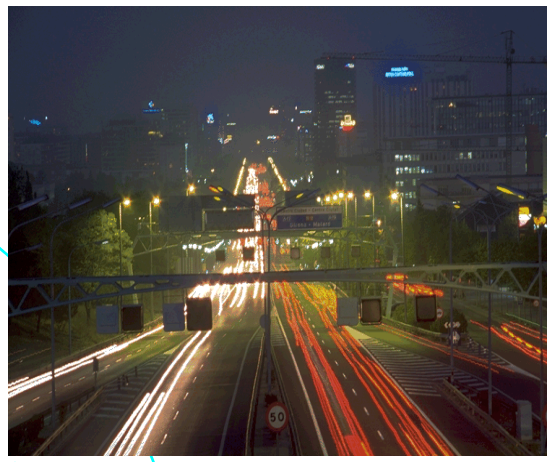
SDH monitoring with Victoria

In-service SDH monitoring makes use of the Bit Interleaved Parity (BIP) mechanism. This mechanism is used on three levels, RSOH, MSOH and POH, and is aimed at checking the integrity of blocks of data at different levels within the synchronous frames.



Application Note navasdhbip22e

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Monitoring tests let us perform an in-service evaluation of block errors in synchronous networks by means of the bit interleaved parity (BIP-n) mechanism. These errors help determine the quality of transmission in the sections and paths being examined.

BIT INTERLEAVED PARITY (BIP-N)

The operating principle involves transmitting code words that are *n* bits long in the overhead bytes B1, B2 and B3 of the STM-N frame. These words are calculated from the portion of the STM-N signal associated to them. Each portion of signal refers to one trail, as shown in Table 1 for STM-1.

Portion of signal monitored	Associated trail
STM-1 (2430 bytes)	Regenerator section
STM-1 without RSOH	Multiplex section
VC-3/4	VC-3/4 path
VC-11/12	VC-11/12 path

Table 1 Portions of signal monitored for STM-1 by the BIP-n codes.

At the receiving end, these same words are generated locally from the STM-N signal received. The code word generated locally is compared with the one received and if these are different, bit errors are assumed to have occurred in the portion of signal monitored.

Each portion of signal is divided into different blocks of interleaved bits. If the code is BIP-n this means that the portion of signal is divided into *n* blocks. For evaluating block errors in regenerator sections and VC3,4 paths, code words of one byte (code BIP-8) are used, and for

STM-1 multiplex sections, 24-bit words are used (BIP-24)[1]. For VC11, 12 paths, 2-bit words are used (BIP-2).

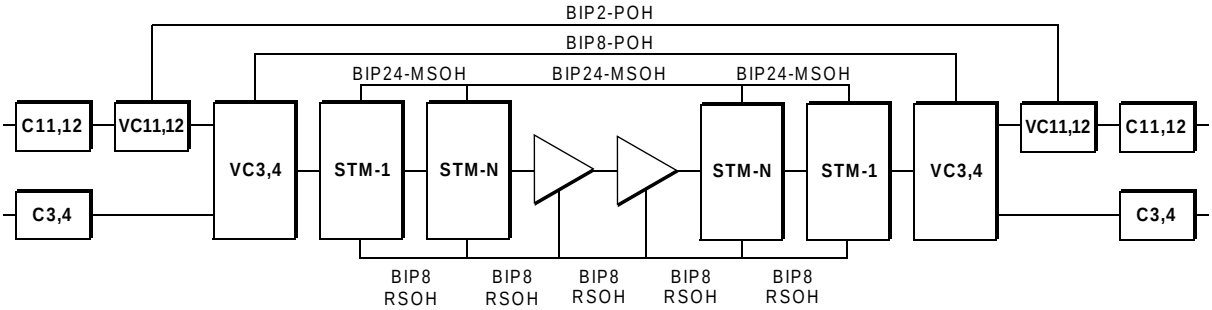


Figure 1 Monitoring SDH paths and sections: BIP-n codes.

FORMING THE CODE WORDS

The mechanism for generating BIP-n code words is basically made up of two phases. The first of these involves dividing the portion of signal into blocks. The second phase involves laying out these blocks in a table made up of *n* columns. Each bit of the code word corresponds to one column/block and has a value of "1" if the number of ones in the column is odd and "0" if it is even, thus defining a method of checking even parity, as shown in Figure 2 with a (BIP-8) example.

A discrepancy between the value received for the *i-th* block monitoring bit and the value calculated on reception implies that one or more bit errors have occurred inside this block, i.e. the block is considered as a *block error*.

The BIP-n code words are introduced in different overhead bytes according to the portion of signal monitored, as shown in Table 2 for the case of STM-1. Each code received corresponds to a portion of signal from the previous frame.

OAM SIGNALS FOR BIP MECHANISMS

The network elements monitor the block errors and send information about them to the transmission source end in the backward frames,

1. *For STM-N with N=4, 16 and 64, BIP-96, BIP-384 and BIP-1536 codes are used respectively.*

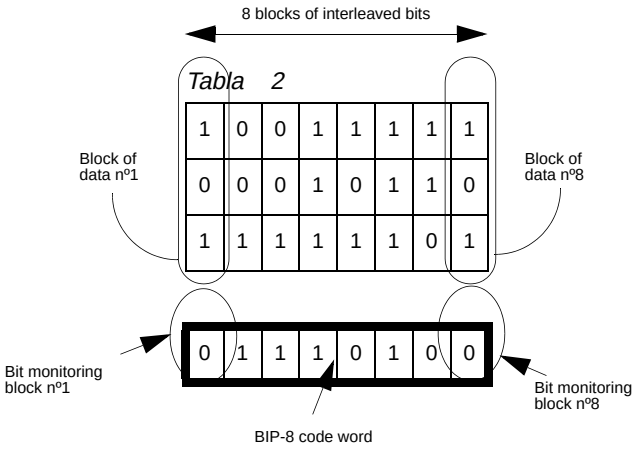


Figure 2 *Forming a code word: Example with BIP-8.*

Parity	Byte	Location	Portion of signal monitored
BIP-8	B1	RSOH	STM-1 (2430 bytes)
BIP-24	B2	MSOH	STM-1 without RSOH
BIP-8	B3	POH of VC-3/4	VC-3/4
BIP-2	V5	POH of VC-11/12	VC-11/12

Table 2 *Associated bytes and BIP parity for STM-1 frames.*

using the bytes assigned for this task for each level. The different errors examined are:

- B1 errors
- B2 errors
- B2 errors
- BIP-2 errors

Each of these errors corresponds to the number of bits in the BIP-n code words received that differ from the code word recalculated on reception, i.e. the number of errored blocks of interleaved bits.

The detection of errors leads to operation and maintenance signals (OAM) being generated and carried in the frames to the information

source. These are basically remote error indication signals (REI). REI signals are defined for multiplex sections and trails:

- MS-REI for multiplex sections (MSOH)
- HP-REI for higher order paths (VC-3/4)
- LP-REI for lower order paths (VC-3, VC-11, VC-12).

The MS-REI signal is sent in the M1 bit of the MSOH and indicates the number of block errors on the multiplex section level. The HP-REI signal is carried in the G1 byte (VC-4 or VC-3 of higher order) and the LP-REI signal is carried in G1 (VC-3 of lower order) or in V5 (VC-11/12). In the case of the byte V5, it is simply the presence or absence of block errors that is shown.

ANALYZING BIP ERRORS

Victoria lets us detect and analyze B1 errors (RSOH), B2 errors (MSOH), B3 errors (LP-POH or HP-POH) and BIP-2 errors (LP-POH) in STM-1 frames. It also detects and analyzes the associated REI signals. In each of these cases a counter, the number of seconds with error and the rate are all measured. In addition, these events can all be

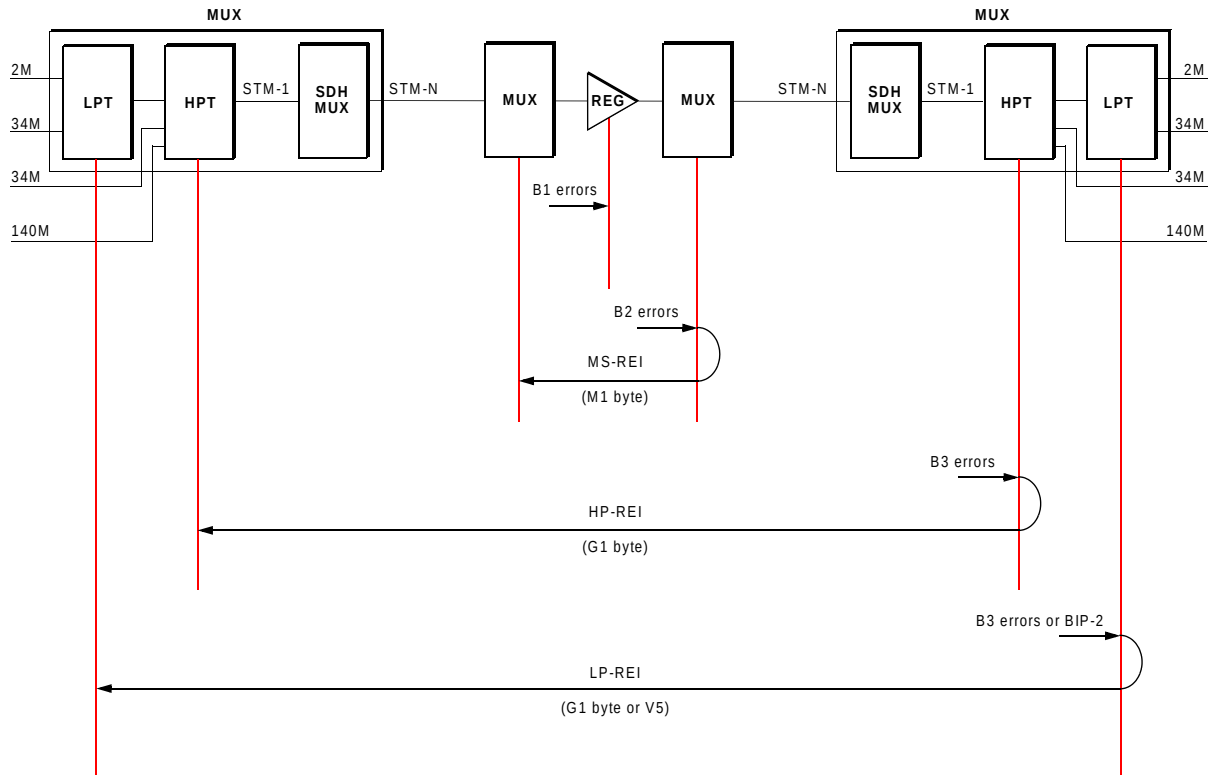


Figure 3 *OAM signals relating to the BIP mechanism. The LPT and HPT blocks symbolize the trail termination functions in an SDH multiplexer.*

generated to check how the network elements under test respond to them. ❒

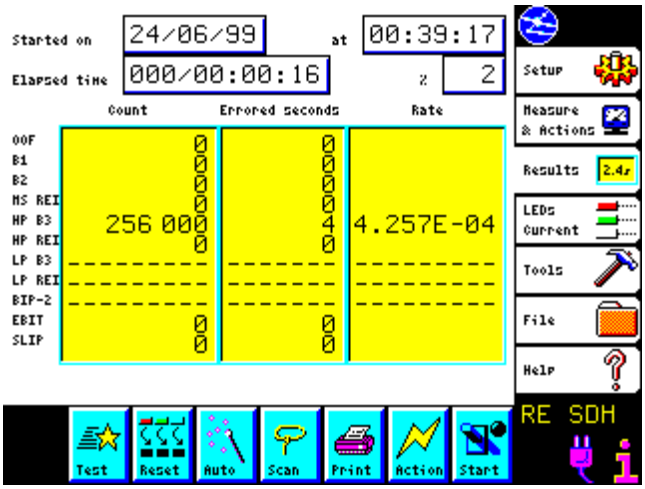


Figure 4 *Results screen showing B3 errors.*

B

BIP (*Bit Interleaved Parity*) 1, 2, 4, 6

H

HP-POH (*Higher Order Path-Path Overhead*) 6
HP-REI (*Higher Order Path-Remote Error Indication*) 5

L

LP-POH (*Lower Order Path-Path Overhead*) 6
LP-REI (*Lower Order Path-Remote Error Indication*) 5

M

MSOH (*Multiplex Section Overhead*) 1, 5, 6
MS-REI (*Multiplex Section-Remote Error Indication*) 5

O

OAM (*Operation And Maintenance*) 1, 4, 5

P

POH (*Path Overhead*) 1

R

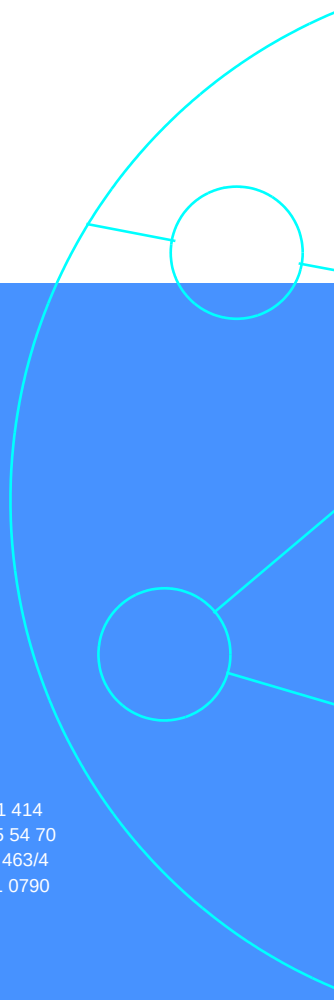
REI (*Remote Error Indication*) 5, 6
RSOH (*Regeneration Section Overhead*) 1, 2, 3, 4, 6

S

SDH (*Synchronous Digital Hierarchy*) 1
STM-N (*Synchronous Transport Module-N*) 2

V

VC (*Virtual Container*) 2, 5



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