Circuit Emulation over IP

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Circuit Emulation over IP (CEoIP) provides a virtual circuit through an IP network—similar to a leased line—to integrate solutions that require a time-sensitive, bit-transparent transport into IP networks. Data, with proprietary framing or without, arrives at its destination unchanged; the transport is transparent to the destination.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the “Feature Information for Circuit Emulation over IP” section on page 20.

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click Cancel at the login dialog box and follow the instructions that appear.

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- Feature Information for Circuit Emulation over IP, page 20
Prerequisites for Circuit Emulation over IP

- The CEoIP feature requires a CEoIP network module (NM) on each end of the connection, either the NM-CEM-4TE1 NM or the NM-CEM-4SER NM. You do not need to use the same type of CEoIP NM on both ends of the connection.
- The CEoIP feature requires 300 KB of flash memory and 1 MB of DRAM in addition to your Cisco IOS software requirements.

Restrictions for Circuit Emulation over IP

- NM-CEM-4TE1 supports only B8ZS (T1) and HDB3 (E1) line codes.
- E1 lines do not support 56 kbps connections.
- CEoIP software cannot run payload compression for more than 3.088 Mbps) per network module.
- If you configure four T1, E1, or serial cables (over 1.544 M) at the same time in Cisco 2600XM series routers, you cannot turn on the data-protection and payload compression features. Also, in framed mode (channelized), you can use up to 60 channels without the data protection and payload compression features on Cisco 2600XM series routers. However, you can turn on the data protection and payload compression feature in one T1/E1.
- There is a limitation on the data protection and payload compression features on Cisco 3660 routers. If you configure four T1, E1, or serial cables on Cisco 3660 routers, you can turn on data protection for up to two T1/E1s. In framed mode, you can use 88 channels.

Information About Circuit Emulation over IP

To configure Circuit Emulation over IP, you should understand the following concepts:

- Circuit Emulation over IP, page 2
- Adaptive Clocking for CEoIP, page 3
- Payload Compression for CEoIP, page 4
- Data Protection (Sample Repetition), page 4
- Dejitter, page 4
- Idle Pattern, page 4
- Payload Size, page 4
- Signaling for CEoIP, page 4
- Control Lead Configurations, page 4

Circuit Emulation over IP

Circuit emulation is an end-to-end service that allows Layer 1 data to be transported transparently through an IP network. Applications that require circuit emulation need the network to provide a constant rate bit stream.
Configuration Circuit Emulation (CEM) can be configured in unidirectional mode using the emulation-mode option. Once configured, traffic will flow only in that direction through the CEM channel. When one direction of CEM traffic is detected on that channel, the CEM channel is considered to be active and a new status of the CEM channel is created to reflect the uni-directional channel.

CEoIP may use adaptive clocking as a means of synchronizing the clock frequencies at the two endpoints. Channel associated signaling (CAS) transport is provided as an optional feature to allow channelized voice applications. Payload compression is provided as an optional feature to improve bandwidth efficiency and data protection is provided to reduce the probability of data loss.

CEoIP software supports the following network modules:

- The NM-CEM-4SER, a network module with four serial ports. To configure CEoIP software for the NM-CEM-4SER, you must configure the options of the ports. Options include dejitter buffer, payload compression, and payload size.
- The NM-CEM-4TE1, a network module with four ports that you can configure as T1 or E1 (where all four ports support the same interface type). To configure CEoIP software for the NM-CEM-TE1, you must define the card type and then configure the options of the port.

**Benefits of CEM over IP**

CEoIP provides a simple migration path to IP-only networks. Examples of solutions that CEoIP integrates with IP include the following:

- Legacy data services
- Legacy video applications
- Satellite data streams
- Radar data streams
- Telemetry for automated industrial environments (for example, power distribution)
- Crypto tunneling for multilevel security

**Adaptive Clocking for CEoIP**

The adaptive clocking option of CEoIP allows the egress clock to vary by expanding or contracting the clock period from the nominal clock. After you have implemented the clocking feature, the adaptive clocking circuits continuously adjust the selected clock based on the data buffer level. You can implement adaptive clocking on each port independently.

**Clock Switchover**

The clock switchover option allows you to switch the clock source over to the internal clock. The switchover ensures continuity of the CEM channel when disruption in receiving the clock from the customer premises equipment (CPE) occurs. To specify the input lead state change that triggers the clock switching over from line to internal or from internal to line, use this option in Data Circuit Terminating Equipment (DCE) split mode.
Payload Compression for CEoIP

The payload compression option minimizes the amount of bandwidth that traffic consumes. It compresses the transmission of any repetitive data pattern (for example, idle code, HDLC flags, and so on) to increase the efficiency of the solution across the network.

With CEoIP software, you can adjust the size (in bytes) of the payload for the IP packet to configure efficiency as opposed to packetization. Larger payloads provide more efficiency but increase the delay. With smaller packets the overhead of the header increases. Payload compression is disabled by default.

Data Protection (Sample Repetition)

The data protection option, also known as sample repetition, reduces the probability of errors due to packet loss by sending each sample twice, in two different IP packets. Data protection consumes more bandwidth than standard transmission, but you can minimize the amount of traffic with payload compression. This feature is disabled by default.

Dejitter

The dejitter buffer size determines the ability of the emulated circuit to tolerate network jitter. The dejitter buffer in CEoIP software is configurable up to 500 milliseconds; the maximum amount of network jitter that CEoIP can tolerate is ±250 milliseconds.

Idle Pattern

The idle pattern option specifies the idle pattern to transmit when the circuit goes down. You can specify a maximum of 64 bits with two 32-bit patterns for the NM-CEM-4SER and 8-bit patterns for the NM-CEM-4TE1.

Payload Size

Payload size is the number of bytes put into each IP packet. This parameter impacts packetization delay and efficiency. Configure a high payload size to increase packetization delay and efficiency. A smaller payload size reduces packetization delay and efficiency.

Signaling for CEoIP

CEoIP software supports the transport of channel associated signaling (CAS) bits in channelized T1/E1 mode. This option extracts incremental signaling information and sends that information in separate packets.

Control Lead Configurations

CEoIP software supports the monitoring and transport of serial interface control leads.
How to Configure Circuit Emulation over IP

This section contains the tasks for configuring an NM-CEM-4TE1 and an NM-CEM-4SER.

To configure an NM-CEM-4TE1, go to the “Configuring the NM-CEM-4TE1 Card Type” section on page 5.

To configure an NM-CEM-4SER, go directly to the “Configuring the Connection Using the xconnect Command” section on page 10.

- Configuring the NM-CEM-4TE1 Card Type, page 5
- Configuring the T1/E1 Line, page 6
- Creating CEM Channels on the T1/E1 Line, page 9
- Configuring the Connection Using the xconnect Command, page 10
- Configuring the CEM Channel, page 12

Configuring the NM-CEM-4TE1 Card Type

Perform this task to configure the card type for an NM-CEM-4TE1.

This task does not apply to the NM-CEM-4SER.

SUMMARY STEPS

1. enable
2. configure terminal
3. card type \{t1 | e1\} slot

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>
What to Do Next

Go to the “Configuring the T1/E1 Line” section on page 6 to continue configuring CEoIP on an NM-CEM-4TE1.

Configuring the T1/E1 Line

Perform this task to configure the T1 or E1 line, starting in global configuration mode.

This task does not apply to the NM-CEM-4SER.

**SUMMARY STEPS**

1. controller {t1 | e1} slot/port
2. framing {esf | sf | unframed}
   or
   framing {crc4 | no-crc4 | unframed}
3. clock source {internal | line | adaptive channel-number}
4. cablelength {long | short} {attenuation | length}
5. crc-threshold value
6. description text
7. loopback {local [line | payload] | network}
DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**
controller (t1 | e1) slot/port | Enters controller configuration mode.  
- Use the slot and port arguments to specify the slot number and port number to be configured. |

*Example:*

Router(config)# controller t1 1/0

| **Step 2**
framing (esf | sf | unframed) | (Optional) Configures the framing format for a T1 or E1 port to synchronize the port and the attached device.  
T1 port framing options:  
- Use the esf keyword to specify Extended Superframe as the T1 framing type.  
- Use the sf keyword to specify the Superframe (also commonly called D4 framing) as the T1 framing type. This is the default.  
E1 port framing options:  
- Use the crc4 keyword to specify the G.704 standard with optional CRC4 mechanism defined in timeslot zero (0) enabled as the E1 framing type. This is the default.  
- Use the no-crc4 keyword to specify the G.704 standard with optional CRC4 mechanism defined in timeslot zero (0) disabled as the E1 framing type.  
T1 or E1 port framing options:  
- Use the unframed keyword to specify the unchannelized mode of framing.  
**Note** If you do not configure framing, the framing on the customer premises equipment (CPE) devices on each end of the connection must match. |

or
framing (crc4 | no-crc4 | unframed)

*Example:*

Router(config-controller)# framing esf

*Example:*

Router(config-controller)# framing crc4
### Command or Action

**Step 3**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>clock source {internal</td>
<td>line</td>
</tr>
</tbody>
</table>

**Example:**

```
Router(config-controller)# clock source adaptive 6
```

- Use the **internal** keyword to specify that the port transmit clock is derived from the time-division multiplexing (TDM) bus backplane clock, if one exists in the router, or the on-board oscillator on the network module.
- Use the **line** keyword to specify that the port transmit clock is derived from the receive clock on the same port.
- Use the **adaptive** keyword to specify that the port transmit clock is locally synthesized based on the average data content of the dejitter buffer of one of the channels on this port.
- If the **adaptive** keyword is selected, use the **channel-number** argument to specify the channel whose dejitter buffer is to be used to synthesize the transmit clock of the port.

**Step 4**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cablelength {long</td>
<td>short} {attenuation</td>
</tr>
</tbody>
</table>

**Example:**

```
Router(config-controller)# cablelength long -15db
```

- Use the **long** keyword to specify that the signal characteristics are set for a long cable length.
- Use the **short** keyword to specify that the signal characteristics are set for a short cable length.
- If the **long** keyword is selected, use the **attenuation** argument to specify the T1 signal attenuation.
- If the **short** keyword is selected, use the **length** argument to specify the T1 cable length.

**Note** This command does not apply to an E1 port.

**Step 5**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>crc-threshold value</td>
<td>(Optional) Configures the number of cyclical redundancy check (CRC) errors in one second that results in the second being declared as a Severely Errored Second (SES).</td>
</tr>
</tbody>
</table>

**Example:**

```
Router(config-controller)# crc-threshold 512
```

- Use the **value** argument to specify the number of CRC errors. Default is 320.

**Note** This command does not apply to an E1 port.
## Creating CEM Channels on the T1/E1 Line

Perform this task to create CEM channels on the T1 or E1 line, starting in controller configuration mode. This task does not apply to the NM-CEM-4SER.

### SUMMARY STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>cem-group</strong> <em>group-number</em> **{unframed</td>
<td>timeslots <em>timeslot</em> [speed {56</td>
</tr>
<tr>
<td>2.</td>
<td>exit</td>
<td></td>
</tr>
</tbody>
</table>

- **Example:**
  ```
  Router(config-controller)# description T1 line to 3rd floor PBX
  ```

  **Example:**
  ```
  Router(config-controller)# loopback network
  ```

### What to Do Next

Go to the “Creating CEM Channels on the T1/E1 Line” section on page 9 to continue configuring CEoIP on an NM-CEM-4TE1.
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> cem-group group-number {unframed</td>
<td>timeslots timeslot [speed {56</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config-controller)# cem-group 6 timeslots 1-4,9,10 speed 64</td>
<td>- The group-number keyword identifies the channel number to be used for this channel. For T1 ports, the range is 0-23. For E1 ports, the range is 0-30.</td>
</tr>
<tr>
<td>- Use the unframed keyword to specify that a single CEM channel is being created including all timeslots and the framing structure of the line.</td>
<td></td>
</tr>
<tr>
<td>- Use the timeslots keyword and the timeslot-range argument to specify the timeslots to be included in the CEM channel. The list of timeslots may include commas and hyphens with no spaces between the numbers, commas, and hyphens.</td>
<td></td>
</tr>
<tr>
<td>- Use the speed keyword to specify the speed of the channels by specifying the number of bits of each timeslot to be used. This keyword applies only to T1 channels.</td>
<td></td>
</tr>
</tbody>
</table>

| **Step 2** exit | Exits controller configuration mode and returns to global configuration mode. |
| Example: | |
| Router(config-controller)# exit | Router(config)# |

### What to Do Next

Go to the “Configuring the Connection Using the xconnect Command” section on page 10 to continue configuring CEoIP on an NM-CEM-4TE1

### Configuring the Connection Using the xconnect Command

Perform this task to create a connection using the xconnect command, starting in global configuration mode. This task applies to configuring CEoIP on both the NM-CEM-4TE1 and the NM-CEM-4SER.

**Note**

To properly configure the CEoIP feature, two CEoIP network modules must use the same UDP port number to communicate.

### SUMMARY STEPS

1. cem slot/port/channel
2. xconnect remote-ip-address virtual-connect-ID encapsulation encapsulation-type
3. local ip address ip-address
4. local udp port port-number
5. **remote udp port** `port-number`
6. **exit**

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> cem slot/port/cem-group</td>
<td>Enters CEM configuration mode to configure CEM channels.</td>
</tr>
<tr>
<td>Example: Router(config)# cem 3/1/0</td>
<td></td>
</tr>
<tr>
<td>- Use the <code>slot</code> argument to specify the slot number in which the network module is installed.</td>
<td></td>
</tr>
<tr>
<td>- Use the <code>port</code> argument to specify the port number of the CEM channel to be configured.</td>
<td></td>
</tr>
<tr>
<td>- Use the <code>channel</code> argument to specify the CEM channel number to be configured. For a serial channel enter zero. For a T1 or E1 channel enter the channel number defined in the <code>cem-group</code> command (see the “Creating CEM Channels on the T1/E1 Line” section on page 9).</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> xconnect remote-ip-address virtual-connect-ID encapsulation encapsulation-type</td>
<td>Creates one end of a connection between two CEM network modules and enters xconnect configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config-cem)# xconnect 10.2.0.1 0 encapsulation udp</td>
<td></td>
</tr>
<tr>
<td>- Use the <code>remote-ip-address</code> argument to specify the IP address of an interface—regular or loopback—on the destination router.</td>
<td></td>
</tr>
<tr>
<td>- Set the <code>virtual-connect-ID</code> argument to be zero.</td>
<td></td>
</tr>
<tr>
<td>Note: Currently the only supported encapsulation type is UDP.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> local ip address <code>local-ip-address</code></td>
<td>Configures the IP address of an interface—regular or loopback—on the source router.</td>
</tr>
<tr>
<td>Example: Router(config-cem-xconnect)# local ip-address 10.2.0.2</td>
<td></td>
</tr>
<tr>
<td>Note: The local IP address must be the same as the remote IP address (at the other side) configured in the <code>xconnect</code> command.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> local udp port <code>udp-port</code></td>
<td>Specifies the User Datagram Protocol (UDP) port number of the local CEM channel.</td>
</tr>
<tr>
<td>Example: Router(config-cem-xconnect)# local udp port 15901</td>
<td></td>
</tr>
<tr>
<td>Note: The local UDP port of a CEM channel must be the same as the remote UDP port of the CEM channel at the other end of the connection.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> remote udp port <code>udp-port</code></td>
<td>Specifies the UDP port number of the remote CEM channel.</td>
</tr>
<tr>
<td>Example: Router(config-cem-xconnect)# remote udp port 15902</td>
<td></td>
</tr>
<tr>
<td>Note: The remote UDP port of a CEM channel must be the same as the local UDP port of the CEM channel at the other end of the connection.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> exit</td>
<td>Exits xconnect configuration mode and returns to CEM configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config-cem-xconnect)# exit Router(config-cem)#</td>
<td></td>
</tr>
<tr>
<td>- Repeat this command if you wish to exit CEM configuration mode return to global configuration mode.</td>
<td></td>
</tr>
</tbody>
</table>
What to Do Next

This task must be repeated on the other CEM network module and each end of the CEM connection must be configured identically to allow traffic to pass between the network modules. When both network modules have been configured, continue to the “Configuring the CEM Channel” section on page 12.

Configuring the CEM Channel

Perform this task to configure the CEM T1/E1 or serial channel, starting in CEM configuration mode.

SUMMARY STEPS

1. clock rate rate
2. clock mode {normal | split}
3. clock source {internal | loop | adaptive}
4. payload-size size
5. dejitter-buffer size
6. control-lead sampling-rate rate
7. control-lead state {active | fail} output-lead {on | off | follow} [{local | remote} input-lead]
8. data-strobe input-lead-name {on | off}
9. idle-pattern length pattern1 [pattern2]
10. signaling
11. payload compression
12. data protection
13. ip dscp dscp
14. ip tos tos
15. ip precedence precedence
16. loopback {local | network}
17. exit
**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> clock rate</td>
<td>(Optional) For serial channels only. Specifies the nominal bit rate of a serial CEM channel.</td>
</tr>
<tr>
<td>Examples:</td>
<td></td>
</tr>
<tr>
<td>Router(config-cem)# clock</td>
<td></td>
</tr>
<tr>
<td>rate 38400</td>
<td>(Optional) Use the <em>rate</em> argument to specify the data rate of the channel in bps. Default is 64000.</td>
</tr>
<tr>
<td><strong>Step 2</strong> clock mode</td>
<td>(Optional) For serial channels only. Specifies the clock mode of a serial CEM channel.</td>
</tr>
<tr>
<td>Examples:</td>
<td></td>
</tr>
<tr>
<td>Router(config-cem)# clock</td>
<td></td>
</tr>
<tr>
<td>mode split</td>
<td>(Optional) Use the <strong>normal</strong> keyword to specify that the Data Circuit-terminating Equipment (DCE) provides both the Receive Clock (RxC) and the Transmit clock (TxC) to the attached Data Terminal Equipment (DTE). Use the <strong>split</strong> keyword to specify that the DCE provides the Receive Clock (RxC) to the attached DTE, and the DTE provides the external Transmit Clock (XTC or TT) to the DCE.</td>
</tr>
<tr>
<td><strong>Step 3</strong> clock source</td>
<td>(Optional) Configures the clock source for a serial CEM channel.</td>
</tr>
<tr>
<td>Examples:</td>
<td></td>
</tr>
<tr>
<td>Router(config-cem)# clock</td>
<td></td>
</tr>
<tr>
<td>source loop</td>
<td>(Optional) This step applies only to configuring serial channels. For information about configuring the clock source for T1 or E1 ports, see the “Configuring the T1/E1 Line” section on page 6. Use the <strong>internal</strong> keyword to specify that the clock(s) provided by the network module to the CPE is derived from the TDM bus backplane clock, if one exists in the router, or the on-board oscillator on the network module. Use the <strong>loop</strong> keyword to specify that the clock provided by the network module to the CPE is derived from the the clock receive from the CPE on the same port. Use the <strong>adaptive</strong> keyword to specify that the clock(s) provided by the network module to the CPE is locally synthesized based on the average data content of the local dejitter buffer. The <strong>loop</strong> keyword is valid only when the <em>clock mode</em> command is configured.</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| 4    | `payload-size size` | (Optional) Specifies the number of bytes encapsulated into a single IP packet.  
  - Use the `size` argument to specify the number of bytes included in the payload of each packet. Default is 32 bytes for a serial CEM channel.  
  - For more information about T1 and E1 default values, see the `payload-size` command in the “Command Reference” section. |
| 5    | `dejitter-buffer size` | (Optional) Specifies the size of the dejitter buffer used to compensate for the network filter.  
  - Use the `size` argument to specify the size of the buffer in milliseconds. Default is 60. |
| 6    | `control-lead sampling-rate rate` | (Optional) Specifies the sampling rate of input control leads on a serial CEM channel.  
  - This command is used only on serial channels.  
  - Use the `rate` argument to specify the frequency with which the control leads are sampled, in samples per second. Default is 0.  
  
  **Note**  
  Control lead update packets are independent of the data packets from the same channel. |
| 7    | `control-lead state {active | fail} output-lead {on | off | follow} [{local | remote}] input-lead` | (Optional) Specifies the state of each output control lead on a serial CEM channel.  
  - This command is used only on serial channels.  
  - Use the `active` keyword to specify the state of the control lead when the connection is active.  
  - Use the `fail` keyword to specify the state of the control lead when the connection has failed.  
  - Use the `output-lead` argument to specify the name of the control lead.  
  - Use the `on` keyword to specify that the control lead is permanently asserted.  
  - Use the `off` keyword to specify that the control lead is permanently not asserted.  
  - Use the `follow` keyword to specify that the control lead is to follow any changes in the state of an input control lead specified by the `local` or `remote` keywords and the `input-lead` argument.  
  - Use the `input-lead` argument to specify the name of the local or remote control lead to follow.  
  
  **Note**  
  Control lead update packets are independent of the data packets for the same channel.  
  
  **Note**  
  The `control-lead sampling-rate` parameter must be set to non-zero for this feature to operate. |
### Step 8

**Command or Action:**

`data-strobe input-lead {on | off}`

**Example:**

```
Router(config-cem)# data-strobe dtr on
```

(Optional) Specifies that an input control lead is to be monitored and data is packetized and sent only when the specified control lead is in the specified state.

- This command is used only on serial channels.
- Use the `input-lead` argument to specify the input control lead to be monitored to determine whether input data is to be packetized.
- Use the `on` keyword to specify that data packets are to be sent from this CEM channel only when the specified input lead is asserted.
- Use the `off` keyword to specify that data packets are to be sent from this CEM channel only when the specified input lead is not asserted.
- Use this command to save bandwidth when the attached CPE is inactive.

**Note**  
Control lead update packets are still sent even if data packets are withheld.

### Step 9

**Cisco NM-CEM-4SER:**

`idle-pattern length pattern1 [pattern2]`

**Cisco NM-CEM-4TE1:**

`idle-pattern pattern1`

**Example:**

**Cisco NM-CEM-4SER:**

```
Router(config-cem)# idle-pattern 53 0x12345678 0x87654321
```

**Cisco NM-CEM-4TE1:**

```
Router(config-cem)# idle-pattern 0x66
```

(Optional) Defines the idle data pattern to send to the attached CPE when packets are lost or the de-jitter buffer experiences an under-run condition.

For serial CEM channels:

- A bit pattern up to 64 bits long may be specified.
- Use the `pattern1` argument to specify up to 32 bits of the least significant bits of the idle data pattern, in hex notation. Default is 0xFF.
- Use the `pattern2` argument to specify the most significant bits of the idle data pattern, in hex notation. If the `length` argument is 32 bits or less, this argument is not permitted.
- Use the `length` argument to specify the total length of the repeating bit pattern. Default is 8 bits.

For T1 or E1 CEM channels:

- An eight-bit pattern is specified.

### Step 10

**Command or Action:**

`signaling`

**Example:**

```
Router(config-cem)# signaling
```

(Optional) Enables the transport of Channel Associated Signaling (CAS) bits.

**Note**  
This command applies only to framed T1 or E1 data channels.

### Step 11

**Command or Action:**

`payload-compression`

**Example:**

```
Router(config-cem)# payload-compression
```

(Optional) Enables payload compression on a CEM channel.

**Note**  
Enabling payload compression adds a delay equal to one packet time.
## Command or Action

<table>
<thead>
<tr>
<th>Step 12</th>
<th>data-protection</th>
</tr>
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<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router(config-cem)# data-protection</code></td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
<td>(Optional) Enables data protection by transmitting each data bit twice, once in each of two consecutive data packets.</td>
</tr>
<tr>
<td><strong>Caution:</strong></td>
<td>Use this command carefully because it increases the network bandwidth used by the CEM connection.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Step 13</th>
<th>ip dscp dscp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router(config-cem)# ip dscp 36</code></td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
<td>(Optional) Configures the IP Differentiated Service Code Point (DSCP) for packets originating from this CEM channel.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>If DSCP is configured, the <code>ip tos</code> and <code>ip precedence</code> commands are not available because they are mutually exclusive.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 14</th>
<th>ip tos tos</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router(config-cem)# ip tos 11</code></td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
<td>(Optional) Configures the IP type of service (ToS) bits for the CEM channel.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>If DSCP is configured, the <code>ip tos</code> command is not available because they are mutually exclusive.</td>
</tr>
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</table>

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<thead>
<tr>
<th>Step 15</th>
<th>ip precedence precedence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router(config-cem)# ip precedence 7</code></td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
<td>(Optional) Configures the IP precedence bits for the CEM channel.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>If DSCP is configured, the <code>ip precedence</code> command is not available because they are mutually exclusive.</td>
</tr>
</tbody>
</table>
Circuit Emulation over IP

Configuration Examples for CEoIP

What to Do Next

Proceed to the “Configuration Examples for CEoIP” section on page 17.

Configuration Examples for CEoIP

This section provides the following configuration examples:

- Configuring a T1 CEM Network Module: Example, page 17

Configuring a T1 CEM Network Module: Example

The following example shows a basic configuration of a T1 network module to configure the CEoIP feature.

card type t1 0
controller t1 4/0
cem-group 6 timeslots 1-4,9,10 speed 64
framing esf
linecode b8zs
clock source adaptive 6
cablelength long -15db
crc-threshold 512
description T1 line to 3rd floor PBX
loopback network
no shutdown
exit
cem 2/1/6
xconnect 10.2.0.1 0 encapsulation udp
local ip-address 10.2.0.9
local udp port 15901
remote udp port 15901
payload-size 512
dejitter-buffer 80
Additional References

For additional information related to the CEoIP feature, refer to the following references:

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>CEoIP NMs</td>
<td>Release Notes for Cisco NM-CEM-4TE1 and NM-CEM-4SER Network Module Software</td>
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Standards

<table>
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<tr>
<th>Standards</th>
<th>Title</th>
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<tbody>
<tr>
<td>GR-1089</td>
<td>Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment</td>
</tr>
<tr>
<td>GR-63</td>
<td>Network Equipment-Building System (NEBS) Requirements: Physical Protection</td>
</tr>
<tr>
<td>TIA/EIA-IS-968</td>
<td>Technical Requirements for Connection of Terminal Equipment to the Telephone Network</td>
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MIBs

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<tr>
<th>MIBs Link</th>
<th>MIBs</th>
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<tbody>
<tr>
<td>OLD-CISCO-CHASSIS-MIB</td>
<td></td>
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<tr>
<td>RFC1406-MIB</td>
<td></td>
</tr>
<tr>
<td>CISCO-ENTITY-VENDORTYPE-OID-MIB</td>
<td></td>
</tr>
</tbody>
</table>

To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:

http://www.cisco.com/go/mibs

RFCs

<table>
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<th>Title</th>
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<tbody>
<tr>
<td>Definitions of Managed Objects for the DS1 and E1 Interface Types</td>
</tr>
<tr>
<td>Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types</td>
</tr>
</tbody>
</table>

Note

CEoIP supports RFC2495 to the same extent as IOS supports this RFC.
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.</td>
<td><a href="http://www.cisco.com/public/support/tac/home.shtml">http://www.cisco.com/public/support/tac/home.shtml</a></td>
</tr>
</tbody>
</table>

Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the Cisco IOS Interface and Hardware Component Command Reference at http://www.cisco.com/en/US/docs/ios/interface/command/reference/ir_book.html. For information about all Cisco IOS commands, go to the Command Lookup Tool at http://tools.cisco.com/Support/CLILookup or to the Cisco IOS Master Commands List.

- cem
- cem-group
- clear cem
- clock mode
- clock source (CEM)
- clock-switchover
- control-lead sampling-rate
- control-lead state
- crc-threshold
- data-protection
- data-strobe
- default (CEM)
- dejitter-buffer
- emulation-mode
- framing (CEM)
- idle-pattern
- ip dscp
- local ip address
- local udp port
- loopback (CEM)
- payload-compression
- payload-size
- remote udp port
- show cem
- signaling
- xconnect (CEM)

**Feature Information for Circuit Emulation over IP**

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
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<tbody>
<tr>
<td>12.3(7)T</td>
<td>This feature was introduced.</td>
</tr>
<tr>
<td>12.2(33)SRD</td>
<td>Included information on clock switchover and unidirectional emulation mode.</td>
</tr>
</tbody>
</table>

Any Internet Protocol (IP) addresses used in this document are not intended to be actual addresses. Any examples, command display output, and figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses in illustrative content is unintentional and coincidental.

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