Advanced Network Testing

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

Dear Reader:

In the last issue of "Advanced Network Testing", we announced that the focus of this, our second issue, would be broadband applications. As it turns out, our scope has broadened a bit — a reflection of the ANT-20's substantial (and growing) application range?

Since we plan to continue expanding and improving the features of this product, we are very interested in what you think. Please use the enclosed questionnaire to let us know what you want in a future SDH/SONET tester.

We're serious about your opinion. The first 100 people to return the questionnaire will receive a free copy of the book "Test solutions for digital networks".

Jochen Hirschinger

Monitoring SDH Networks (In-Service Measurements)

Application Example: Pointer Analysis

Broadband Applications: Precision Testing of ATM Traffic Contracts

Frequently Asked Questions
Jitter: RMS or peak-to-peak?
Trigger output options
Typical delay values

Fully-Automated Measurement of Wander and Jitter Tolerance

WG Training Center

Monitoring SDH Networks (In-Service Measurements)

New SDH networks are generally built today under intense deadline pressure, and it is common to see the first customer connected even before a proper acceptance test can be performed. This makes it impossible to perform a complete out-of-service (OOS) acceptance procedure. It also restricts the ability to make basic monitoring and troubleshooting tests. In-service monitoring is the answer. This article takes a look at the interfaces (monitor points). Monitor points are either implemented by the system manufacturer or can be arranged externally (at extra expense) in the networks.

Wandel & Goltermann
Communications Test Solutions

Built-in monitor points

CMI electrical monitor points

Protected monitor points (PMP, Fig. 1) exist in systems with a 75 Ohm electrical output using CMI coding, and also in radio relay systems. The CMI output signal is connected internally in the SDH system via a decoupling impedance to an output jack (usually 1.6/5.6). Together with the 75 Ohm terminating impedance of the test set, this causes 20 dB attenuation of the CMI signal. The ANT-20 is set for increased input (PMP) sensitivity. The internal preamp then boosts the level by 20 dB so that the standard CMI level is available in the test set.
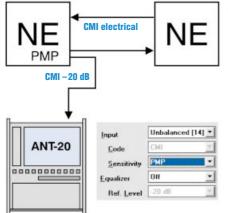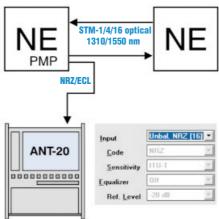

Figure 1: CMI electrical monitor point

NRZ/ECL electrical monitor points

The network element has an internal electrical/optical converter for its STM-N output; the electrical signal is NRZ/ECL. This signal is simply con-nected in parallel via an additional gate to the monitor jack (Fig. 2). In practice, there are two ways of connecting the NRZ signal to the output. The ECL out-put gate is generally terminated inter-nally into −2 V so that in conjunction with the test set's termination (normally 50 Ohm) a suitable signal is available for evaluation. However, some system manufacturers have eliminated the internal termination so that the test set

must simulate a d.c. termination. There is no unified jack for these interfaces — different manufacturers use different jacks and adapter cables are required as a result.

Figure 2: NRZ/ECL electrical monitor point

External monitor points

External optical monitor point

If the system manufacturer did not implement a monitor point with an optical output, an optical power splitter can be used externally to create an optical monitor point. The incoming light (100%) is split into two paths, with the path leading to the next NE receiving the largest share (90%, or a loss of 0.46 dB).
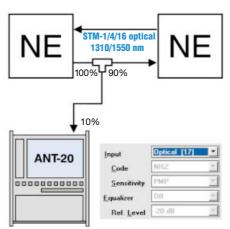

Figure 3: External optical monitor point

The smaller share (10%, or a loss of 10 dB) is diverted to the test set. Fig. 3 shows the settings on the ANT-20; the optical RX level on the test set can also be monitored.

STM-1 (CMI) external monitor point

If the system manufacturer did not implement a monitor point with an electrical output, an electrical tee and a series impedance can be used externally to create an electrical monitor point. The incoming electrical CMI signal is distributed over two paths. The path to the next NE is through-connected with no additional loss, while the path to the test set is diverted via a series impedance. The method described in Fig. 4 is also suitable for unbalanced outputs in PDH systems with bit rates of 2, 8, 34 and 140 Mbit/s.
An external monitor point kit of this sort can be purchased from Wandel & Goltermann and other suppliers. It can be permanently installed so that the network never needs be interrupted again for monitoring purposes.
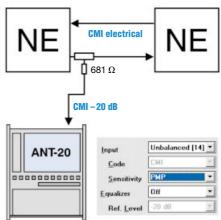

Figure 4: STM-1 (CMI) external monitor point

Instrument configuration for tests on monitor points

Possibilities for in-service measurements on the monitor points are limited. For example, a BERT (bit error ratio test) is not possible directly on live data traffic since there is no way to make a bit-by-bit comparison with a known reference pattern. It is thus necessary to configure the receiver for live traffic instead of a reference pattern. If we don't do this, the test set will keep displaying a loss of sequence synchronization (LSS) error message, indicating repeated pattern synchronization loss.

Fig. 5 shows the ANT-20 receiver configured for an STM-1 signal with VC12 mapping via AU4. Note that 2 Mbit/s channel number 1 is monitored, which is configured for "Traffic". During monitoring, it does not matter how the transmitter is set.

Thanks to Frank Kaplan,
Wandel & Goltermann Sales, Germany

The following in-service measurements permit quality assessments:

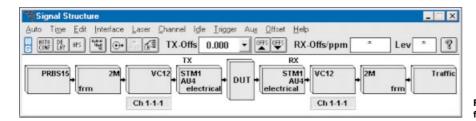| Measurement	Function
Monitoring system indicator signals	Evaluation of anomalies: Code errors, checksums (B1...BIP2, FAS, CRC4) Evaluation of defects: Loss of signal (LOS), loss of frame (LOF)...
Quality analysis (performance)	G.821, e.g. frame alignment signal (FAS) at 2 Mbit/s G.826 at any hierarchy level, e.g. BIP2 at 2 Mbit/s M.2100, e.g. CRC4 checksum at 2 Mbit/s
Pointer analysis	Monitoring clock quality in the network
Wander analysis	Classifying clock quality of an STM-N path
Output jitter	Checking allowable output jitter
Overhead analysis	Monitoring and recording overhead bytes, e.g. clock indicator S1
Mapping test	Troubleshooting and testing a mapped PDH tributary signal on STM-N end for bit errors
Trouble scan	Automatic detection of alarms during troubleshooting and for determining the configuration of a network element
Path trace (trace identifier)	Checks routing of 2 Mbit/s links during troubleshooting after connection of 2 Mbit/s PDH tributary signals

Figure 5: Setting the signal structure for monitoring

Application Example: Pointer Analysis

The aim of pointer analysis
Pointer analysis provides an initial overview of clock quality in an SDH network. A large number of pointer actions indicates that a clock source does not have sufficient precision and stability to clock an SDH network.

There is no international recommendation on the maximum number of pointer actions per day. In the real world with good clock quality, we can expect 1 to 50 pointer actions per day. It is important for the pointer actions to be distributed over the day, but individual "double-pointer" actions (two pointer actions per second) do occur with some system manufacturers. Graphical evaluation of the pointer actions provides a good overview and also makes it possible to determine the direction of the pointer action.

Instrument setting
The ANT-20 is set for the signal structure present at the monitor point (see examples in previous article). If the signal structure is unknown, the ANT-20's "autoconfiguration" function is very useful (see the last issue of "Advanced Network Testing" for details). We need a test interval of at least 24 hours to observe pointer actions.

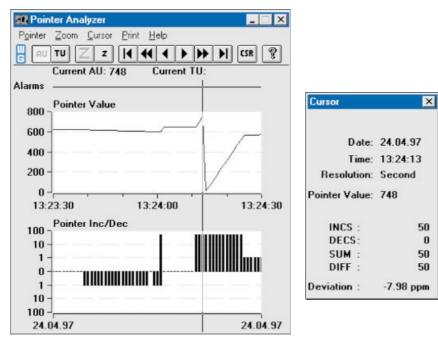Example: With SDH network elements, the clock derivation priority tables must be manually entered when the NEs are commissioned. These tables determine what clock source the NE gets its clock from, and if this source fails, what source to use as a back-up. If an incorrect entry is made or the entry simply omitted, then the NE operates in free-running mode with an internal clock source that is designed to bridge over failures (but is not suited to normal clock supply in an SDH network). The resulting clock differences are compensated with pointer actions, which in turn lead to heightened output jitter on the PDH outputs.

Results

Figure 6: The ANT-20 Pointer Analysis window

Interpreting the results
The Fig. 6 illustrates how the pointer actions behave, blown up over a minute. The actions here indicate massive clock problems in the SDH network. What now? Wander analysis is a good way to take a closer look.

For more information on the critical topic of synchronization, see our Application Note "Are you in Sync?", downloadable at http://www.wg.com/appnotes.

Thanks to Frank Kaplan,
Wandel & Goltermann, Germany.

Broadband Applications:
Precision Testing of ATM Traffic Contracts

In conjunction with the ANT-20's "Broadband Analyzer/Generator" module (BAG), you have at your fingertips an exciting array of possibilities for testing compliance of ATM traffic contracts. Traffic contracts prevent overload situations in ATM networks, which could impair network performance.
The ANT-20 transmits precisely defined ATM cell streams to the device under test (DUT). This is a way of simulating subscriber behavior and analyzing the response of the ATM system. Four identical test channels are available, each of which can carry a different traffic profile and be manipulated separately.

Select the ATM traffic contract parameters
Use the "Channel Editor" to set the properties of each test channel. There are different contract parameters and conformance criteria that you can set for the different service categories.
The BAG module supports contract editing of service categories as per ATM Forum (CBR, VBR realtime/non-realtime, UBR) and ITU-T (DBR, SBR). The contract parameters in the "Traffic Contract" dialog field (Fig. 7) are used in the

Figure 7:
Traffic Contract
dialog box

signalling process by the BAG module in SVC mode, with the two CDTV parameters being specified by the switch. Non-contract-compliant cell streams can be generated for test purposes. In the "Channel Editor" window, use the "Traffic Source" dialog field to set the default TX parameters for starting the measurement. During a measurement, hit the "Set Default" button at any time to go back and change them. In both modes (SVC and PVC), the outgoing cell streams from the ANT-20 are checked using GCRA algorithms (leaky bucket) for conformance with the values set in the "Traffic Contract" dialog field and the result displayed.

Traffic contract parameters are agreed upon between the subscriber and network provider. **Source parameters** determine the transmission behavior of the ANT-20.

Example: **Traffic contract**		Source parameter		
PCR:	15 Mbit/s	PCR	16 Mbit/s	*Non-compliant*
CDVT peak:	60 µs	Cell Jitter	60 µs	*Compliant*
SCR:	5 Mbit/s	MCR	3.9995 Mbit/s	*Compliant*
BT:	800 µs	Burst Size	319 µs	*Compliant*
CDVT sustained:	120 µs			

Vary the transmission behavior
In the "Source Parameter" dialog window (Fig. 8) (provided for each test channel), you can alter the TX behavior of the ANT-20 during a measurement. The possibilities are many: The BAG module lets you vary parameters in very small steps. Increase the cell rate of the channel with the "Mean Cell Rate" parameter, or alter the burstiness by modifying the "Burst Size" parameter! If the "Shape to Contract" button is activated, you can rest assured that contract-compliant traffic is being generated.

Check whether the transmitted traffic complies with the contract
In the "Test online control" window, you can view the percentage of non-conforming cells (NCC) during the measurement. There are different combinations of source parameters that can lead to non-conforming cell streams. If the "Set Maximum" button is activated, all source parameters are set to the maximum conforming values. This setting is a good starting point for further study. For example, by increasing the parameters by steps, you can slowly enter non-conforming regions.

Test the switch's policing function
Use these settings to simulate non-conforming subscribers who attempt to overuse network resources, for example. To prevent disruption of contract-compliant subscribers, many ATM switches are capable of discarding non-conforming cells. This function is known as "policing". The policing

Want to know more about ATM or applications of the BAG module? The Application Note "Can You Be Sure that There Are No Weak Links – Advanced Broadband Testing" offers practical examples and explains terms such as SVC and traffic contract. You can download the Application Note at http://www.wg.com/appnotes.

Figure 8: On-line Control source parameter

threshold indicates where to begin discarding non-conforming cells and must be precisely measured. Using the BAG module's source parameter control, you have the right tool to slowly approach this value. Cell losses can be assessed in the "Test Results" window, which provides QoS evaluations to ITU-T O.191.

ATM	Asynchronous Transfer Mode
BT	Burst Tolerance
CBR	Constant Bit Rate
CDVT	Cell Delay Variation Tolerance
DBR	Deterministic Bit Rate
GCRA	Generic Cell Rate Algorithm
MCR	Mean Cell Rate
PVC	Permanent Virtual Circuits
SBR	Sustainable Bit Rate
SCR	Sustainable Cell Rate
SVC	Switched Virtual Circuits
UBR	Unspecified Bit Rate
UPC	Usage Parameter Control
VBR	Variable Bit Rate

Fully-Automated Measurement of Wander and Jitter Tolerance

WG CATS Test Sequencer (BN 3035/95.90) is test automation software that runs directly on the ANT-20. The sequencer enables fully automatic measurement of jitter and wander tolerance (MTJ) and jitter and wander transfer functions (JTF, WTF), e.g. as described in ITU-T Recommendation G.823 or G.825. Note that wander tolerance tests are generally very time-consuming since wander frequencies are in the microhertz range. The period of a 12 μHz signal is about one day!

The procedure is as follows:
– Input the wander frequency
– Input the wander amplitude
– Initiate the BERT, wait for test completion (from minutes up to days per frequency)
– Read the bit error result and enter it into result form
– Input the next wander frequency, etc.

If we do this manually, it is a very time-consuming process. But an ANT-20 fitted with CATS does it automatically. Just enter a list of 10 or more different wander frequencies (range 12 μHz to 0.1 Hz) and amplitudes (1 to 99999 UI) and press the Start button. If this test case is combined with the existing jitter tolerance test case, it is possible to check the complete tolerance for wander *and* jitter with a single keypress; there is no need to manually enter new test points!

In instruments equipped with the wander option (BN 3035/90.67), the MTIE value measured at the output of the DUT is recorded for each generated wander frequency, enabling assessment of the wander transfer function. Note that the Wander option is *not* required for pure wander stress tests with no wander measurement.
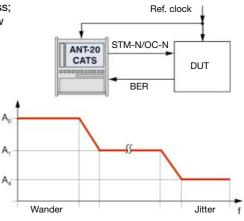

Figure 9: Test setup and tolerance mask

Get Ready for Tomorrow's World of Communications: WG Training Center

In today's fast moving world, personal and professional development is an attitude and a lifelong process rather than an sporadic activity. However, carefully selected workshops and seminars at the right time improve efficiency and have a lasting beneficial effect. With experts in various fields relating to state-of-the-art test and measurement equipment, the Wandel & Goltermann Training Center is uniquely positioned to deliver high-quality, leading-edge expertise. We make sure that training is practice-focused. No busywork. No theory you will never use – only the theory you will need for the job. And plenty of hands-on training to help you put your new knowledge and skills to use immediately to achieve your goals.

The Training Center offers the following workshops for **SDH** and **SONET:**

– Meeting the challenges of synchronous networks
– Avoiding downtime in SDH and SONET networks
– Synchronicity of SDH / SONET networks
– Avoiding problems caused by jitter

– Verifying quality of service (QoS) in synchronous networks
– Test automation Remote control and operation via PC

and for **ATM:**

– Optimizing traffic management
– Commissioning ATM service
– Can you rely on the quality of your connection?

If you would like more information or want to sign up for a workshop please contact:

Stephan Schultz
E-mail:
stephan.schultz@wago.de
Phone: +49 7121 861877
Fax: +49 7121 862054

Or contact your local Wandel & Goltermann sales organization.

We look forward to welcoming you to one of our seminars in the near future.

Figure 10: Our training brochure – available free of charge

Training for tomorrow's world of communications

Wandel & Goltermann
Communications Test Solutions

Questionnaire for an SDH/SONET tester

Please return this questionnaire!

The first 100 replies will receive a Free SDH/SONET book

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FAX to
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Roland Kiefer

Test solutions for digital networks

Basic principles and measurement techniques for PDH, SDH, ISDN and ATM

Hüthig

Your name:

_____

Your organization:

_____

Your address:

_____

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Serial no. of your ANT-20:

_____

Dear User,
We want to know what you think.
Your valuable opinion will help us in the continuing development of our SDH/SONET testers. Please rate the following items in level of importance to your application when it comes to deciding what SDH/SONET tester to buy.

Please mark:

How important are the following in your decision to purchase:

	Vital	Important	Moderately important	Less important	Un-important
General issues					
Manufacturer's reputation	☐	☐	☐	☐	☐
Purchase price	☐	☐	☐	☐	☐
Cost of ownership	☐	☐	☐	☐	☐
Quality of service and support	☐	☐	☐	☐	☐
Delivery time	☐	☐	☐	☐	☐
Product training	☐	☐	☐	☐	☐
Instrument design					
Portability	☐	☐	☐	☐	☐
Ease of use & operation	☐	☐	☐	☐	☐
Windows-based GUI	☐	☐	☐	☐	☐
Reliability of results, compliance with standards, e.g ITU-T, ANSI	☐	☐	☐	☐	☐
Modular design with future viability	☐	☐	☐	☐	☐
Remote operation	☐	☐	☐	☐	☐
Technical features					
Interface variety & flexibility	☐	☐	☐	☐	☐
Instrument up to STM-16/OC-48	☐	☐	☐	☐	☐
Combined SDH & SONET	☐	☐	☐	☐	☐
Jitter & wander applications	☐	☐	☐	☐	☐
Upgrade to ATM applications	☐	☐	☐	☐	☐
Automatic test sequences	☐	☐	☐	☐	☐
Complete solution in one box	☐	☐	☐	☐	☐
More					
_____	☐	☐	☐	☐	☐
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Next Page ➡

Questionnaire for an SDH/SONET tester

What other functions do you need in an SDH/SONET tester (state up to three preferences)?

1. _____
_____
2. _____
_____
3. _____
_____

What training would interest you as an aid to broadening your understanding of SDH/SONET/ATM?

1. _____
_____
2. _____
_____
3. _____
_____

Would you like a free subscription to "Advanced Network Testing"?

☐ Yes   ☐ Already subscribed   ☐ Not interested

Thank you very much for answering these questions.

As you already know, we care about your opinion:
100 copies of the SDH/SONET book are waiting.

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