SignalWizard: all-channel testing technology (SONET)

Product note

The role of SONET technology is evolving. Network elements are now incorporating grooming capability coupled with switching and multiplexing. Increasingly deployed in the access network, they enable bandwidth in the core network to be used effectively. To ensure these network elements are fully and efficiently tested, new test techniques are required if installation, commissioning and troubleshooting are to be cost-effective propositions.

To fully check routing of transmission paths in multi-service aggregation platforms each channel must be tested sequentially. This is time consuming and inefficient. An obvious solution to increase productivity would be to simultaneously monitor all the channels in a single test, without compromising measurement accuracy.

Agilent's new family of portable Transmission Test Set offers the very latest in all-channel testing technology. It provides simultaneous monitoring of up to 192 channels continuously at 10 Gb/s, with granularity down to the STS-1 level. This product note explains how this technology can be applied to reduce network operational costs and improve network quality of service.

Agilent Technologies

Introduction

To cope with the growth in traffic volume and diversity of traffic types in today's networks, transmission systems are evolving. The latest network elements aggregate any voice, data and video services and efficiently concentrates them for optimal use of bandwidth in the long-haul transmission network.

These network elements bring all the functionality of multiple multiplexers, optical networking and switching together into a single platform, and typically support a variety of interfaces and bandwidths to STS-1 grooming granularity. Of course, as the volume and diversity of traffic expands, quick provisioning, fast commissioning and the need for service differentiation must be considered if the demands of customers are to be satisfied.

Agilent's new generation of field-portable SONET/SDH Transmission Test Sets provide a test platform that allows continuous monitoring of up to 192 channels (all STSs) at the same time. They allow you to automatically identify the line rate and channel structure of a received SONET signal, then monitor all channels for errors, alarms and pointer movements. In addition, they identify the traffic carrying status of each channel, including the type of service signal being transported. This level of precision is necessary if network elements such as new-generation aggregation platforms, add-drop multiplexers and digital cross-connects are to be both efficiently and rigorously tested.

Simultaneous monitoring can be performed both in-service and out-of-service at all SONET rates from 52 Mb/s up to 10 Gb/s. This capability is provided by the instrument's SignalWizard facility. Once enabled, SignalWizard automatically:

- discovers the line rate and channel structures of any valid OC-n signal. This includes OC-n signals that contain any mix of standard and concatenated channels.
- simultaneously monitors the line signal and all STS channels (up to 192) for errors, alarms and pointer activity.
- shows which channels are unequipped and the type of service signal being carried by equipped channels.
- provides listing and search tools to identify path routing errors within the network, and searches on any sub-string contained within the target path trace message.

From a test perspective, this technology can be used for in-service and out-of-service monitoring for faster problem resolution and improved quality-of-service.

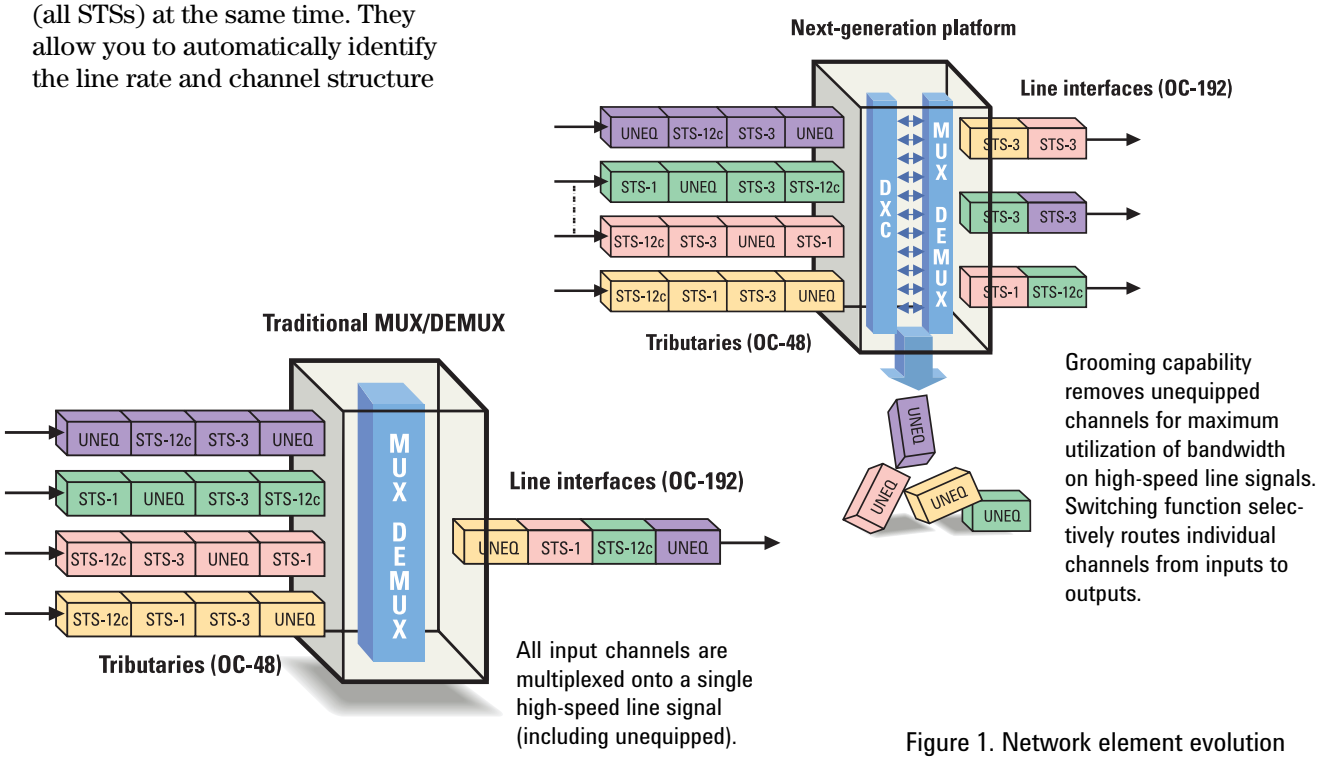


Figure 1. Network element evolution

In-service monitoring

In-service monitoring of live SONET signals is typically performed during the troubleshooting of transmission problems, commissioning (configuring) of new SONET transmission systems and service paths, and routine maintenance checks. The ability to automatically identify, then simultaneously monitor, all channels within the source signal helps rapidly verify network performance. This ensures more problems are found quickly and easily, and reduces the number of fault escalation procedures being activated. The simple operation of SignalWizard ensures that network staff can also find problems fast and readily without setting up complex testing procedures.

The transmission tester has the ability to view the full structure of the signals at both the input and output ports of an aggregation platform. This means that it is not necessary to have full cross-connection details of the aggregation platform before performing a test procedure.

For example, when commissioning a new network element, SignalWizard can be used to quickly determine whether all the paths through the network element are configured correctly, and operating error-free.

In addition, if a customer has degraded performance on their service, SignalWizard will show the operator instantly whether errors are occurring only in that customer's channel, or across additional channels.

A typical connection diagram when performing in-service monitoring is shown in Figure 2.

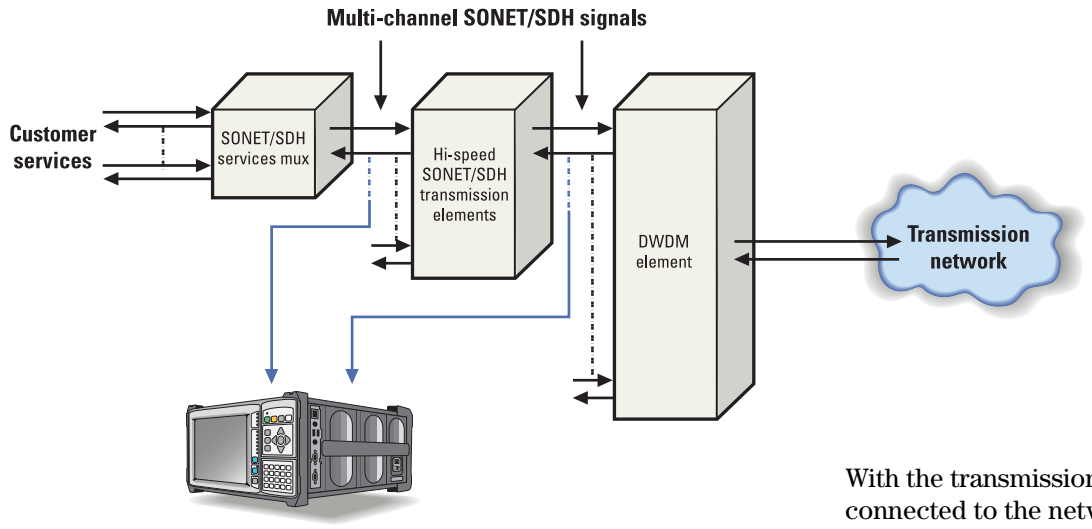


Figure 2. Typical in-service test connections

With the transmission test set connected to the network monitor point, the test set's receiver automatically synchronizes to the network clock.

Just two key presses on the test sets are required to access the test set's all-channel monitoring function. Once the OC-n signal of interest is connected to the appropriate receiver port on the test set, press the 'Smart Test' button on the front panel of the instrument.

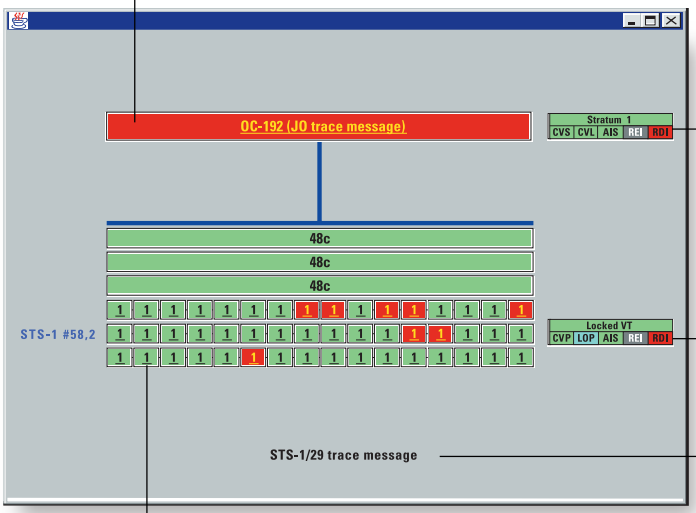
SignalWizard is now initiated and scans all the input ports to determine those receiving signals. (If more than one signal is detected, these will be displayed together with their associated line rates.)

The instrument displays the signal overview page allowing you to monitor the signal of interest, including error and alarm status, in its entirety.

In figure 3, it is evident that some of the STS channel mappings contain a sub-VT signal structure. By highlighting the signal of interest and pressing the 'Select' button, in-depth analysis can take place as shown in figure 4.

Line signal viewer

Displays the detected SONET signal (OC-192/48/12/3/1 or STS-1/3). If a J0 trace message is detected this is also displayed (both 16 and 64 byte message formats are supported).



Section/line viewer

Displays results information associated with the section and line levels of the signal, including

- synchronization status message (decoded S1 byte)
- CV-S (B1), CV-L (B2) and REI-L error status
- AIS-L and RDI-L alarm status

(LOS, LOF, OOF alarms are displayed on the instrument's front-panel LEDs.)

Selected STS channel viewer

Displays result information associated with the selected STS channel, including

- type of payload (traffic) being carried in the channel (decoded C2 byte)
- CV-P and REI-P error status
- AIS-P, LOP-P and RDI-P alarm status
- indicator for detected pointer adjustments

STS channel viewer

Each STS channel detected in the signal is provided with a dedicated box that summaries the channels status. An STS channel carrying a VT mapping is highlighted by its size designator being underlined. Broadband mappings are not underlined.

The size designator displayed within each box is the channel size identifier, where 1 indicates STS-1 (3c indicates STS-3c, 12c indicates STS-12c, 48c indicates STS-48c and 192c indicates STS-192c). While any non-standard concatenated channel will be detected and displayed, no errors or alarms are reported. Unequipped channels are grayed out.

Pointer activity within the channel structure is indicated by the STS background flashing blue.

J1 trace mesage

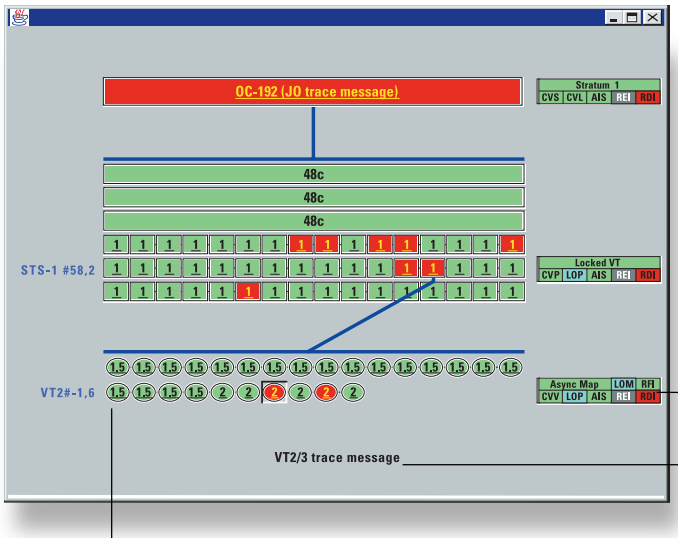
Displays the decode path trace message associated with the selected channel. Both 16 and 64 byte message formats are supported.

Color-coded results key

green	No errors/alarms detected since test started
red	Errors/alarms currently detected
yellow	Currently no alarms detected and error-free, however, errors/alarms detected earlier in measurement
grey	Unequipped channel
blue	Pointer adjustment detected
black	Illegal pointer value
red/black	AIS alarm

Figure 3. SignalWizard STS-level monitoring

Figure 4. SignalWizard STS and VT monitoring



Selected VT channel viewer

Displays result information associated with the selected VT channel, including

- type of service mapping being carried in the channel (decoded V5 byte)
- BIP-2 and REI-V error status
- AIS-V, LOP-V, RFI-V and RDI-V alarm status
- indicator for detected pointer adjustments

VT channel viewer

Each VT channel detected is provided with a dedicated display area identifying traffic status. The VT channel's size designator identifies the tributary rate, where 1.5 indicates VT1.5 and 2 indicates VT2. Channels underlined indicate the channel is carrying a mapped service. Unequipped channels are grayed out.

Pointer activity within the channel structure is indicated by the VT background flashing blue.

J2 trace message

Is displayed for the selected VT channel. Both 16 and 64 byte message formats are supported.

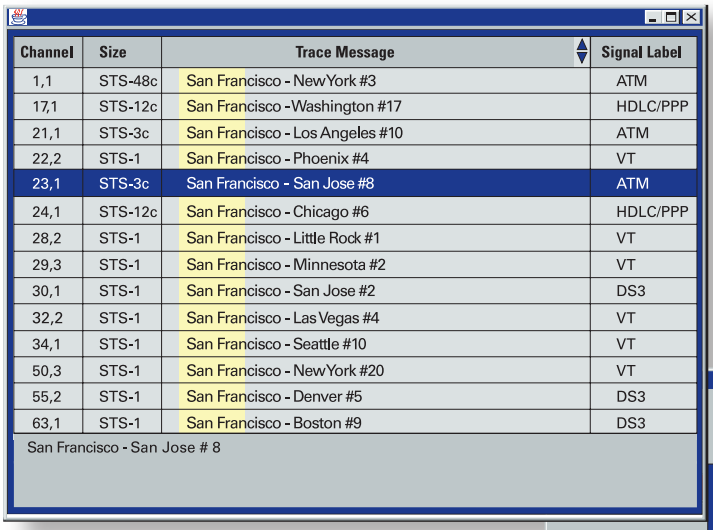
Path routing and traffic overview

When installing and commissioning new services, or troubleshooting, the ability to generate and monitor path trace messages is essential. These messages allow you to confirm correct routing performance of the aggregation elements, and allow you to identify and locate any routing errors within the network. Path trace messages are also useful for checking routing performance of network elements during protection switching to confirm the correct signals have been protected in fault conditions.

The path trace and traffic overview facilities are available for both the STS and the VT signal structures. All the J1 path trace messages can be displayed at the same time.

In addition, J2 path trace messages associated with each VT channel for a selected STS can be viewed at the same time. This allows you to continually monitor and easily identify path routing errors within the network.

It is also possible to perform a search on any sub-string contained within a target path trace message. This includes all J1 path trace messages in the STS channels, all J2 path trace messages in the VT channels within a selected STS, or all VT channels in all STS channels.



Channel	Size	Trace Message	Signal Label
1,1	STS-48c	San Francisco - NewYork #3	ATM
17,1	STS-12c	San Francisco - Washington #17	HDLC/PPP
21,1	STS-3c	San Francisco - Los Angeles #10	ATM
22,2	STS-1	San Francisco - Phoenix #4	VT
23,1	STS-3c	San Francisco - San Jose #8	ATM
24,1	STS-12c	San Francisco - Chicago #6	HDLC/PPP
28,2	STS-1	San Francisco - Little Rock #1	VT
29,3	STS-1	San Francisco - Minnesota #2	VT
30,1	STS-1	San Francisco - San Jose #2	DS3
32,2	STS-1	San Francisco - Las Vegas #4	VT
34,1	STS-1	San Francisco - Seattle #10	VT
50,3	STS-1	San Francisco - NewYork #20	VT
55,2	STS-1	San Francisco - Denver #5	DS3
63,1	STS-1	San Francisco - Boston #9	DS3

San Francisco - San Jose # 8

Figure 5. Path trace overview

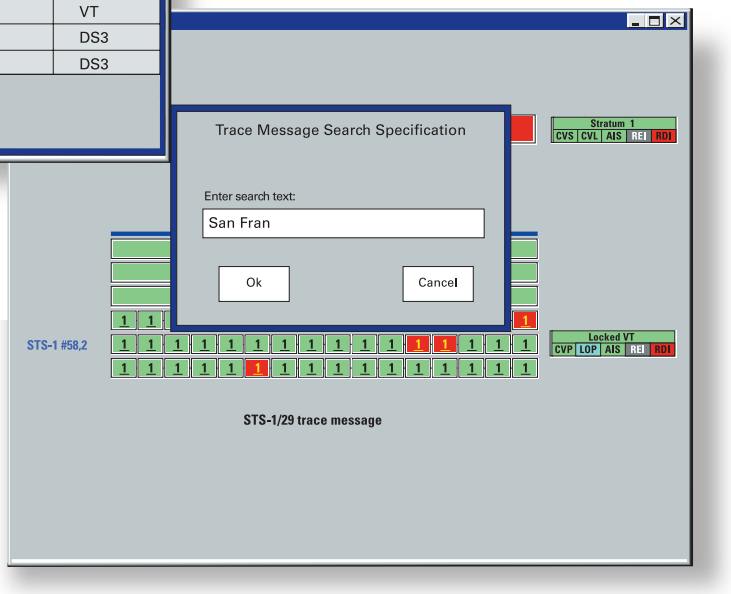


Figure 6. Path trace search window

Out-of-service testing

When used in conjunction with the test set's versatile transmitter, SignalWizard's unique all-channel monitoring capability delivers significant reductions in test time when installing, commissioning and troubleshooting the new generation of SONET transmission systems. Since these new transmission systems typically provide STS channel grooming and switching functions in addition to multiplexing, full verification of their operation is only possible by performing tests on each individual STS path processed by the system. With traditional SONET test sets this can only be achieved by sequentially testing each STS path carried within the OC-n tributary or line signals. For example, testing an OC-48 tributary signal containing forty-eight STS-1s would require forty-eight individual tests. SignalWizard requires just two key presses to test all forty-eight STS-1s allowing a faster method of independently verifying the channel provisioning setup in the system-under-test (see figure 7).

Additionally, SignalWizard identifies:

- the type of network paths present in the signal output by the network element, including the mix of STS-1/3c/12c/48c/192c channels.
- the traffic-carrying status of each STS channel, showing which channels are equipped.

This also applies at the VT channel level in any selected STS channel.

Generating a test signal with the ability to simultaneously monitor all of the channels within the signal quickly determines the integrity of the network element-under-test without setting up complex testing procedures. The signal can be applied to both the tributary side or the line side of the network element. The attractive proposition of stimulating the element from the line side (see figure 8) is the reduction in the amount of test ports that need to be tested to completely check operational conformance of the network element. (It should be noted that this is only possible if the line-side signal has no forward error correction (FEC), or if this is turned off during testing.) For example, when commissioning and acceptance testing a new network element, SignalWizard can be used to quickly determine whether all the paths through the network element are configured correctly, and operating error-free.

The simultaneous all-channel monitoring technology of SignalWizard means that these tasks can be accomplished fast, effortlessly and comprehensively, improving quality of service to all your customers.

Figure 7. Tributary-side testing a next-generation platform

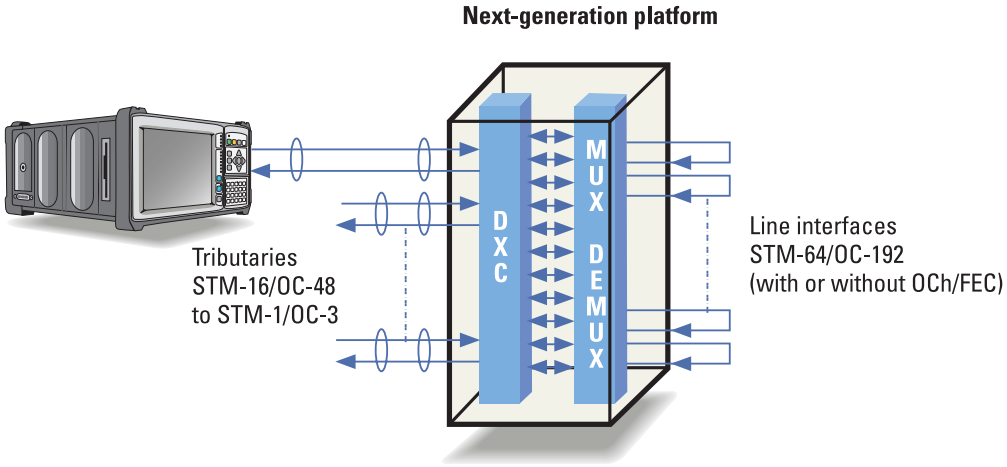
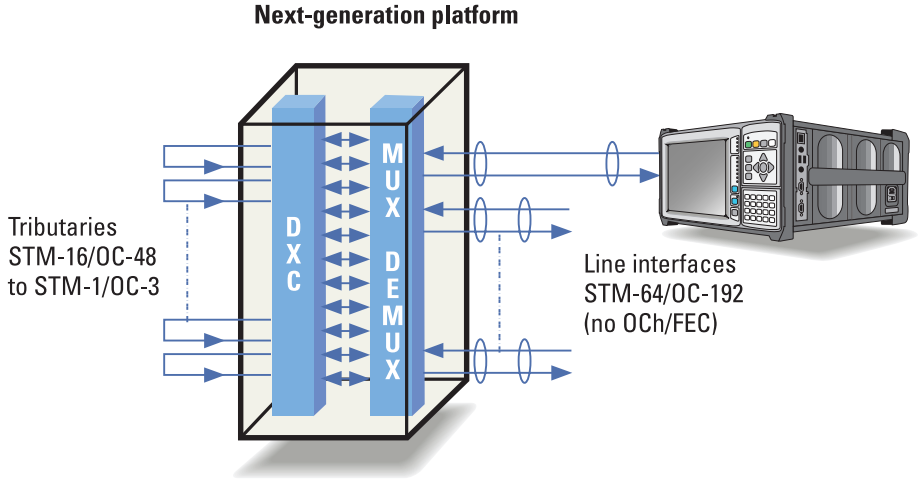


Figure 8. Line-side testing a next-generation platform



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