Configuring SDH

SDH is a standard that defines optical signals as well as a synchronous frame structure for multiplexed digital traffic. It is is used in Europe by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T). The SDH equipment is used everywhere except North America. The IM supports the entire SDH hierarchy (except VC-2/C-2).

Overview of SDH

SDH was defined by European Telecommunications Standards Institute (ETSI) and is now being controlled by the ITU-T standards body. SDH standard is prevalently used everywhere outside North America and Japan.

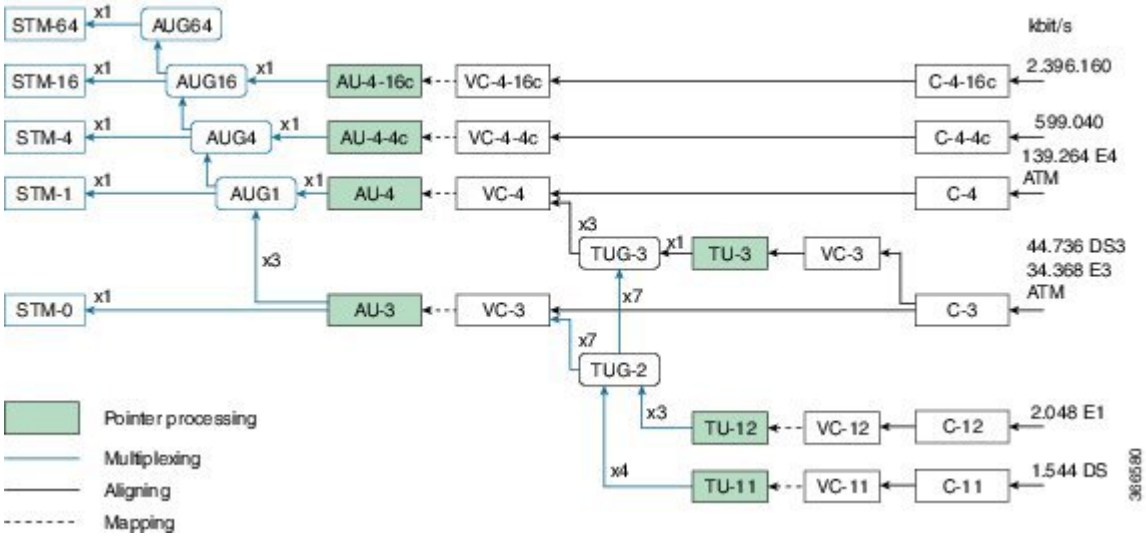
The following are true for SDH:

- Network Node Interface (NNI) defined by CCITT/ITU-TS for worldwide use and partly aompatible with SONET
- One of the two options for the User-Network Interface (UNI) (the customer connection) and formally the U reference point interface for support of BISDN

Basic SDH Signal

The basic format of an SDH signal allows it to carry many different services in its VC because SDH signal is bandwidth-flexible. This capability allows the transmission of high-speed packet-switched services, ATM, contribution video, and distribution video. However, SDH still permits transport and networking at the 2 Mbit/s, 34 Mbit/s, and 140 Mbit/s levels, accommodating the existing digital hierarchy signals. In addition, SDH supports the transport of signals based on the 1.5 Mbit/s hierarchy.

SDH Hierarchy



SDH Frame Structure

The STM-1 frame is the basic transmission format for SDH. The frame lasts for 125 microseconds, therefore, there are 8000 frames per second. The STM-1 frame consists of overhead plus a Virtual Container (VC) capacity.

The SDH frame consists of 270 columns. The first nine columns of each frame make up the Section Overhead, and the last 261 columns make up the VC capacity. The VC plus the pointers (H1, H2, H3 bytes) are called the Administrative Unit (AU). Carried within the VC capacity, which has its own frame structure of nine rows and 261 columns, is the Path Overhead and the Container. The first column is for Path Overhead; it is followed by the payload container, which can itself carry other containers. VCs can have any phase alignment within the Administrative Unit, and this alignment is indicated by the Pointer in row four. Within the Section Overhead, the first three rows are used for the Regenerator Section Overhead, and the last five rows are used for the Multiplex Section Overhead. The STM frame is transmitted in a byte-serial fashion, row-by-row, and is scrambled immediately prior to transmission to ensure adequate clock timing content for downstream regenerators.

Figure 1: STM1 Frame Structure

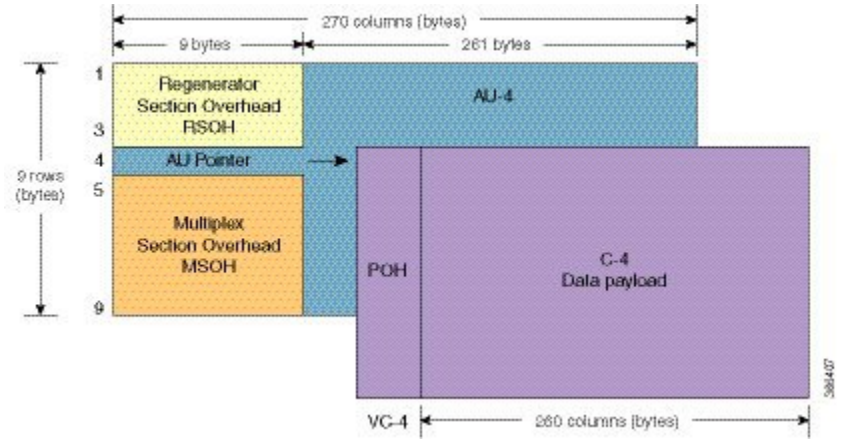
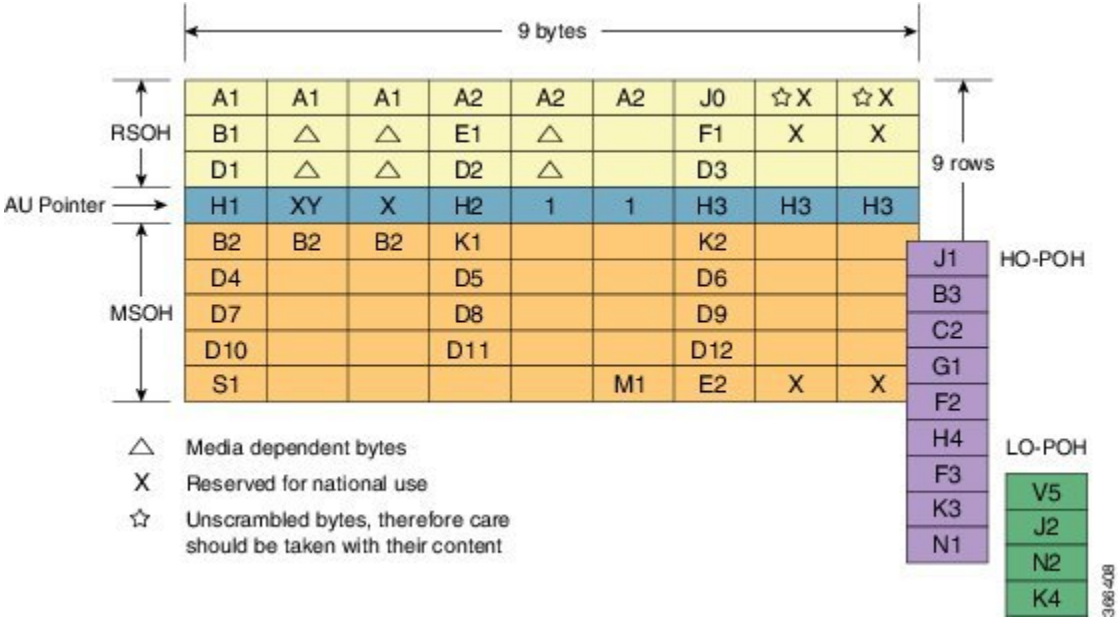


Figure 2: STM1 Section Overhead



VC

SDH supports a concept called VC. Through the use of pointers and offset values, VCs can be carried in the SDH payload as independent data packages. VCs are used to transport lower-speed tributary signals. Note that it can start (indicated by the J1 path overhead byte) at any point within the STM-1 frame. The start location of the J1 byte is indicated by the pointer byte values. VCs can also be concatenated to provide more capacity in a flexible fashion.

CEM Overview

Circuit Emulation (CEM) is a way to carry TDM circuits over packet switched network. CEM embeds the TDM circuits into packets, encapsulates them into an appropriate header, and then sends that through Packet Switched Network. The receiver side of CEM restores the TDM circuits from packets.

Modes of CEM

- **Structure Agnostic TDM over Packet (SAToP)** (RFC 4553) – SAToP mode is used to encapsulate T1/E1 or T3/E3 unstructured (unchannelized) services over packet switched networks. In SAToP mode, the bytes are sent out as they arrive on the TDM line. Bytes do not have to be aligned with any framing.

  In this mode, the interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4553. All signaling is carried transparently as a part of a bit stream.

- **Circuit Emulation Service over Packet (CEP)** (RFC 4842) - CEP mode is used to encapsulate SDH payload envelopes (SPEs) like VC11, VC12, VC4, or VC4-Nc over PSN. In this mode, the bytes from the corresponding SPE are sent out as they arrive on the TDM line. The interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4842.

Table 1: SDH CEM Channelization Modes

SDH Modes	CEM	Ports
VC4-16c	CEP	STM16
VC4-4c	CEP	STM4, STM16
VC4	CEP	STM1, STM4, STM16
TUG-3-E3	SAToP	STM1, STM4, STM16
TUG-3-T3	SAToP	STM1, STM4, STM16
TUG-2-VC11	CEP	STM1, STM4, STM16
TUG-2-VC12	CEP	STM1, STM4, STM16
TUG-2-T1	SAToP	STM1, STM4, STM16
TUG-2-E1	SAToP	STM1, STM4, STM16

Services Provided by SDH Configuration

The following services are provided by SDH Configuration:

SDH Circuits	Configuration Details
Configuring VC4 CEP circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configurin AU-3 or AU-4 Mapping* • *Configuring Modes under AU-4 Mapping* • *Configuring Mode VC4 CEP*

SDH Circuits	Configuration Details
Configuring VC4-4c circuit or Configuring VC4-16c circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Modes under AU-4 Mapping* • *Configuring Mode VC-4 Nc*
Configuring VC4—TUG3—E3 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode TUG-3*
Configuring VC4—TUG3—T3 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode TUG-3* • *Configuring AU-4—TUG-3—VC-3—DS3*
Configuring VC4—TUG-3—TUG-2—VC-12 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode TUG-3* • *Configuring VC4—TUG-3—TUG-2—VC-12—VC*
Configuring VC4 — TUG-3 — TUG-2 — VC-12 — E1 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode TUG-3* • *Configuring AU-4—TUG-3—TUG-2—VC-12*

SDH Circuits	Configuration Details
Configuring VC4— TUG-3—TUG-2—VC-11 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode TUG-3* • *Configuring AU-4—VC4—TUG-3—TUG-2—VC-11—T1*
Configuring AU-3—VC-3—E3 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring AU-3—VC-3—E3*
Configuring AU-3—VC-3—DS3 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring AU-3—VC-3—DS3 circuit*
Configuring (AU-3) VC-3—TUG-2—VC-12—T1 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode VC-1x* • *Configuring AU-3—TUG-2—VC-11—T1*
Configuring (AU-3) VC-3—TUG-2—VC-12 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode VC-1x* • *Configuring AU-3—TUG-2—VC-12—E1*
Configuring (AU-3) VC-3—TUG-2—VC11 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode VC-1x* • *Configuring AU-3—TUG-2—VC-11—T1*

SDH Circuits	Configuration Details
Configuring (AU-3) VC-3—TUG-2—VC11—E1 circuit	• *Configuring Mediatype Controller* • *Configuring Rate on SDH Ports* • *Configuring AU-3 or AU-4 Mapping* • *Configuring Mode VC-1x* • *Configuring AU-3—TUG-2—VC-12—E1*

SDH Multiplexing

The terms and definitions of SDH multiplexing principles are:

- **Mapping** – A process used when tributaries are adapted into VCs by adding justification bits and Path Overhead (POH) information.
- **Aligning** – This process takes place when a pointer is included in a Tributary Unit (TU) or an Administrative Unit (AU), to allow the first byte of the VC to be located.
- **Multiplexing** – This process is used when multiple lower-order path layer signals are adapted into a higher-order path signal, or when the higher-order path signals are adapted into a Multiplex Section.
- **Stuffing** – As the tributary signals are multiplexed and aligned, some spare capacity is designed into the SDH frame to provide enough space for all the various tributary rates. Therefore, at certain points in the multiplexing hierarchy, this space capacity is filled with “fixed stuffing” bits that carry no information, but are required to fill up the particular frame.

Modes of SDH

A Synchronous Transport Module (STM) signal is the Synchronous Digital Hierarchy (SDH) equivalent of the SONET STS. In this document, STM term refers to both path widths and optical line rates. The paths within an STM signals are called administrative units (AUs).

An AU is the information structure that provides adaptation between the higher-order path layer and the multiplex section layer. It consists of an information payload (the higher-order VC) and an AU pointer, which indicates the offset of the payload frame start relative to the multiplex section frame start.

The AU-3 pointer is composed of 3 bytes; the AU-4 pointer is composed of 9 bytes.

The payload of the STM-1 frame consists of one AU-4 unit or three AU-3 units.

Augment Mapping

An administrative unit group (AUG) consists of one or more administrative units occupying fixed, defined positions in an STM payload. Augment mapping is supported at STM1 level.The following types of augment mapping are supported:

- Augment Mapping AU-4

Note This is the default augment mapping mode.

- Augment Mapping AU-3
- Mixed (AU-3 and AU-4) Augment Mapping

The supported modes of SDH are:

- AU-4-16c (VC4-16c)
- AU-4-4c (VC4-4c)
- AU-4 (VC4)
- AU-4 — TUG-3 — VC-3 — DS3
- AU-4 — TUG-3 — VC-3 — E3
- AU-4 — TUG-3 — TUG-2 — VC-11 — T1
- AU-4 — TUG-3 — TUG-2 — VC-12 — E1
- AU-4 — TUG-3 — TUG-2 — VC-11
- AU-4 — TUG-3 — TUG-2 — VC-12
- AU-3 — VC-3 — DS3
- AU-3 — TUG-2 — VC-11 — T1
- AU-3 — TUG-2 — VC-12 — E1
- AU-3 — TUG-2 — VC-11
- AU-3 — TUG-2 — VC-12
- AU-3 — VC-3 — E3

Configuring AUG Mapping

This section describes the configuration of Administration Units Group (AUG) mapping.

Configuring AU-3 or AU-4 Mapping

To configure AU-3 or AU-4 mapping:

```
configure terminal
aug mapping [au-3 | au-4]
end
```

Note The **aug mapping** command is available only when SDH framing is configured.

Note The AUG mapping mode is AU-4 by default. AUG mapping is supported at STM-1 level.

Configuring Mixed AU-3 and AU-4 Mapping

To configure mixed AU-3 and AU-4 mapping:

```
configure terminal
aug mapping [au-3 | au-4] stm [1-1] stm1 number [1-4]
end
```

Note Use the following command to change the AUG mapping of a particular STM-1 to AU-3:

aug mapping *au-3* **stm** [*1-16*] *path number 1-16*

After configuring this command for STM-4 the AUG mapping of path 2, 3, and 4 is AU-4 and for path 1 it is AU-3.

Verifying AUG Mapping Configuration

Use **show running-configuration** command to verify the AUG mapping configuration.

```
show running-config | sec 0/3/4
PDT: %SYS-5-CONFIG_I: Configured from console by console
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4 stm 1
aug mapping au-3 stm 2
aug mapping au-4 stm 3
aug mapping au-4 stm 4
au-4 1
!
au-3 4
!
au-3 5
!
au-3 6
!au-4 3
!au-4 4
!
```

Configuring Modes under AU-4 Mapping

This section describes the configuration of modes under AU-4 mapping.

Configuring Mode VC-4 CEP

To configure mode VC-4 CEP:

```
enable
configure terminal
controller sdh 0/0/16
rate stm 4
aug mapping au-4
au-4 1
mode vc4
cem-group 100 cep
end
```

Note Overhead C2 should match with the peer end else it will result in PPLM alarm.

Verifying Mode VC-4 Configuration

Use the **show running-configuration** command to verify the mode VC-4 configuration.

```
#show running-config | sec 0/3/4
PDT: %SYS-5-CONFIG_I: Configured from console by console
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
clock source internal
au-4 2
!
au-4 3
!
au-4 4
```

Configuring Mode TUG-3

To configure mode TUG-3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
end
```

Note Mode TUG-3 creates three TUG-3 paths. TUG-3 range is 1 to 3.

Configuring AU-4 — TUG-3 — VC-3 — DS3

To configure AU-4 — TUG-3 — VC-3 — DS3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode t3
cem-group 100 unframed
end
```

Verifying DS3 Configuration

Use **show running-configuration** command to verify DS3 configuration:

```
#show running-configuration | sec 0/3/4
platform enable controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1mode T3
t3 clock source internal
t3 framing c-bit
!
tug-3 2
!
tug-3 3
!
au-4 2
!
au-4 3
!
au-4 4
```

Configuring AU-4 — TUG-3 — VC-3 — E3

To configure AU-4 — TUG-3 — VC-3 — E3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode e3
cem-group 100 unframed
end
```

Verifying E3 Configuration

Use **show running-configuration** command to verify E3 configuration.

```
#show running-configuration | sec 0/0/16
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode E3
e3 clock source internal
e3 framing g751
!
tug-3 2
!
tug-3 3
!
au-4 2
```

Configuring Mode VC-1x

To configure mode VC-1x:

```
enable
configure terminal
controller sdh 0/0/16
rate stm1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
tug-2 2 payload VC11
tug-2 3 payload VC11
tug-2 4 payload VC11
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
end
```

Note When you configure mode VC-1x, seven TUG-2 payloads are created. TUG-2 payloads can be of two types, VC-11 and VC-12. Default for TUG-2 payload mode is VC-11.

TUG-2 payload VC-11 can be configured as VC or T1 and the range is 1 to 4.

TUG-2 payload VC-12 can be configured as VC or E1 and the range is 1 to 3.

Configuring AU-4 — TUG-3 — TUG-2 — VC-11 — T1

To configure AU-4 — TUG-3 — TUG-2 — VC-11 — T1:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 1 payload vc11
t1 1 cem-group 10 unframed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Note Overhead v5 has to be matched with the peer end.

Configuring AU-4 — TUG-3 — TUG-2 — VC-12

Use the following commands to configure AU-4 — TUG-3 — TUG-2 — VC-12:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 3 payload vc12
e1 1 cem-group 10 unframed
vc 1 overhead v5 2
end
```

Note Overhead v5 should match with the peer end.

Configuring AU-4 — TUG-3 — TUG-2 — VC-11 — VC

To configure AU-4 — TUG-3 — TUG-2 — VC-11 — VC:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 2 payload vc11
vc 1 cem-group 2 cep
end
```

Configuring AU-4 — TUG-3 — TUG-2 — VC-12 — VC

To configure AU-4 — TUG-3 — TUG-2 — VC-12 — VC:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 4 payload vc12
vc 1 cem-group 10 cep
end
```

Verifying Mode VC-1x Configuration

Use **show running-configuration** command to verify mode VC-1x configuration.

```
#show running-configuration
controller MediaType 0/3/4
mode sdh
controller SDH 0/3/4
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
t1 1 cem-group 1 unframed
tug-2 2 payload VC11
vc 1 cem-group 2 cep
tug-2 3 payload VC12
e1 1 cem-group 3 unframed
tug-2 4 payload VC12
vc 1 cem-group 4 cep
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
!
tug-3 2
!
tug-3 3
!
```

```
au-4 2
!
au-4 3
!
au-4 4
```

Configuring Mode VC-4 Nc

To configure mode VC-4 Nc:

```
enable
configure terminal
controller sdh 0/0/16
au-4 1 - 4 mode vc4-4c
cem-group 100 cep
end
```

Note Overhead C2 should match with the peer end else it will result in PPLM alarm.

Verifying Mode VC-4 Nc Configuration

Use **show running-configuration** command to verify mode VC-4 Nc configuration.

```
#show running-configuration
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1 - 4 mode vc4-4c
clock source internal
cem-group 10 cep
interface CEM 0/0/16
no ip address
cem 10
```

Configuring AU-3 — VC-3 — DS3

To configure AU-3 — VC-3 — DS3:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode t3
cem-group 100 unframed
end
```

Configuring AU-3 — VC-3 — E3

To configure AU-3 — VC-3 — E3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode e3
cem-group 100 unframed
end
```

Configuring Modes under AU-3 Mapping

This section describes the configuration of modes under AU-3 mapping.

Configuring Mode VC-1x

To configure mode VC-1x:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode VC1x
tug-2 1 payload VC11
tug-2 2 payload VC11
tug-2 3 payload VC11
tug-2 4 payload VC11
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
end
end
```

Configuring AU-3 — TUG-2 — VC-11 — VC

To configure AU-3 — TUG-2 — VC-11 — VC:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 1 payload vc11
vc 1 cem-group 10 cep
end
```

Configuring AU-3 — TUG-2 — VC-12 — VC

To configure AU-3 — TUG-2 — VC-12 — VC:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
```

```
au-3 1
mode vc1x
tug-2 1 payload vc12
vc 1 cem-group 10 cep
end
```

Configuring AU-3 — TUG-2 — VC-11 — T1

To configure AU-3 — TUG-2 — VC-11 — T1:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 1 payload vc11
t1 1 cem-group 10 unframed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Configuring AU-3 — TUG-2 — VC-12 — E1

To configure AU-3 — TUG-2 — VC-12 — E1:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 3 payload vc12
e1 1 cem-group 10 unframed
vc 1 overhead v5 2
end
```

Verifying Mode VC-1x Configuration

Use **show running-configuration** command to verify mode VC-1x configuration.

```
#show running-configuration
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-3
au-3 1
clock source internal
mode VC1x
tug-2 1 payload VC11
t1 1 cem-group 1 unframed
tug-2 2 payload VC11
vc 1 cem-group 2 cep
```

```
tug-2 3 payload VC12
tug-2 4 payload VC12
vc 1 cem-group 4 cep
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
```

Configuring AU-4 — TUG-3 — TUG-2 — VC-12 for Framed SAToP

Use the following commands to configure AU-4 — TUG-3 — TUG-2 — VC-12 for framed SAToP under mode VC-1x (AU-4 mapping):

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 3 payload vc12
e1 1 cem-group 1 framed
vc 1 overhead v5 2
end
```

Configuring AU-3 — TUG-2 — VC-11 — T1 for Framed SAToP

To configure AU-3 — TUG-2 — VC-11 — T1 for framed SAToP under mode VC-1x (AU-3 mapping):

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 1 payload vc11
t1 1 cem-group 0 framed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Verifying SDH Configuration for Framed SAToP

Use **show running configuration** command to verify SDH configuration for Framed SAToP:

```
Router#show running configuration | sec 0/0/16
platform enable controller mediatype 0/0/16 oc3
controller mediatype 0/0/16
mode sdh
controller sdh 0/0/16
rate stm1
no ais-shut
alarm-report all
```

```
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vc1x
tug-2 1 payload vc11
tug-2 2 payload vc12
e1 1 cem-group 1 framed
tug-2 3 payload vc11
tug-2 4 payload vc11
tug-2 5 payload vc11
tug-2 6 payload vc11
tug-2 7 payload vc11
!
interface cem 0/0/16
no ip address
cem 0
!
cem 1
!
cem 2
!
cem 3
!
Router#
```

Restrictions for SDH

- The maximum supported bandwidth is STM-16.
- Any Port (16-19) is configurable for STM-1, STM-4 or STM-16.
- The IM has 4 X STM-4 ports. You can configure STM-1 or STM-4 on all four ports. If you configure rate STM-16 on any of the four ports, others ports will not be available.
- This IM does not support CEP on AU-4 — VC-4 — TUG-3 — VC-3.
- This IM does not support CT3, CE3, CT3-E1 under the VC3 container. Only clear channel T3 services are supported.
- This IM does not support the framed SAToP CESoPSN.
- Eight BERT engines are supported for Higher Order and 16 BERT engines are supported for Lower Order hierarchy.
- If a port is configured as SDH, all ports can only be configured as SDH unless the mode SDH is removed from all the ports on the IM.
- VC-4-64c and VC-2 are not supported.
- AU-4 CT3, AU-4 CE3, AU-4 CT3-E1, AU-3-CT3, AU-3-CE3, and AU-3 CT3-E1 are not supported.

  AU-4 — VC-4 — TUG-3 — VC-3 — DS3 — T1/E1, AU-4 — VC-4 — TUG-3 — VC-3 — E3 — E1, AU-3 — VC-3 — DS3 — T1/E1, and AU-3 — VC-3 — E3 — E1 are not supported.
- Concatenation VC-4-Nc is only supported for augment mapping AU-4.

- MDL is not supported.
- SNCP is not supported.

Restrictions on Bandwidth

- Total available bandwidth is 2.5G.

  The following configuration is blocked and an error message is displayed after the maximum bandwidth is utilized:

```
rate stm1 | rate stm4 | rate stm16
```

Table 2: Bandwidth Used by Different Rates

Rate	Bandwidth (kbit/s)
STM-1	150,336
STM-4	601,344
STM-16	2,405,376

Restrictions for Scale PW Circuits

- Only 1000 CEM PW Circuits per OCN Interface modules are supported.

Configuring Mediatype Controller

Each SFP port (16-19) can be configured as STM-1, STM-4, STM-16.

You must select the MediaType controller to configure and enter the controller configuration mode.

You must configure the controller as a SDH port.

To configure MediaType Controller:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
end
```

Configuring Rate on SDH Ports

To configure rate on SDH ports:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate [stm1 | stm4 | stm16]
end
```

Note The configuration of **no** form of the command is not suported. To restore to the default condition, use **no mode sdh** command under Mediatype controller after removing all configuration under that port. .

SDH Line and Section Configuration Parameters

The following parameters affect SDH configuration at the line and section levels.

Overhead

Sets the SDH overhead bytes in the frame header to a specific standards requirement, or to ensure interoperability with equipment from another vendors.

- **J0** — Sets the J0 or C1 byte value in the SDH section overhead.

  Note The supported values of J0 are 1 byte, 16 bytes, and 64 bytes.

- **S1S0** — Sets the SS bits value of the H1 byte in the SDH line overhead.

Configuring Line and Section Overhead

To configure line and section overhead:

```
enable
configure terminal
controller sdh 0/0/16
overhead s1s0 2
overhead j0 expected length 16-byte
overhead j0 expected tracebuffer rx Message
overhead j0 tx length 1-byte
overhead j0 tx tracebuffer tx Message
end
```

Note To restore the system to its default condition, use the **no** form of the **overhead j0** command.

Threshold

Set the path BER threshold values.

- **b1-tca** — Enables Bit Error Rate (BER) threshold crossing alerts for B1.
- **b2-tca** — Enables BER threshold crossing alerts for B2.
- **sd-ber** — Enables the threshold of the Signal Degrade (SD) BER that is used to trigger a signal degrade alarm.

- **sf-ber** — Configures the threshold of the Signal Failure (SF) BER that is used to trigger a link state change.

Configuring Line and Section Threshold

To configure line and section threshold:

```
enable
configure terminal
mode sdh
controller sdh 0/0/16
threshold b1-tca 5
threshold b2-tca 5
threshold sd-ber 5
threshold sf-ber 5
end
```

Note To restore the system to its default condition, use the **no** form of the threshold command.

Loopback

Sets a loopback to test the SDH port.

- local — Loops the signal from Tx to Rx path. Sends alarm indication signal (AIS) to network.
- network — Loops the signal from Rx to Tx path.

Configuring Line Loopback

To configure loopback:

```
enable
configure terminal
controller sdh 0/0/16
loopback [local | network]
end
```

Note To restore the system to its default condition, use the **no** form of the loopback command.

Note When loopback is configured as network, it is recommended to use the configuration of clock source as line.

AIS-Shut

Enables automatic insertion of a Line Alarm Indication Signal (LAIS) in the sent SDH signal whenever the SDH port enters the administrative shutdown state.

Configuring AIS Shut

To configure AIS-Shut:

```
enable
configure terminal
controller sdh 0/0/16
ais-shut
end
```

Note The **no ais-shut** command does not send AIS.

Shutdown

Disables the interface.

Configuring Shut

To configure Shut:

```
enable
configure terminal
controller sdh 0/0/16
shutdown
end
```

Note Use the **no shutdown** command to disable the interface.

Alarm Reporting

Enables reporting for all or selected alarms.

- **b1-tca** — Enables BER threshold crossing alarm for B1.
- **b2-tca** — Enables BER threshold crossing alarm for B2.
- **b3-tca** — Enables BER threshold crossing alarm for B3.
- **lais** —Enables line alarm indication signal.
- **lom** — Enables loss of multiframe signal.
- **lrdi** — Enables line remote defect indication signal.
- **pais** — Enables path alarm indication signal.
- **plop** — Enables loss of pointer failure signal for a path.
- **pplm** — Enables path payload mismatch indication.
- **prdi** — Enables path remote defect indication signal.
- **puneq** — Enables path unequipped (path label equivalent to zero) signal.

- **sd-ber** — Enables LBIP BER in excess of SD threshold.
- **sf-ber** — Enables LBIP BER in excess of SF threshold.
- **slof** — Enables section loss of frame signal.
- **slos** — Enables section loss of signal.

Configuring Alarm Reporting

To configure alarm reporting:

```
enable
configure terminal
controller sdh 0/0/16
alarm-report [b1-tca | b2-tca | b3-tca | lais | lom | lrdi | pais | plop | pplm | prdi |
puneq | sd-ber | sf-ber | lof | los]
end
```

Note To restore the system to its default condition, use the **no** form of the alarm report command.

Clock Source

Specifies the clock source, where

- **line** —The link uses the recovered clock from the line.
- **internal** — The link uses the internal clock source. This is the default setting.

Configuring Clock

To configure clock, use the following commands:

```
enable
configure terminal
controller sdh 0/0/16
clock source [line | internal]
end
```

Note The default mode is internal.

Note To restore the system to its default condition, use the **no** form of the command.

Configuring Network-Clock SDH

To configure network-clock SDH, use the following commands:

```
enable
configure terminal
controller sdh 0/0/16
```

```
clock source line
end
enable
configure terminal
network-clock input-source 1 controller sdh 0/0/16
end
```

Verifying SDH Line and Section Parameters Configuration

Use **show controllers** command to verify SDH Line and Section Parameters Configuration:

```
Rotuer#show controller sdh 0/7/7
SDH 0/7/7 is up.
Hardware is A900-IMA3G-IMSG
Port configured rate: STM16
 Applique type is Channelized SDH
 Clock Source is Internal, AUG mapping is AU4.
Medium info:
  Type: SDH, Line Coding: NRZ,
 Alarm Throttling: OFF
 Regenerator Section:
  LOS = 0          LOF = 0                          BIP(B1) = 0

SDH Section Tables
  INTERVAL       CV    ES   SES  SEFS
  21:24-21:24     0     0     0     0

Multiplex Section:
  AIS = 0          RDI = 0          REI = 0          BIP(B2) = 0
Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: SLOS SLOF LAIS SF SD LRDI B1-TCA B2-TCA
BER thresholds:  SF = 10e-3  SD = 10e-6
TCA thresholds:  B1 = 10e-6  B2 = 10e-6
Rx: S1S0 = 00
    K1 = 00,   K2 = 00
    J0 = 00

    RX S1 = 00

Tx: S1S0 = 00
    K1 = 00,   K2 = 00
    J0 = 04

Tx J0 Length : 16
Tx J0 Trace :

  50 45 31 20 20 20 20 20 20 20 20 20 20 20 20 00     PE1            .

Expected J0 Length : 16
Expected J0 Trace :

  50 45 31 20 20 20 20 20 20 20 20 20 20 20 20 00     PE1            .

Rx J0 Length : 0
Rx J0 Trace :


SDH Line Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:24-21:24     0     0     0     0     0     0      0      0
```

```
High Order Path:

PATH 1:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: PPLM
Asserted/Active Alarms: PPLM
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = FE
Tx: C2 = 01

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 00 00 00 00 00     PE1 0/7/7.1.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 00 00 00 00 00     PE1 0/7/7.1.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 16
Rx J1 Trace
  CRC-7: 0xBA OK

  4F 4E 54 20 48 4F 2D 54 52 41 43 45 20 20 20 00     ONT HO-TRACE   .

SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:24-21:24     0     0     0     0     0     0      0      0

PATH 4:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: PPLM LOM
Asserted/Active Alarms: PPLM LOM
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = FE
Tx: C2 = 02

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 32 00 00 00 00 00     PE1 0/7/7.2.....

Expected J1 Length : 16
Expected J1 Trace
```

```
  50 45 31 20 30 2F 37 2F 37 2E 32 00 00 00 00 00     PE1 0/7/7.2.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 16
Rx J1 Trace
  CRC-7: 0xBA OK

  4F 4E 54 20 48 4F 2D 54 52 41 43 45 20 20 20 00     ONT HO-TRACE   .

SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:23-21:24     0     0     0   382     0     0      0      0

PATH 7:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 33 00 00 00 00 00     PE1 0/7/7.3.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 33 00 00 00 00 00     PE1 0/7/7.3.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:24-21:25     0     0     0     0     0     0      0      0

PATH 10:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
```

```
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 34 00 00 00 00 00     PE1 0/7/7.4.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 34 00 00 00 00 00     PE1 0/7/7.4.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 13:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 35 00 00 00 00 00     PE1 0/7/7.5.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 35 00 00 00 00 00     PE1 0/7/7.5.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 16:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
```

```
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 36 00 00 00 00 00     PE1 0/7/7.6.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 36 00 00 00 00 00     PE1 0/7/7.6.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 19:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 37 00 00 00 00 00     PE1 0/7/7.7.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 37 00 00 00 00 00     PE1 0/7/7.7.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
```

```
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 22:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 38 00 00 00 00 00     PE1 0/7/7.8.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 38 00 00 00 00 00     PE1 0/7/7.8.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 25:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 39 00 00 00 00 00     PE1 0/7/7.9.....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 39 00 00 00 00 00     PE1 0/7/7.9.....
```

```
PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 28:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 30 00 00 00 00     PE1 0/7/7.10....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 30 00 00 00 00     PE1 0/7/7.10....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 31:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
```

```
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 31 00 00 00 00     PE1 0/7/7.11....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 31 00 00 00 00     PE1 0/7/7.11....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 34:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 32 00 00 00 00     PE1 0/7/7.12....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 32 00 00 00 00     PE1 0/7/7.12....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 37:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
```

```
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 33 00 00 00 00     PE1 0/7/7.13....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 33 00 00 00 00     PE1 0/7/7.13....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:25-21:25     0     0     0     0     0     0      0      0

PATH 40:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 34 00 00 00 00     PE1 0/7/7.14....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 34 00 00 00 00     PE1 0/7/7.14....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:26-21:26     0     0     0     0     0     0      0      0

PATH 43:
```

```
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 35 00 00 00 00     PE1 0/7/7.15....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 35 00 00 00 00     PE1 0/7/7.15....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:26-21:26     0     0     0     0     0     0      0      0

PATH 46:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 36 00 00 00 00     PE1 0/7/7.16....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 36 00 00 00 00     PE1 0/7/7.16....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
```

```
Rx J1 Trace


SDH Path Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  21:26-21:26     0     0     0     0     0     0      0      0


SDH 0/7/7.1 PATH  mode vc4 is down
  cep is configured: TRUE cem_id  :20
  clock source internal

 AU-4 2, TUG-3 1, TUG-2 1, VC12 1 (SDH 0/7/7.2/1/1/1 VC12) is down
 VT Receiver has LP-RDI.
  cep is configured: FALSE cem_id  (0)
  fwd_alarm_ais :0    fwd_alarm_rai :0
  Framing is unframed, Clock Source is Internal
  BIP2-tca:6, BIP2-sf:3, BIP2-sd:6
  Tx V5:1
  Rx V5:6
  Tx J2 Length=16
  TX J2 Trace Buffer:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................

  Expected J2 Length=16
  Expected J2 Trace Buffer:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................

  Rx J2 Length=16
  RX J2 Trace Buffer:
  CRC-7: 0x81 OK

  4F 4E 54 20 4C 4F 2D 54 52 41 43 45 20 20 20 00     ONT LO-TRACE   .

 Data in curerent interval (140 seconds elapsed)
   Near End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 269 Unavailable Secs
   Far End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs

 AU-4 2, TUG-3 1, TUG-2 1, E1 1 (SDH 0/7/7.2/1/1/1 E1) is down
  Receiver is getting AIS.
  Framing is unframed, Clock Source is Internal
  Data in current interval (140 seconds elapsed):
   Near End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     293 Unavail Secs, 0 Stuffed Secs
   Far End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs

 AU-4 2, TUG-3 1, TUG-2 1, VC12 2 (SDH 0/7/7.2/1/1/2 VC12) is down
 VT Receiver has LP-RDI.
  cep is configured: FALSE cem_id  (0)
  fwd_alarm_ais :0    fwd_alarm_rai :0
  Framing is unframed, Clock Source is Internal
  BIP2-tca:6, BIP2-sf:3, BIP2-sd:6
  Tx V5:1
  Rx V5:6
  Tx J2 Length=16
```

```
 TX J2 Trace Buffer:
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................

 Expected J2 Length=16
 Expected J2 Trace Buffer:
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................

 Rx J2 Length=16
 RX J2 Trace Buffer:
 CRC-7: 0x81 OK

 4F 4E 54 20 4C 4F 2D 54 52 41 43 45 20 20 20 00     ONT LO-TRACE   .

Data in curerent interval (150 seconds elapsed)
  Near End
   0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 483 Unavailable Secs
  Far End
   0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs

AU-4 2, TUG-3 1, TUG-2 1, E1 2 (SDH 0/7/7.2/1/1/2 E1) is down
 Receiver is getting AIS.
 Framing is unframed, Clock Source is Internal
 Data in current interval (150 seconds elapsed):
  Near End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
    90 Unavail Secs, 0 Stuffed Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
    0 Unavail Secs
```

Configuring SDH Path Parameters

This section describes the configuration of SDH path parameters.

Path Overhead

J1 Flag

Sets the message length and the message text of the High Order Path Trace identifier (J1).

C2 Flag

Sets the C2 byte in the Path OverHead (POH) to indicate the contents of the payload inside the frame.

The path overheads, C2 flag and J1 flag can be configured for the following modes:

- AU-4 Mapping
  - Mode VC-4
  - Mode VC-4 Nc
  - Mode TUG-3

    For more information, refer Configuring Modes under AU-4 Mapping, on page 9.
- AU-3 Mapping

- Mode E3
- Mode T3

  For more information, refer Configuring Modes under AU-3 Mapping.

Configuring C2 Flag

To configure the C2 flag:

```
enable
configure terminal
controller Mediatype 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
overhead c2 10
end
```

J1 Flag

To configure the J1 flag:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
overhead j1 expected length 16
overhead j1 expected message expectedmessage
overhead j1 tx length 16
overhead j1 tx message testmessage
end
```

Path Threshold

Set the path BER threshold values.

- **b3-tca** — Enables BER threshold crossing alerts for B3.
- **sd-ber** — Enables the threshold of the Signal Degrade (SD) BER that is used to trigger a signal degrade alarm.
- **sf-ber** — Configures the threshold of the Signal Failure (SF) BER that is used to trigger a link state change.

The path threshold can be configured for the following modes:

- AU-4 Mapping
  - Mode VC-4
  - Mode VC-4 Nc
  - Mode TUG-3

    For more information, refer Configuring Modes under AU-4 Mapping, on page 9.
- AU-3 Mapping

- For more information, refer Configuring Modes under AU-3 Mapping.

Configuring Path Threshold

To configure path threshold:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
threshold b3-ber_sd 7
threshold b3-ber_sf 7
end
```

Path Loopback

Sets a loopback to test the SDH port.

- local — Loops the signal from Tx to Rx path. Sends alarm indication signal (AIS) to network.
- network — Loops the signal from Rx to Tx path.

Configuring Path Loopback

To configure path loopback:

```
enable
configure terminal
controller sdh 0/0/16
au-4 1
loopback [local | network]
end
```

Note To restore the system to its default condition, use the **no** form of the command.

Configuring Path BERT

For more information on BERT configuration, see Configuring BERT in SDH for SAToP, on page 39 section.

Verifying Path Parameters Configuration

Use **show running-configuration** command to verify path parameters configuration.

```
#show running-configuration
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM16
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
```

```
clock source internal
loopback local
overhead c2 10
threshold b3-ber_sd 7
threshold b3-ber_sf 7
overhead j1 tx message STRING
overhead j1 expected message STRING
threshold b3-tca 5
au-4 2
```

Configuring BERT in SDH for SAToP

Bit-Error Rate Testing (BERT) is used to analyze quality and to resolve problems of digital transmission equipment. BERT tests the quality of an interface by directly comparing a pseudorandom or repetitive test pattern with an identical locally generated test pattern.

The BERT operation is data-intensive. Regular data cannot flow on the path while the test is in progress. The path is reported to be in alarm state when BERT is in progress and restored to a normal state after BERT has terminated.

The supported BERT patterns are 2^15, 2^20, 2^23, all 0s.

BERT is supported in the following two directions:

- Line - Supports BERT in TDM direction.
- System - Supports BERT in PSN direction. CEM must be configured before running BERT towards system direction.

The following table shows the SDH level of BERT patterns supported.

Modes	Patterns
SDH - VC4-4c, VC4-8c, VC4-16c, AU4-VC4, AU4-TUG3-VC3 levels	• 0s - Repeating pattern of zeros • 2^15 - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps • 2^20 - O.153 • 2^20 - O.151 - Error and Jitter measurement upto 72 kbps • 2^23 - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps

Modes	Patterns
SDH - AU4-TUG3-CT3/CE3/E3 and AU4-TUG3-VC11/VC12 levels	• 0s - Repeating pattern of zeros • 2^11 2^11-1 test pattern • 2^15 - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps • 2^20 - O.153 • 2^20 - O.151 - Error and Jitter measurement upto 72 kbps • 2^23 - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps

Configuring BERT in Modes VC-4 and VC Nc

To configure BERT in modes VC-4 and VC Nc:

```
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
clock source internal
bert pattern 2^15 internal 10 direction [line | system]
```

Verifying BERT Configuration in Modes VC-4 and VC Nc

Use **show controllers** command to verify BERT Configuration in Modes VC-4 and VC Nc:

```
#show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47
Bit Errors (since BERT started): 0 Mbits,Bits Received (since BERT started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : LineRouter#
```

Configuring E1 Bert

To configure E1 Bert:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
```

```
au-3 1
mode vc1x
tug-2 1 payload vc12
e1 1 bert pattern 2^11 interval 10
end
```

Configuring T1 Bert

To configure T1 Bert:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 1 payload vc11
t1 1 bert pattern 2^11 interval 10
end
```

Configuring BERT in Mode T3/E3

To configure BERT in Mode T3/E3 for both AUG mapping AU-3 and AU-4:

```
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode t3
threshold b3-tca 0
overhead c2 0
t3 clock source internal
t3 bert pattern 2^15 internal 10 direction [line | system]
```

Verifying BERT Configuration in Mode T3 or E3

Use **show controllers** command to verify BERT configuration in mode T3 or E3:

```
show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47
Bit Errors (since BERT started): 0 Mbits,
Bits Received (since BERT started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : Line
```

Configuring BERT in Mode VC-1x

To configure BERT in mode VC-1x for both AUG mapping AU-3 and AU-4:

```
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode vc-1x
tug-2 1 payload VC11
vc 1 bert pattern 2^15 internal 10 direction [line | system]
```

Verifying BERT Configuration in Mode VC-1x

Use **show controllers** command to verify BERT configuration in mode VC-1x:

```
#show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47Bit Errors (since BERT started): 0 Mbits,Bits Received (since BERT
started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : Line
```

SDH T1/E1 Configuration Parameters

The following parameters affect SDH T1/E1 configuration:

- **BERT** — Starts the BERT test.
- **CEM Group** — Creates a circuit emulation (CEM) channel from one or more time slots of a T1 or E1 line of an NM-CEM-4TE1 network module,
- **Clock** — Specifies the clock source for T1 or E1 interface.
- **Description** — Specifies the description of the controller.
- **Loopback** — Sets the T1 or E1 interface in the loopback mode.

Configuring T1/E1 Parameters

To configure T1/E1 parameters:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
```

```
mode vc1x
tug-2 1 payload vc11
t1 1 loopback [local | network line]
t1 1 clock source [line | internal | recovered]
end
```

Note Loopback network payload is not supported. This is applicable for AU-4 Vc-1x and AU-3 Vc-1x modes.

Note If T1/E1 is enabled on a particular J/K/L/M, you can only configure overhead and threshold for that J/K/L/M value.

Verifying T1 or E1 Parameters Configuration

Use **show running-configuration** command to verify T1 or E1 parameters configuration:

```
#show running-configuration
controller SDH 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 2
mode VC1x
tug-2 1 payload VC11
t1 1 loopback network line
t1 1 clock source line
```

SDH T3/E3 Configuration Parameters

The following parameters affect SDH T3/E3 configuration:

- **Clock** — Specifies the clock source for T3 or E3 link.
- **Loopback** — Sets the T3 or E3 link in the loopback mode.
- **CEM Group** — Creates a circuit emulation (CEM) channel from one or more time slots of a T1 or E1 line.
- **BERT** — Bit-Error Rate Testing (BERT) is used for analyzing quality and for problem resolution of digital transmission equipment.

Configuring SDH T3/E3 Parameters Configuration

To configure SDH T3/E3 parameters configuration:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug 3
tug-3 1
mode e3
e3 1 clock source [line | internal | recovered]
e3 framing [m13 | c-bit ] (applicable to for mode e3)
e3 1 loopback [local | network line]
e3 bert pattern 0s interval 2
tug-3 2
mode t3
t3 1 clock source [line | internal | recovered]
t3 framing [m13 | c-bit ] (applicable to for mode t3)
t3 1 loopback [local | network line]
t3 bert pattern 0s interval 2
end
```

Note This is applicable to AUG mappaing AU-4 mode T3 and AU-3 mode T3.

Verifying SDH T3 or E3 Parameters Configurations

Use **show running-configuration** command to verify SDH T3 or E3 parameters configurations:

```
# show running-configuration
controller sdh 0/0/16
rate stm1
au-4 2
mode tug-3
clock source internal
tug-3 1
mode E3
threshold b3-tca 0
overhead c2 0
e3 clock source internal
e3 framing g751
!tug-3 2mode T3
threshold b3-tca 0
overhead c2 0
t3 clock source internal
t3 framing c-bit!
```

SDH VC Configuration Parameters for SAToP

The following parameters affect SDH VC configuration:

- **BERT** — Starts the BERT test.
- **CEM Group** — Specifies the time slots for CEM group mapping.
- **Clock** — Specifies the clock source for VC.
- **Loopback** — Sets the VC in the loopback mode.
- **Overhead** — Configures VC line path overhead flags.

- **Shutdown** — Disables the VC interface.

Configuring VC Parameters

To configure VC parameters:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode vc1x
tug-2 1 payload vc11
vc 1 loopback [local | network]
vc 1 clock source internal
vc 1 overhead j2 expected [16  | 64]
vc 1 overhead j2 expected message STRING
vc 1 overhead j2 tx [16  | 64]
vc 1 overhead j2 tx message STRING
vc 1 overhead v5 [0 - 7]
vc 1 [threshold bip2-sd 4 | threshold bip2-sf  4 | threshold bip2-tca 9]
end
```

Note v5 overhead should match with the far end tx v5.

Verifying VC Configuration Parameters Configurations

Use **show running-configuration** command to verify VC configuration parameters configuration:

```
#show running-configuration
controller SDH 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
vc 1 overhead j2 tx message STRING
vc 1 overhead j2 expected message STRING
vc 1 threshold bip2-sd 4
vc 1 threshold bip2-sf 4
vc 1 threshold bip2-tca 9
```

Configuring ACR

Adaptive Clock Recovery (ACR) is an averaging process that negates the effect of random packet delay variation and captures the average rate of transmission of the original bit stream. ACR recovers the original clock for a synchronous data stream from the actual payload of the data stream. In other words, a synchronous

clock is derived from an asynchronous packet stream. ACR is a technique where the clock from the TDM domain is mapped through the packet domain, but is commonly used for SAToP. Both unframed and framed SAToP modes are supported.

To configure E1 ACR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vc1x
tug-2 1 payload vc12
e1 1 cem-group 1 unframed
e1 1 clock source recovered 1
tug-2 2 payload vc11
tug-2 3 payload vc11
tug-2 4 payload vc11
end
```

To configure E3 ACR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode e3
overhead c2 0
cem-group 1 unframed
e3 clock source recovered 1
```

ACR Global Configuration

```
enable
configure terminal
recovered-clock 0 4
clock recovered 1 adaptive cem 0 1
end
```

Verifying ACR Configuration

Use **show recovered clock** command to verify E1 ACR configuration:

```
#show recovered clock
Recovered clock status for subslot 0/16
```

```
----------------------------------------
Clock    Type      Mode         CEM    Status    Frequency Offset(ppb)  Circuit-No
1        STMx-E1  ADAPTIVE      1    ACQUIRED   n/a                    0/1/1/1/1
(Port/au-4/tug3/tug2/e1)
```

Use **show recovered clock** command to verify T3 ACR configuration:

```
#show recovered clock
Recovered clock status for subslot 0/16
----------------------------------------
Clock    Type      Mode         CEM    Status    Frequency Offset(ppb)  Circuit-No
1        STMx-E3  ADAPTIVE      1    ACQUIRED   n/a                   0/1/1 (Port/au-4/tug3)
```

Configuring DCR

Differential Clock Recovery (DCR) is another technique used for Circuit Emulation (CEM) to recover clocks based on the difference between PE clocks. TDM clock frequency are tuned to receive differential timing messages from the sending end to the receiving end. A traceable clock is used at each end, which ensures the recovered clock is not affected by packet transfer. Both unframed and framed SAToP modes are supported.

To configure E1 DCR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vc1x
tug-2 1 payload vc12
e1 1 cem-group 1 unframed
e1 1 clock source recovered 1
tug-2 2 payload vc11
tug-2 3 payload vc11
tug-2 4 payload vc11
end
```

To configure E3 DCR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode e3
```

```
overhead c2 0
cem-group 1 unframed
e3 clock source recovered 1
```

DCR Global Configuration

```
enable
configure terminal
recovered-clock 0 4
clock recovered 1 differential cem 0 1
end
```

Verifying DCR Configuration

Use **show recovered clock** command to verify E1 DCR configuration:

```
#show recovered clockRecovered clock status for subslot 0/16
----------------------------------------
Clock    Type     Mode          CEM    Status    Frequency Offset(ppb)  Circuit-No
1        STMx-E1  DIFFERENTIAL     1    ACQUIRED   n/a                    0/1/1/1/1
(Port/au-4/tug3/tug2/e1)
```

Use **show recovered clock** command to verify T3 DCR configuration:

```
#show recovered clock
Recovered clock status for subslot 0/16
---------------------------------------
Clock    Type     Mode         CEM    Status    Frequency Offset(ppb)  Circuit-No
1        STMx-E3  DIFFERENTIAL     1    ACQUIRED   n/a                    0/1/1
(Port/au-4/tug3)
```

Loopback Remote on T1 and T3 Interfaces

The remote loopback configuration attempts to put the far-end T1 or T3 into a loopback.

The remote loopback setting loops back the far-end at line or payload, using IBOC (inband bit-orientated CDE) or the ESF loopback codes to communicate the request to the far-end.

Restrictions for Loopback Remote

E1 and E3 loopback remote are not supported.

Configuring Loopback Remote in SDH

To set T1 loopback remote iboc fac1/fac2/csu for OCX in SDH, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller sdh 0/2/0
mode vc1x
tug-2 1 payload vc1x
t1 1 loopback remote iboc {fac1 | fac2 | csu}
```

To set T1 loopback remote iboc esf line csu/esf payload for OCX in SDH, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller sdh 0/2/0
mode vc1x
tug-2 1 payload vc1x
t1 1 loopback remote esf {line csu | payload}
```

To set T3 loopback remote line/payload for OCX in SDH, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller sdh 0/2/0
mode t3
t3 loopback remote {line | payload}
```

Note **loopback remote esf line niu** is not supported.

Verifying the Loopback Remote Configuration

Use the following command to check the T1 loopback remote configuration:

```
router# show run | sec 0/2/0
controller SDH 0/2/0
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
  clock source internal
 mode tug-3
  tug-3 1
   mode VC1x
   tug-2 1 payload VC11
    t1 1 Loopback remote iboc fac1
```

Use the following command to verify the T1 loopback remote configuration:

```
Router(config-ctrlr-tug2-vcx)#do show controller sdh 0/2/0 | be T1 1
AU-4 1, TUG-3 1, TUG-2 1, T1 1 (C-11 1/1/1/1) is up
  timeslots:
  Configured for NIU FAC1 Line Loopback with IBOC
  Currently in Inband Remotely Line Looped
  Receiver has no alarms.
  Framing is SF, Clock Source is Internal
  Data in current interval (250 seconds elapsed):
   Near End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavailable Secs, 0 Stuffed Secs
     0 Path Failures, 0 SEF/AIS Secs
   Far End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
```

```
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
    0 Unavailable Secs 0 Path Failures
  Data in Interval 1:
   Near End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
   Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs 0 Path Failures
  Total Data (last 1 15 minute intervals):
   Near End
    0 Line Code Violations,0 Path Code Violations,
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
   Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures
```

Use the following command to check the T3 loopback remote configuration:

```
Router#show run | sec 0/4/7
platform enable controller MediaType 0/4/7 oc3
controller MediaType 0/4/7
mode sdh
controller SDH 0/4/7
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
  clock source internal
  mode tug-3
  tug-3 1
   mode T3
   t3 clock source internal
   t3 framing c-bit
   t3 loopback remote line
```

Use the following command to verify the T3 loopback remote configuration:

```
Router#show controll sdh 0/4/7 | be T3
SDH 0/4/7.1/1 T3 is up. (Configured for Remotely Looped)
  Hardware is NCS4200-1T8S-10CS
  Applique type is T3
  Receiver has no alarms.
  Data in current interval (240 seconds elapsed):
   Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
```

```
      0 Unavailable Secs, 0 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      0 Severely Errored Line Secs, 0 Path Failures
      0 AIS Defect Secs, 0 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs
      0 C-bit Unavailable Secs, 0 Path Failures
      0 Code Violations, 0 Service Affecting Secs
  Data in Interval 1:
    Near End
      0 Line Code Violations, 0 P-bit Coding Violations
      0 C-bit Coding Violations, 0 P-bit Err Secs
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
      20 Unavailable Secs, 20 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      20 Severely Errored Line Secs, 1 Path Failures
      0 AIS Defect Secs, 20 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs
      0 C-bit Unavailable Secs, 0 Path Failures
      0 Code Violations, 0 Service Affecting Secs
  Total Data (last 1 15 minute intervals):
    Near End
      0 Line Code Violations, 0 P-bit Coding Violations,
      0 C-bit Coding Violations, 0 P-bit Err Secs,
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
      20 Unavailable Secs, 20 Line Errored Secs,
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      20 Severely Errored Line Secs, 1 path failures
      0 AIS Defect Secs, 20 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs
      0 C-bit Unavailable Secs, 0 Path Failures
      0 Code Violations, 0 Service Affecting Secs

T1 1 is up
  timeslots:
  FDL per AT&T 54016 spec.
  No alarms detected.
  Framing is ESF, Clock Source is Internal
  Data in current interval (250 seconds elapsed):
    Near End
      0 Line Code Violations, 0 Path Code Violations
      0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
      0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
      0 Unavailable Secs, 0 Stuffed Secs
      0 Path Failures, 0 SEF/AIS Secs
    Far End
      0 Line Code Violations, 0 Path Code Violations
      0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
      0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
      0 Unavailable Secs 0 Path Failures
  Data in Interval 1:
    Near End
      0 Line Code Violations, 0 Path Code Violations
      0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
      2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
      0 Unavailable Secs, 0 Stuffed Secs
      1 Path Failures, 2 SEF/AIS Secs
    Far End
      0 Line Code Violations, 0 Path Code Violations
      0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
      3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
      0 Unavailable Secs 0 Path Failures
```

```
Total Data (last 1 15 minute intervals):
 Near End
   0 Line Code Violations,0 Path Code Violations,
   0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
   2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
   0 Unavailable Secs, 0 Stuffed Secs
   1 Path Failures, 2 SEF/AIS Secs
 Far End
   0 Line Code Violations,0 Path Code Violations
   0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
   3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
   0 Unavailable Secs, 0 Path Failures
```