the N1 byte in SONET).



ANT-20 Jitter News – Software Release 6.6

Jitter vs. time

This function allows the ANT-20 to record the jitter vs. time. The instrument can measure positive and negative peak values or peak-to-peak values. This allows, for example, changes in intrinsic jitter to be measured. Evaluation is on a per second basis. Measurement duration is up to 99 days, same as for other measurement modes. By simultaneously evaluating alarms and errors, correlations between events can be easily verified and the sources of errors quickly identified.



Test of mapping jitter with adjustable tributary offset

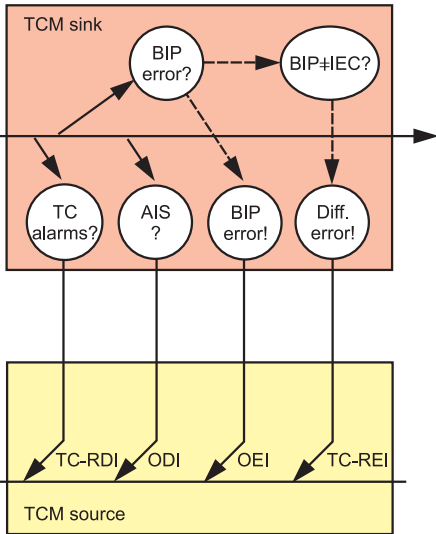
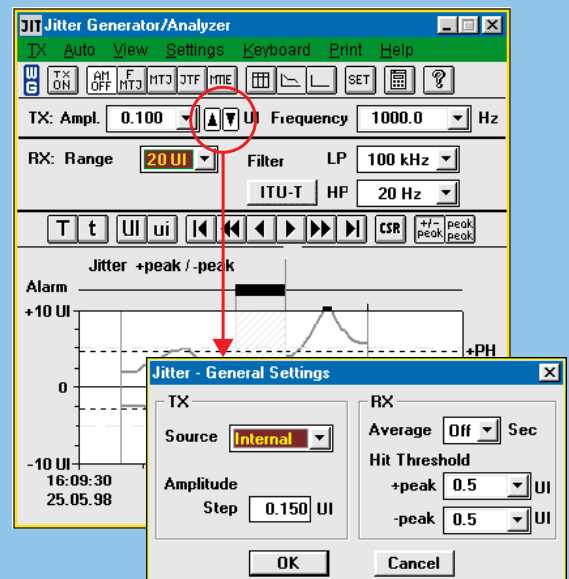
When PDH tributaries are mapped into an SDH signal with a clock offset, what arises is known as “mapping jitter”. ITU-T G.783 prescribes the following maximum values for mapping jitter:

Bit rate	Max. offset	Max. pk-pk jitter	High pass	Low pass
1.544 Mbit/s (DS1)	± 50 ppm	0.1 UI	8 kHz	40 kHz
2.048 Mbit/s (E1)	± 50 ppm	0.075 UI	18 kHz	100 kHz
34.368 Mbit/s (E3)	± 30 ppm	0.075 UI	10 kHz	800 kHz
44.736 Mbit/s (DS3)	± 20 ppm	0.1 UI	30 kHz	400 kHz
139.264 Mbit/s (E4)	± 20 ppm	0.075 UI	10 kHz	3500 kHz

The new ANT-20 function allows the offset to be set in the range of ± 100 ppm in steps of 1 ppm (e.g. STM-1 signal including 2 Mbit/s ± x ppm). The complete test procedure can be automated by the WG ANT-20 CATS test sequencer.

Jitter increment/decrement step buttons

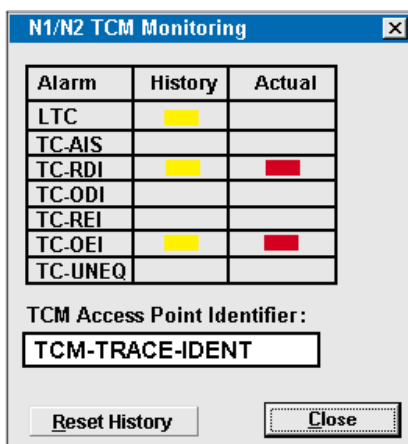
The jitter tolerance of a device under test is checked by applying a signal with a specific jitter frequency and increasing the jitter amplitude until the device can no longer process the signal. This procedure is repeated at different frequencies. With the new software release 6.6, the ANT-20 can modify the jitter amplitude in small, programmable steps (with the step button or automatically).



The N1/N2 bytes from 76 frames form a TCM frame; in SONET signals, only the N1 byte is used (formerly known as Z5). The TCM alarm responses listed above are transmitted in this TCM frame. The ANT-20 enables detailed analysis of the TCM protocol:

- Capture of N1/N2 bytes (with manual trigger, with TCM trigger)
- Interpretation of TCM events
- TCM error measurement (e.g. in the Anomaly & Defect Analyzer)
- TCM alarm & trace monitoring: The different events and the TCM path trace identifier are displayed in a window of their own.

Jochen Hirschinger



TCM events, as presented by the ANT-20. All of the functions described in this article are part of the “Extended Overhead Analysis” option, BN 3035/90.15. This option also allows:

- Capture of SOH, POH bytes
- APS time measurement
- APS protocol decoding

Werner Habisreiterger

For extended analysis of the P bits and CP bits in the DS3 C-bit framing format, both parities can now be tested separately with the ANT-20's new software version 6.6.

DS3 – Separate parity insertion

DS3 frame formats

The North American DS3 frame contains seven DS2 signals, each of which is multiplexed from four DS1 signals. The frame consists of seven sub-frames each comprising eight blocks with an overhead bit and 84 data bits. There are two formats.

C-bit parity: The frame contains two P bits for a classic parity check and also three CP bits for performance monitoring.

M13 asynchronous: This standard DS3 frame contains the two P bits, but also has 21 C bits as stuffing control bits, which precludes the possibility of CP bits. This is why network operators have been using systems with the C-bit parity frame format for some time now.

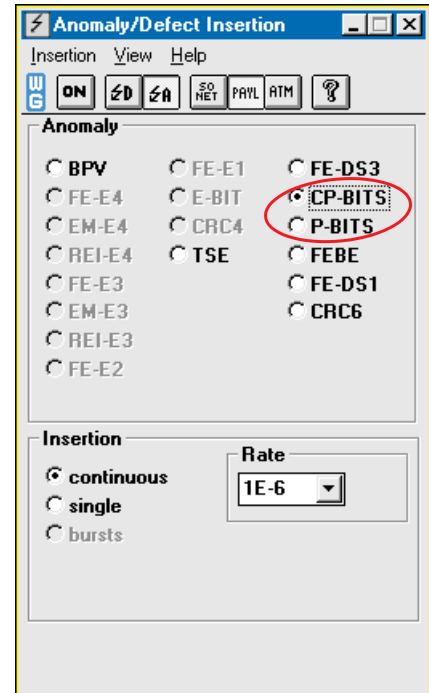
P bits for error detection between network elements

The two P bits are used for in-service error detection. On the transmitting end, a parity is computed for the entire DS3 frame less the 56 overhead bits. This parity is recorded in the two P bits of the following DS3 frame. The two P bits are always set to the same value, and are

set to "1" if the preceding DS3 frame has an odd number of ones, or "0" for an even number of ones. If a difference between the recorded value and the newly computed value occurs during analysis in the next receiver, then at least one bit error occurred during transmission.

CP bits for end-to-end performance information

The three CP bits contain the DS3 path parity information. The CP bits are computed using the same parity technique as the P bits and are used for error monitoring. The main difference from the P bits is that over the entire transmission path no new values are computed and recorded. Accordingly, they can be used for in-service end-to-end performance monitoring. The P bits, which are recomputed and recorded by each network element, cannot be used for this purpose.



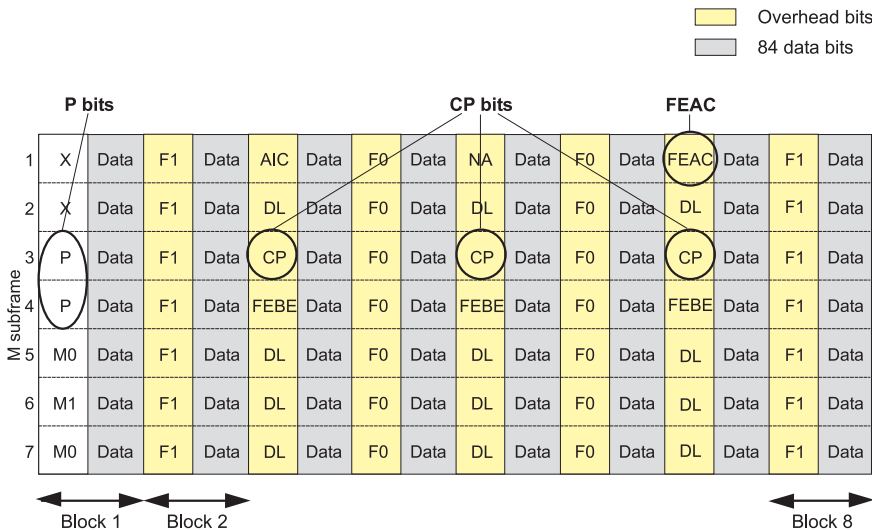
The ANT-20's anomaly/defect insertion enables separate insertion of CP and P bits

DS3 monitoring and analysis with the ANT-20

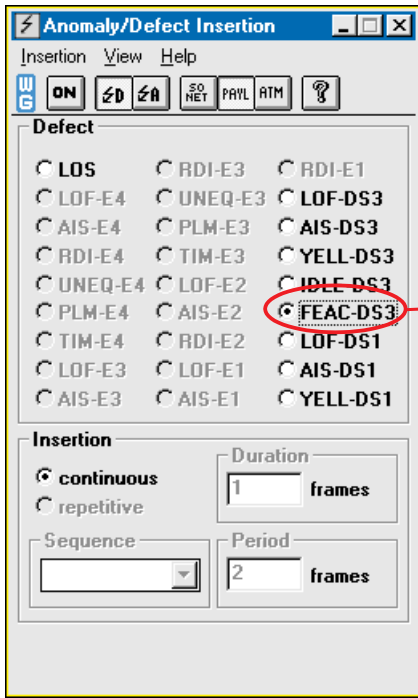
The ANT-20 generates DS3 frames according to ANSI T1.107 and GR-499 Core. If the DS3 C-bit framing format is chosen, errors can be inserted into the P bits or the CP bits (singly or continuously). This is handled in the Anomaly/Defect Insertion menu. The Anomaly/Defect Analyzer checks for the presence of corresponding parity errors.

This new ANT-20 feature provides a means of guaranteeing the performance of your DS3 connection.

Adolf Habitzreither

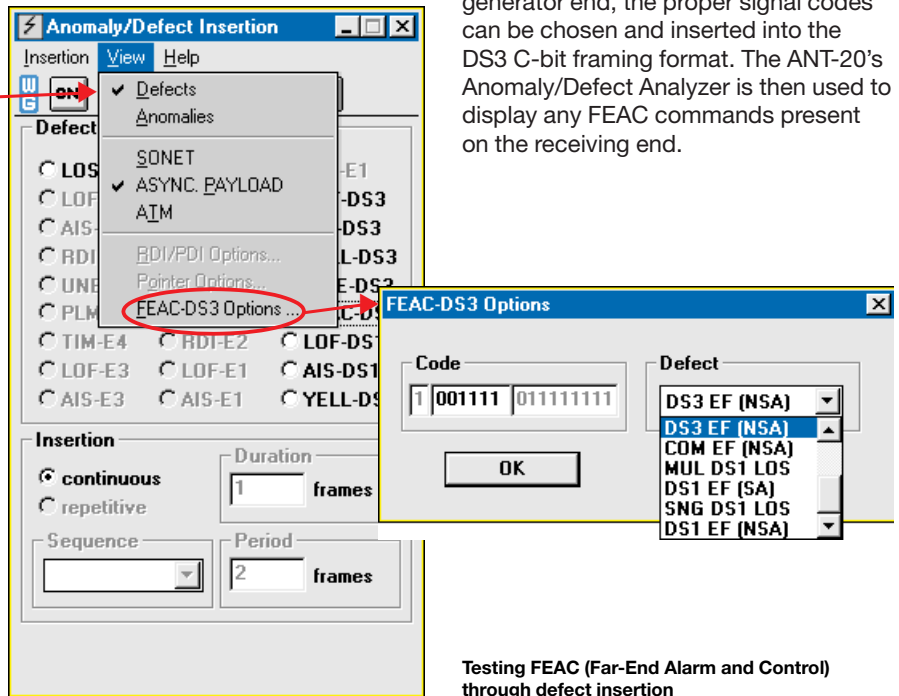


DS3 C-bit parity format. The CP bits in the 3rd M subframe occupy the positions of C bits in the earlier M13 asynchronous format



ANT-20 tests FEAC alarm and status information

To check for proper transmission of the FEAC information, all of the currently defined alarm/status signal codes have been stored in the ANT-20. On the generator end, the proper signal codes can be chosen and inserted into the DS3 C-bit framing format. The ANT-20's Anomaly/Defect Analyzer is then used to display any FEAC commands present on the receiving end.



Testing FEAC (Far-End Alarm and Control) through defect insertion

New FEAC functions

In the DS3 C-bit framing format, the FEAC (Far-End Alarm and Control) overhead bit has two functions:

1. Transmission of alarm and status information from the far-end terminal to the near-end terminal, and
2. Switching of DS3 and DS1 loopbacks at the far-end terminal from the near-end terminal.

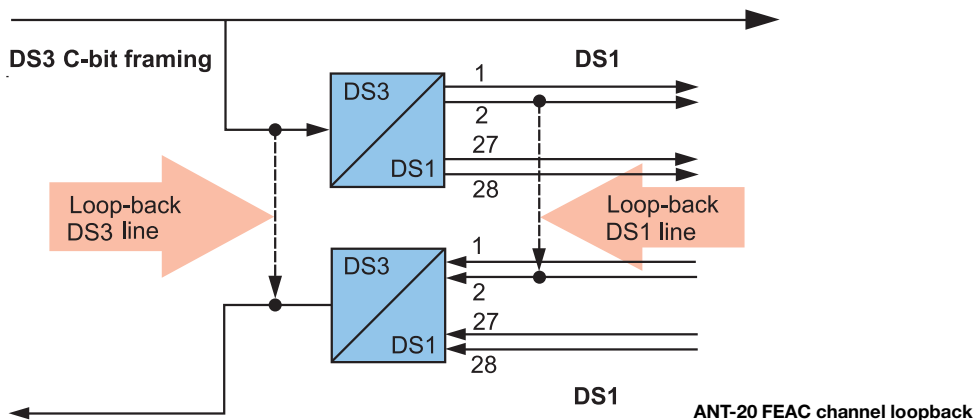
In the FEAC overhead bit (1st M sub-frame, block 7), a repeating 16-bit sequence is transmitted with the code

pattern "0xxxxxx0 11111111". This 16-bit sequence is used to transmit alarm and status information as well as loopback commands. The "x" bits are filled according to the commands specified in ANSI T1.107 or GR-499 Core. When no alarm or status information is transmitted, all of the FEAC bits are set to "1".

ANT-20 loops back DS1 and DS3 signals

For use in isolating error sources, the ANT-20 can switch loopbacks of DS1 or DS3 signals and perform error measurements. In the PDH Generator/Analyzer menu, the DS1 channels within a DS3 signal (or an actual DS3 signal) are chosen and then looped back with the aid of the FEAC commands. This procedure enables section-by-section testing of DS1 channels in case errors were detected in an end-to-end test.

Adolf Habitzreither



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Tandem connection monitoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
New jitter functions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
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