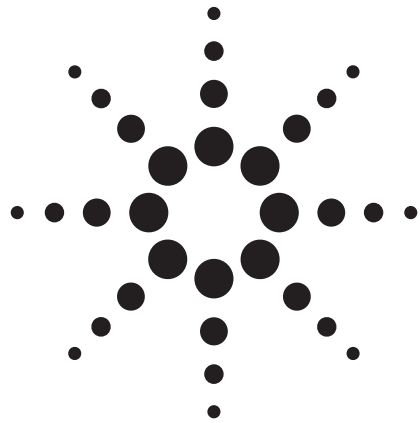


# OmniBER OTN 10 Gb/s communications performance analyzer

Product Note



STM-64c/OC-192c  
concatenated payloads -  
essential for testing  
DWDM, OTN and  
broadband systems



**Agilent Technologies**

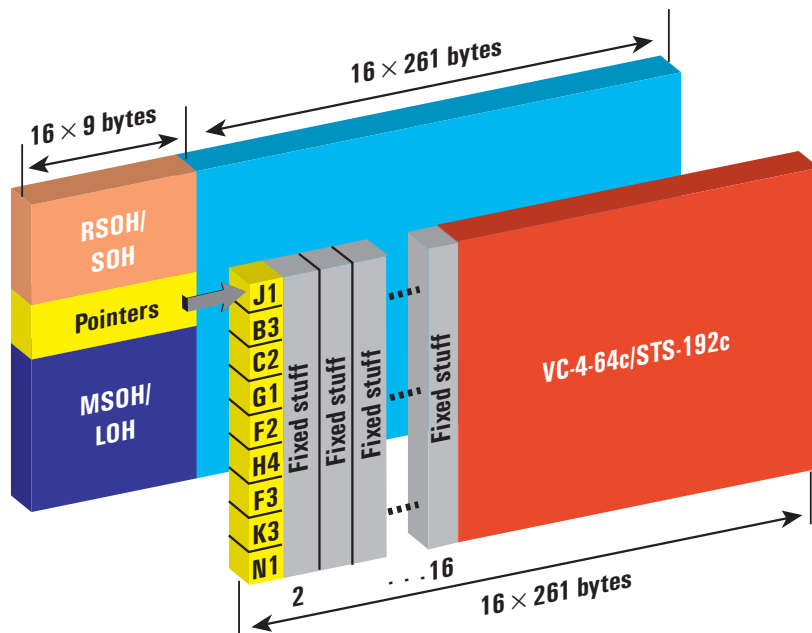


Figure 1.  
STM-64c (VC-4-64c) or OC-192c  
(STS-192c) concatenation.  
(Contiguous concatenation technique.)

## Introduction

It is widely accepted that an OC-192c/STM-64c signal is the most repeatable and realistic signal structure for BER testing. Testers that don't generate OC-192c/STM-64c signals cannot be reliably used for accurate BER testing of broadband network equipment. This product note explains why a tester with OC-192c/STM-64c capability is the only solution to accurate, fast BER testing when verifying DWDM, Optical Transport Network (OTN), and broadband system performance.

## What is a concatenated payload?

Bulk filled or contiguous concatenated payload signal structures are designed for carrying broadband services. The entire payload area is used to carry the service with no structured mapping or channelization. Typical payloads are STM-64c/OC-64c or STM-16c/OC-48c. The 64 VC-4/STS-3 containers in each STM-1/STS-3 are linked together to form one large VC-4-64c/STS-192c container. Instead of 64 different pointers, there is only one. The 63 remaining pointers are set to "concatenation indication". In addition, instead of 64 columns of path overhead, there is now only one column of path overhead.

The remaining 63 columns of path overhead contain fixed stuff, that is, all bytes are set to zero. The advantage of such payloads is that a higher bandwidth, that is, higher than a normal STM-1/STS-3 channelized signal structure, is available to carry the service. This could be ATM, video or data for instance.

## More accurate testing

An STM-16c/OC-48c signal tests the entire payload area simulating live traffic. Stimulating each tributary with channelized 155 Mb/s payload does not provide a reliable or realistic test signal as the remaining 63 channels will be either unequipped (for example, each byte in the channel contains all zeros) or contain an identical copy of the 155 Mb/s test signal.

Channelized testers which only provide STM-1/STS-3 granularity (for example, those which do not support STM-16c payloads) cannot check the entire payload area simultaneously. In other words, a tester not supporting STM-64c/OC-192c signal structures will only be able to test one part of the payload, that is, one STM-1/STS-3 channel. This means that only  $1/64$  of the payload area is being tested.

Copying the test signal into the remaining channels or not loading the remaining channels with a PRBS (pseudo random bit sequence) test signal means that crosstalk effects and pattern dependency problems may go undetected until the real service is turned up and the customer complaints start arriving at the service provider. Therefore, a 155 Mb/s channelized test signal cannot be reliably used for accurate BER testing.

The formula used to calculate residual BER assumes a gaussian error distribution:

$$C = 1 - e^{-nb}$$

**C** = Degree of confidence required  
(0.95 = 95% confidence)  
**n** = No. of bits examined with no error found.  
**b** = Upper bound on BER with a confidence **C**  
( $b = 10^{-15}$ )

To determine the length of time, that is, the number of bits needed to test for (at a given bit rate), requires the above equation to be transposed:

$$n = \log_e(1 - C)/b$$

So, to test for a residual BER of  $10^{-13}$  with a 95% confidence limit requires a test pattern equal to  $3 \times 10^{13}$  bits. This equates to only 0.72 hours using an OC-192c/STM-64c payload rather than 55.6 hours using an STS-3c/VC-4 bulk filled payload (149.76 Mb/s). The graph in Figure 2 plots test time versus residual BER and shows the difference in test time for OC-192c/STM-64c payloads versus an OC-48c/STM-16c payload.

The graphs are plotted for different confidence limits and they clearly indicate that the payload capacity is the dominant factor in improving the test time and not the confidence limit. Table 1 shows the exact test times for each BER threshold and confidence limit.

Figure 2 .  
Residual BER versus test time  
(for 95% degree confidence, C.)

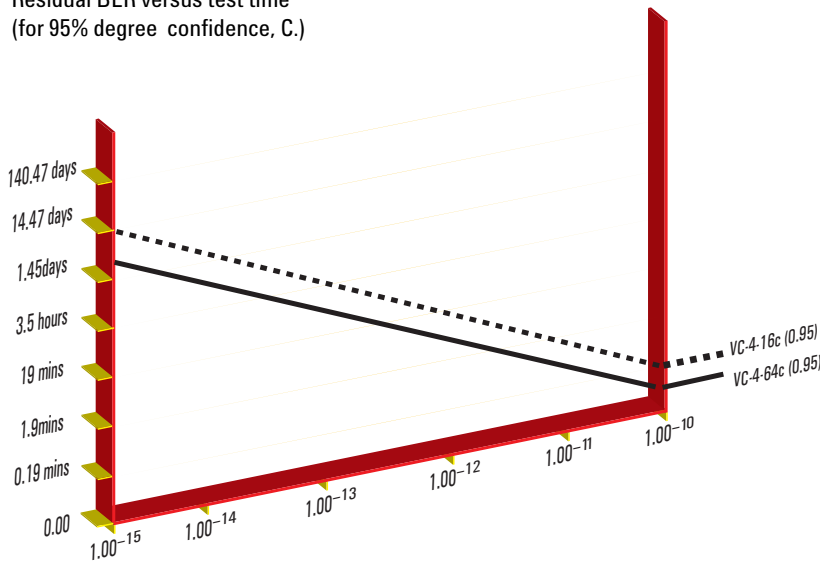


Table 1. Residual BER versus test time

C	VC-4-64c 0.95	VC-4-16c 0.95	VC-4 0.95	VC-4-64c 0.975	VC-4-16c 0.975	VC-4 0.975	VC-4-64c 0.99	VC-4-16c 0.99	VC-4 0.99	VC-4-16c 0.995	VC-4-16c 0.995	VC-4 0.995	Test Time
$1.00E^{-15}$	3.50	14.47	231.52	4.25	17.82	285.09	5.56	22.24	355.91	6.40	25.59	409.48	days
$1.00E^{-14}$	0.30	1.45	23.15	0.42	1.78	28.51	0.56	2.22	35.59	0.64	2.56	40.95	days
$1.00E^{-13}$	0.03	0.14	2.32	0.04	0.18	2.85	0.06	0.22	3.56	0.07	0.26	4.09	days
$1.00E^{-12}$	0.08	0.35	5.56	0.10	0.43	6.84	0.13	0.53	8.54	0.15	0.61	9.83	hours
$1.00E^{-11}$	0.50	2.08	33.34	0.61	2.57	41.05	0.80	3.20	51.25	0.92	3.69	58.96	minutes
$1.00E^{-10}$	0.05	0.21	3.33	0.06	0.26	4.11	0.08	0.32	5.13	0.09	0.37	5.90	minutes

## Broadband testing

The above arguments also apply to the installation of networks carrying broadband services such as ATM or IP over SONET/SDH. Prior to turning up an OC-192c/STM-64c ATM service, it is necessary to perform an OC-192c/STM-64c clear channel test to verify the integrity of the pipe. Only a concatenated payload test signal can verify all the payload area.

## Product literature

You'll find further details of the OmniBER OTN's capability in the product specification publications no. 5988-3653EN and configuration guide publication no. 5988-3654EN or at [www.agilent.com/comms/otn](http://www.agilent.com/comms/otn)

## Related products

The Agilent Technologies OmniBER 718 communications performance analyzer is the proven SONET/SDH one-box test solution. It provides full T-carrier/PDH and SONET/SDH up to 2.5 Gb/s, including concatenated payloads, ATM, Jitter and POS. For further information, refer to publication no. 5968-8740E

OmniBER 718



The OmniBER 725 combines best in class SDH and SONET jitter capability at all rates up to 2.5 Gb/s, with differential electrical interfaces. Offering unframed PRBS signals, it's the ideal choice for testing optical components and modules. For further information, refer to publication no. 5988-0327EN.



OmniBER 725

Focused on field applications, the J2127A transmission test sets cover all rates from 64 kb/s up to 10 Gb/s. Supporting SONET/SDH and T-carrier/PDH configurations, the test set offers simultaneous monitoring technology for faster turn-up and troubleshooting. For further information, refer to publication no. 5988-2569EN.



Transmission test set

*Agilent Technologies manufactures the OmniBER OTN under a quality system approved to the international standard ISO 9001 plus TickIT (BSI Registration Certificate No FM 10987).*

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