



## **L2TP**

### Teldat-Dm 760-I

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## I Related documents

Teldat-Dm 710-I PPP Interface

Teldat-Dm 772-I Common Configuration Interfaces

# Chapter 1 L2TP protocol

## 1.1 Introduction

The Point-to-Point Protocol (PPP) RFC describes an encapsulation mechanism for transporting multi-protocol packets across Layer 2 point-to-point links. In a normal operating scenario, a user uses a technique (such as a PSTN or ISDN call, or an ADSL/SHDSL link) to obtain a layer 2 connection to a network access server (NAS) and then runs PPP over said connection. The link termination point and the PPP session endpoint in this scenario reside on the same physical device, i.e., in the access server or NAS (in the case of ADSL for example, in the DSLAM).

The Layer 2 Tunneling Protocol (L2TP) extends the PPP model by allowing the link and PPP endpoints to reside on different devices interconnected by an IP network. With L2TP, the user establishes a point-to-point connection to an access concentrator and the concentrator then tunnels the PPP frames to the NAS. This allows the processing of PPP packets to be separated from the termination of the layer 2 circuit.

This scheme has the advantage of shortening the distance between user and layer 2 termination so that the PPP session can be concentrated on a shared point over a shared IP network infrastructure. In the context of switched network access scenarios, the savings are obvious (calls are local rather than long distance). It is also completely transparent to the user.

The L2TP protocol can also be used to initiate tunnels locally (following a similar scheme to GRE tunneling), to encapsulate traffic originated locally by the router towards an already existing NAS on the service provider network. This modularity is known as L2TP client-initiated tunneling (L2TP-CI).

Version 3 of the Layer 2 Tunneling Protocol (L2TPv3) defined in RFC3931 establishes yet another application of L2TP: In this case the protocol is used to simulate a cable connection between two points. Thus, a tunnel is set up and an L2TP session simulating a cable, which in the RFC is known as "pseudowire".

This document sets out the router commands relating to L2TP configuration and monitoring. This manual is closely related to the Teldat-Dm710-I PPP Interface manual which explains PPP configuration and monitoring in depth.

### 1.1.1 Protocol overview

L2TP uses two types of messages, control messages and data messages:

- Control messages are used to establish, maintain and release sessions and tunnels. These messages use a reliable transmission channel to guarantee delivery.
- Data messages are used to encapsulate PPP frames being transported over the tunnel. Data messages are not retransmitted when packet loss occurs (the upper level protocol is expected to force retransmission if necessary).

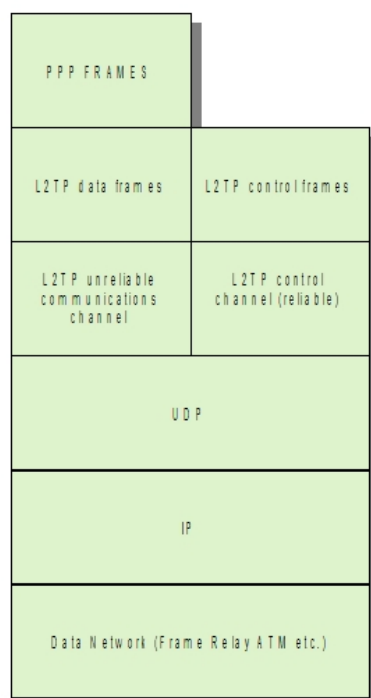


Fig. 1: L2TP protocol structure

Figure 1 shows the relationship between L2TP PPP frames, control messages, and protocol transmission channels. PPP frames are sent over an unreliable L2TP logical channel, i.e., an L2TP header is added to PPP frames and then they are encapsulated in UDP. Control messages, however, are transmitted in-band over a reliable communications channel implemented over UDP. For this, sequence numbers are used in the L2TP headers of the control messages, and a message acknowledgement scheme is used with retransmission upon timer expiration.

### 1.1.2 PPP over L2TP

The steps to follow to connect a remote user to an L2TP network server (LNS) through an L2TP access concentrator (LAC) are:

- (1) The remote user initiates a PPP connection with an ISP (typically using a PSTN or an ISDN modem).
- (2) The ISP LAC accepts the connection and sets up the PPP LCP layer.
- (3) Once the LCP layer is established, the LAC uses CHAP or PAP to authenticate the end user. Based on the PPP user domain name received in the CHAP/PAP response, the LAC checks whether it can create an L2TP tunnel for this user. If it can't (normal PPP connection), the PPP authentication process described in the PPP protocol manual continues. If the domain name is associated with an L2TP group, the LAC obtains the L2TP tunnel parameters associated with this domain from the group definition.
- (4) The LAC brings up an L2TP tunnel with the associated LNS after exchanging authentication information (if necessary).
- (5) The L2TP tunnel is then up between the LAC and the LNS and a new session is triggered for the end user.
- (6) The LAC forwards the negotiated LCP options and PPP authentication information to the LNS. The LNS listens to this information and negotiates the PPP parameters, authenticating the end user and negotiating the necessary NCPs. If the PPP negotiation fails, the LNS closes the L2TP session created in step five and the associated tunnel, if necessary.

Throughout this process, the end user is only aware of the PPP negotiation with the LNS. Thus, the LAC device is transparent to the end user.

### 1.1.3 L2TP client-initiated tunneling

In this case the client router (LAC) negotiates and establishes a direct tunnel to the LNS, without the mediation of the NAS. As soon as the LAC and LNS have IP connectivity between them, they begin the tunnel negotiation. This negotiation cannot be triggered by interesting traffic, as was the case above. The client router uses a PPP virtual interface in this operating mode. The virtual interface adds layer 2 encapsulation to layer 2 packets, allowing them to be sent to the LNS through an L2TP tunnel.

### 1.1.4 L2TP pseudowire

The main feature of this mode is the simulation of a layer 2 physical circuit between two IP nodes through an L2TP tunnel. An interface on each device, the LAC and the LNS, is associated with the L2TP tunnel. The L2TP tunnel is set up between the two associated physical interfaces and simulates a physical connection between them over an IP network which both devices are connected to. This is known as pseudowire (see **Figure 2**). Each *pseudowire* has a distinguishing identifier.

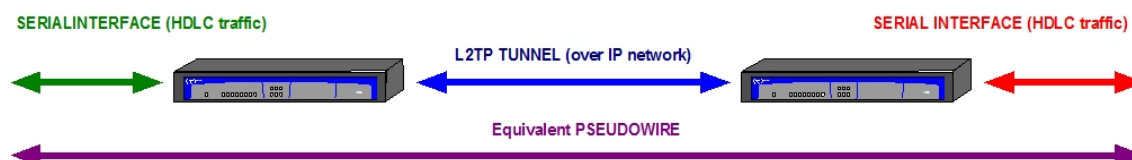


Fig. 2: Pseudowire over L2TP

This operating mode lets us have either dynamic or static tunnels, depending on the way in which they are set up. Dynamic tunnels are dynamically negotiated and created between the LAC and the LNS. Static tunnels are defined in the device configuration and are considered established from the moment the device starts up.

There are also point-to-point and multipoint tunnels. Static multipoint tunnels have been created to allow multicast traffic to be broadcast through L2TP tunnels. Static multipoint L2TP tunnels only permit traffic in one direction (downstream). To send traffic in the opposite direction (upstream), we need to set up dynamic multipoint tunnels between each unicast end and the multicast side, creating what is known as a dynamic multipoint tunnel (see **Figure 3**). So, two groups must be defined for multipoint tunnels, a static multipoint group and a dynamic multipoint one. Further information on how to configure this type of tunnel can be found in *L2TP configuration examples* on page 31.

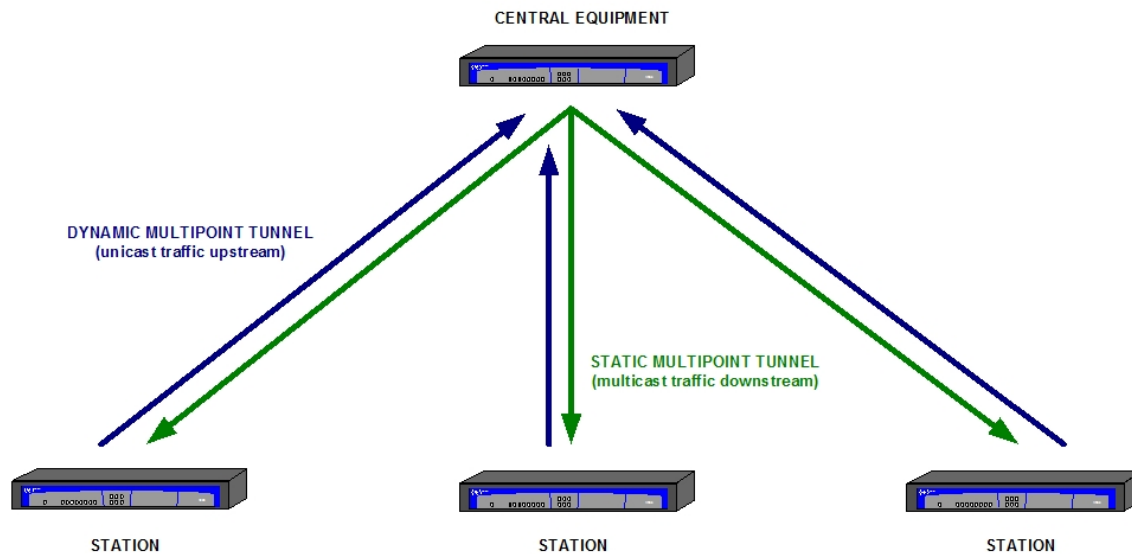


Fig. 3: Multipoint L2TP tunnels

A dynamic tunnel negotiation takes place either when the interface associated with the *pseudowire* on one of the routers becomes active, or when one of the routers receives traffic that it must encapsulate and send through the tunnel. As mentioned above, static tunnels are always up and end-to-end communications will not be compromised as long as the tunnel definition on both endpoints matches. That is, the tunnel, session and *pseudowire* identifiers must be the same at both ends of the tunnel.



#### Note

Currently, only synchronous serial, asynchronous serial and G703 interfaces are supported.

We also envisage the possibility of associating another L2TP tunnel (rather than a physical interface) with the *pseudowire*, so that data received through the tunnel are sent through the associated tunnel.



## 1.2 Terminology

- **Attribute Value Pair (AVP)** : A pair of values exchanged between the LNS and the LAC. For example, in the pair AV domain = "teldat.es", "domain" is the attribute and "teldat.es" is the value.
- **Challenge Handshake Authentication Protocol (CHAP)**: An authentication protocol used in PPP in which the clear text password is not sent over the line. This allows the secure exchange of a shared secret between the two endpoints of a PPP connection.
- **Client or User**: Instigator of a PPP session.
- **Control messages**: Messages exchanged between the LAC-LNS pair, and sent in-band over a reliable L2TP channel. These messages control the L2TP protocol logic itself: establishing and releasing sessions/tunnels, establishing the reliable logical channel, managing the protocol's options, etc.
- **L2TP**: The layer 2 tunneling protocol is an extension of the PPP protocol widely used in virtual private networks. L2TP is essentially a merger of Microsoft's PPTP and Cisco's Layer 2 Forwarding (L2F). The technical specification is currently detailed in RFC 2661.
- **LCP**: The link control protocol is responsible for establishing, configuring and testing the status of point-to-point links in a PPP connection.
- **LAC**: Short for access concentrator. This device multiplexes PPP connections in L2TP tunnels and sessions. In this way, PPP frames are encapsulated in L2TP tunnels and vice versa.
- **LNS**: this is the termination point for L2TP tunnels, and therefore, where PPP frames are processed and generated by higher layer protocols. The LNS is responsible for receiving L2TP tunnel establishment requests and processing received PPP frames before sending them on to the next layer.
- **NAS**: The network access server is a device providing temporary network access to remote users. Generally, access is through "last mile" links, like PSTN/ISDN calls or ADSL links. In an L2TP scenario, the NAS is also the LAC.
- **NCP**: The network control protocol is the part of PPP responsible for negotiating layer 3 parameters. More specifically, IPCP is the Internet Protocol NCP for the PPP protocol.
- **PAP**: Authentication protocol based on a password. This is a simple authentication scheme used in PPP which sends the user name and password in clear text. This makes it much less secure than CHAP, which explains why CHAP is more widely used.
- **PPP**: Point to point transmission protocol; this encapsulates packets over the PPP links. This is described in the STD0051.
- **PSTN**: Public Switched Telephone Network.
- **Tunnel**: A virtual connection between the LAC and the LNS that can carry multiple simultaneous PPP sessions.
- **Pseudowire**: This is the connection established between two IP nodes through an L2TP tunnel and which simulates a layer 2 physical circuit between the two nodes.

## Chapter 2 Configuring L2TP

### 2.1 Introduction

To configure the L2TP protocol for PPP, perform the following steps:

- Add and configure the PPP interface associated with the tunnel (in the case of the LAC) or the base interfaces that are going to be L2TP interfaces (in the case of the LAC-CI and LNS). For further instructions, see manual Teldat-Dm710-I PPP Interface.
- Add and configure an L2TP interface (in the case of the LAC-CI and LNS).
- Enable the L2TP protocol (enable command).
- Define the L2TP tunnel group/s. For each group we need to:
  - Define the L2TP tunnel destination (this is the LNS address that we want to connect to).
  - Specify the associated PPP domain.
  - Specify group type.
  - We can also modify the tunnel destination port and specify authentication (tunnel password)/security (hiding AVPS) parameters if desired.

To configure an L2TP pseudowire, perform the following steps:

- Enable the L2TP protocol (enable command).
- Define the L2TP tunnel group/s. Here the steps vary depending on the type of tunnel:
  - Point-to-point tunnels:
    - Set the pseudowire identifier.
    - Define the L2TP tunnel destination (this is the address of the remote device that we want to connect to).
    - Assign the physical interface associated with the pseudowire.
    - Indicate whether we are the LAC, LNS or both.
    - We can also define a number of additional features such as the persistence of the tunnel, who will open it if it is a dynamic tunnel, sequence number control and packet reordering.
  - Static multipoint tunnels:
    - Set the pseudowire identifier.
    - Multicast address used by the tunnel.
    - Assign the physical interface associated with the tunnel.
    - Define the tunnel ID and the static session ID.
  - Dynamic multipoint tunnels:
    - Set the pseudowire identifier.
    - Indicate that it is multipoint and that it accepts connections.
    - Assign the associated interface.

The following section describes the above configuration commands in detail.

## 2.2 PPP interface configuration commands



### Note

Please see manual Teldat-Dm710-I for instructions on adding and configuring PPP interfaces. We will only be explaining L2TP-related parameters here.

To establish specific L2TP parameters, enter the **L2TP** command from the PPP interface configuration menu:

```
Config>NETWORK ppp1
```

```
-- Generic PPP User Configuration --
```

```
ppp1 config>l2tp
```

```
-- L2TP Configuration --
```

```
ppp1 L2TP config>
```

The following commands are available in the PPP interface configuration menu:

```
ppp1 L2TP config>?
```

```
  lac      Set L2TP (LAC) configuration
  lns      Set L2TP (LNS) configuration
  no       Negate a command or set its defaults
  exit
```

```
ppp1 L2TP config>
```

Command	Function
? ( <i>HELP</i> )	Displays the available commands or options.
<i>LAC</i>	Specifies L2TP parameters functioning as a LAC device.
<i>LNS</i>	Specifies L2TP parameters functioning as an LNS device.
<i>NO</i>	Restores an option's default values, disables parameters or deletes previously added configuration elements.
<i>EXIT</i>	Exits the PPP interface L2TP configuration.

### LAC

The available options are:

```
ppp1 L2TP config>lac ?
```

```
  enable    Enable L2TP (LAC)
```

```
ppp1 L2TP config>
```

*enable* When this option is configured, the router behaves as a LAC, as described in chapter 1, section 1.3.

### LNS

The available options are:

```
ppp1 L2TP config>lms ?
```

```
  enable    Enable this interface as L2TP (LNS) template
  max-tunnels Tunnels to infer from this interface
```

```
ppp1 L2TP config>
```

*enable* When this option is configured, the router behaves as a tunnel server (LNS) template. Note that if we are only going to open one tunnel to the router, we don't need to enable the PPP interface to behave as a tunnel template. A tunnel template is used to clone the PPP interface and corresponding L2TP interface as many times as necessary to attend all of the tunnels that can be opened to the device. After enabling this option, use the following option to specify a maximum number of tunnels.

*max-tunnels* This option specifies the maximum number of interfaces that can be cloned by the tunnel server template. Valid values range between 0 and 30. The default is 0 (indicating that none of the interfaces will be cloned).

**Note**

A tunnel template is used to clone the PPP interface and corresponding L2TP interface as many times as necessary to attend all of the tunnels that can be opened to the device.

## 2.3 L2TP interface configuration commands

When L2TP is operating in LAC-CI or LNS mode, we need to add and configure an L2TP interface to behave as the base interface of the previous PPP interface. This is not necessary with *pseudowires*.

### 2.3.1 Adding L2TP interfaces

To create L2TP interfaces, enter the following command from the general configuration menu:

**add device l2tp <L2TP interface identifier>**

Once added, the created PPP interface is shown.

```
Config>add device l2tp 1
Config>
```

We can check that the new interface has been added correctly by listing the existing interfaces on the device:

```
Config>list devices

Interface          Connector      Type of interface
-----
ethernet0/0        FE0/LAN1      Fast Ethernet interface
ethernet0/1        FE1/LAN2      Fast Ethernet interface
serial0/0          SERIAL0/WAN1  X25
serial0/1          SERIAL1/WAN2  X25
x25-node           ---           Router->Node
hssil/0            SLOT1         High Speed Serial Interface
ppp1               ---           Generic PPP
l2tp1              ---           L2TP
```

### 2.3.2 Deleting L2TP interfaces

To delete an L2TP interface, use the **NO DEVICE** command in the general configuration menu.

**Syntax:**

```
Config>NO DEVICE <interface_name>
```

- **<interface\_name>** name of the interface to delete (*l2tpX*, X=Interface Identifier).

**Example:**

```
*CONFIG
Config>NO DEVICE L2TP1
Config>
```

We can check that the interface has been deleted correctly by listing the existing interfaces on the device:

```
Config>list devices

Interface          Connector      Type of interface
-----
ethernet0/0        FE0/LAN1      Fast Ethernet interface
ethernet0/1        FE1/LAN2      Fast Ethernet interface
serial0/0          SERIAL0/WAN1  X25
serial0/1          SERIAL1/WAN2  X25
x25-node           ---           Router->Node
hssil/0            SLOT1         High Speed Serial Interface
ppp1               ---           Generic PPP
l2tp1              ---           L2TP
Config>no device l2tp1
Config>list devices
```

```

Interface          Connector      Type of interface
ethernet0/0        FE0/LAN1      Fast Ethernet interface
ethernet0/1        FE1/LAN2      Fast Ethernet interface
serial0/0          SERIAL0/WAN1  X25
serial0/1          SERIAL1/WAN2  X25
x25-node           ---           Router->Node
hssil/0           SLOT1        High Speed Serial Interface
ppp1              ---          Generic PPP
Config>

```

### 2.3.3 Configuring L2TP interfaces

To access the configuration menu of an L2TP interface, enter **NETWORK <L2TP interface>** in the general configuration menu. For example, if we want to access interface **12tp2**, enter:

```

Config>network 12tp2

-- L2TP (virtual) Interface Configuration --
12tp2 config>

```

The commands available in the L2TP interface configuration menu are as follows:

```

12tp2 config>?
  bandwidth      Set bandwidth of the L2TP interface
  description     Enter interface description
  list           Show L2TP interface configuration parameters
  no             Negates a command or sets its defaults
  shutdown       Change state to administratively down
  type           Set type of L2TP interface
  update         Update a level indicator
  exit
12tp2 config>

```

Some commands are common to all of the device interfaces. These commands are described in the manual on common configuration interfaces (Teldat-Dm722-I Common Configuration Interfaces).

Command	Function
<i>?</i> ( <i>HELP</i> )	Displays the commands or the available options.
<i>BANDWIDTH</i>	Specifies the link bandwidth for MPPP.
<i>LIST</i>	Lists the L2TP interface configuration.
<i>NO</i>	Restores an option's default value, disables parameters or deletes previously added configuration elements.
<i>TYPE</i>	Configures the type of L2TP interface.
<i>EXIT</i>	Exits the L2TP interface configuration.

#### BANDWIDTH

This command allows us to specify the bandwidth for MPPP when sharing traffic between various L2TP links. The bandwidth value is in bits per second.

```

12tp2 config> bandwidth ?
<0..2147483647>  Value in the specified range. (Use 0 for 'Unknown')
12tp2 config>

```

In L2TP links, the link speed used to set up the tunnel can't be automatically determined because this is done at level 3.

The 'bandwidth' command allows us to specify a bandwidth value that MPPP will consider when distributing traffic between multiple links.

This parameter should either be configured on all, or none, of the L2TP interfaces when an MPPP is made up of various L2TP links. The payload is divided uniformly between all of the interfaces when this parameter isn't configured on any of the interfaces.

If an MPPP is made up of an L2TP link and another type of interface, load balancing is performed according to the bandwidth values (L2TP interfaces) and the line speed values of the other interfaces.

For example, if an MPPP was in theory made up of an ISDN link (64 kbps) and an L2TP interface with a 512000 bps bandwidth, the MPPP delivers eight times more bytes to the L2TP interface than to the ISDN interface.

In any event, an MPPP link does not use the bandwidth or line speed values to perform rate control; it simply uses them as relative values for load sharing.

## TYPE

This command allows us to specify the type of L2TP interface. The available options are:

```
l2tp2 config>type ?
 lac-ci   L2TP Access Concentrator (Client-Initiated)
 lns      L2TP Network Server
l2tp2 config>
```

*lac-ci* We configure this option when we want the L2TP interface to operate in LAC-CI mode. This is the default option.

*lns* We configure this option when we want the L2TP interface to behave as a tunnel server.



### Note

There is also a third option (L2TP as pure LAC) where we don't need to create an L2TP interface.

## 2.4 L2TP protocol configuration commands

To access the L2TP protocol configuration menu, type **protocol L2TP** in the general configuration menu. For example:

```
Config>protocol l2tp
-- Layer 2 Tunneling Protocol user configuration --
L2TP config>
```

The commands available in the protocol L2TP general configuration menu are as follows:

```
L2TP config>?
 disable      Disable L2TP protocol
 enable      Enable L2TP protocol
 group       Group definition
 list        List L2TP config
 listen-port  UDP Port for L2TP protocol
 no          Negates a command or sets its defaults
 exit
```

Command	Function
<i>? (HELP)</i>	Displays the commands or the available options.
<i>DISABLE</i>	Disables the L2TP protocol.
<i>ENABLE</i>	Enables the L2TP protocol.
<i>GROUP</i>	Allows us to access a group's configuration submenu.
<i>LISTEN-PORT</i>	Defines the local UDP port used by the L2TP protocol.
<i>LIST</i>	Displays the current L2TP protocol configuration.
<i>NO</i>	Restores an option's default value, disables parameters or deletes previously added configuration elements.
<i>EXIT</i>	Exits the L2TP interface configuration.

### 2.4.1 DISABLE

The disable command globally disables the L2TP protocol. Any L2TP configuration will be ignored if the L2TP protocol is disabled.

*Syntax:*

```
L2TP config>disable
```

*Example:*

```
L2TP config>disable
L2TP config>
```

## 2.4.2 ENABLE

This command enables the L2TP protocol. If this command is not specified, any additional L2TP configuration will have no effect on device functioning.

### Syntax:

```
L2TP config>enable
```

### Example:

```
L2TP config>enable
L2TP config>
```

## 2.4.3 LISTEN-PORT

This command defines the *local* UDP port used for the L2TP protocol. The default port is 1701.

### Syntax:

```
L2TP config>listen-port <port>
```

*port* Local UDP port used to send the UDP packets (if the device is behaving as LAC) or used to listen for tunnel establishment requests from other LACs (if the device is behaving as LNS).

### Example:

```
L2TP config> listen-port 2025
L2TP config>
```

## 2.4.4 GROUP

This command accesses an L2TP group's configuration submenu.

### Syntax:

```
L2TP config>group <group-number>
```

*group-number* Group number to be configured. The maximum number of L2TP groups currently supported is 120, numbered from 1 to 120 inclusive.

### Example:

```
L2TP config>group 1
-- L2TP group configuration --
L2TP-group 1 config>
```

### Command history:

Release	Modification
10.09.27	This command was modified as of version 10.09.27 to increase the maximum number of L2TP groups supported to 120.
11.00.06	This command was modified as of version 11.00.06 to increase the maximum number of L2TP groups supported to 120.
11.01.01	This command was modified as of version 11.01.01 to increase the maximum number of L2TP groups supported to 120.

The group configuration menu has the following commands available:

Command	Function
<b>accept-dialin</b>	Accepts incoming calls.
<b>destination-port</b>	Changes the UDP destination port used set up the tunnel.
<b>domain</b>	Defines the domain associated with the L2TP group.

<b>elastic-store</b>	Enables elastic storage upon receipt of a pseudowire.
<b>hello</b>	Time interval between HELLO maintenance packets.
<b>hide-avps</b>	When possible, hides the attribute value pair exchange between LAC and LNS.
<b>holdoff</b>	Time to wait before trying to reestablish the session.
<b>hostname</b>	Local name sent to the remote.
<b>initiate-to</b>	Defines the group's L2TP tunnel destination address, which must be the IP address of the LNS that we want to connect to.
<b>interface [group]</b>	Interface/L2TP group associated with the group.
<b>listen-addr</b>	L2TP protocol listening address.
<b>loopback</b>	Enables <i>loopback</i> mode.
<b>maxfail</b>	Maximum number of failed session reestablishment attempts.
<b>multicast-addr</b>	IP-Multicast address.
<b>multicast-grp</b>	The multicast group's associated L2TP group.
<b>multicast-ifc</b>	The multicast group's associated interface.
<b>multipoint</b>	Dynamic multipoint tunnel.
<b>no</b>	Removes a configuration parameter.
<b>persist</b>	Persistence group. This tries to maintain the session that has been established.
<b>pseudowire</b>	Defines the pseudowire group.
<b>request-dialin</b>	Configures the group as LAC, that is, instigator of L2TP tunnels upon receipt of PPP calls.
<b>sequencing</b>	Sequencing and re-ordering.
<b>session-limit</b>	Maximum number of sessions.
<b>static</b>	Static group.
<b>strict-ip-check</b>	Rejects datagrams not sent by the configured IP address.
<b>terminate-from</b>	Remote end ID.
<b>tie-breaker</b>	Enables tie breaker.
<b>timeout</b>	Out-of-sequence packet queue timeout value.
<b>timeslot</b>	G703 interface timeslot.
<b>tunnel-password</b>	Configures the L2TP tunnel password.
<b>exit</b>	Exits group configuration.

The following paragraphs describe the above commands in more detail.

#### 2.4.4.1 ACCEPT-DIALIN

Marks the group as an LNS group, i.e., as a group that accepts L2TP tunnel establishment requests from a LAC.

This is disabled by default.

*Syntax:*

```
L2TP-group 1 config> accept-dialin
```

*Example:*

```
L2TP-group 1 config> accept-dialin
L2TP-group 1 config>
```

#### 2.4.4.2 DESTINATION-PORT

This command defines the UDP destination port used to establish L2TP tunnels. This value must match the port listening to incoming tunnel establishment requests configured in the LNS.

The default port is 1071.

*Syntax:*

```
L2TP-group 1 config> destination-port <port>
```

*port* LNS UDP port used to establish L2TP tunnels. This value is an integer between 1 and 65535.



*Example:*

```
L2TP-group 1 config> destination-port 2342
L2TP-group 1 config>
```

### 2.4.4.3 DOMAIN

This command establishes the domain associated with the L2TP group. For example, to associate the PPP users from the teldat.es domain with L2TP group 1 parameters, we must execute the “*domain teldat.es*” command.

By default, the domain is not defined.

*Syntax:*

```
L2TP-group 1 config> domain <domain>
```

*domain*            Domain that is associated with the L2TP group parameters.

*Example:*

```
L2TP-group 1 config> domain teldat.es
L2TP-group 1 config>
```

### 2.4.4.4 ELASTIC-STORE

This command lets us enable intermediate buffering between receipt of an L2TP pseudowire and transmission through its associated interface. This buffer compensates for the differences in timing between the synchronous serial interface clocks at both ends of the pseudowire.

The buffer can hold up to five L2TP packets and behaves like a queue (LIFO). We use this command to define a threshold. If the buffer fill level goes below the buffer threshold (*underrun*) when an L2TP packet arrives, the packet is copied and both the copy and the original are added to the buffer. If, however, the buffer fill level goes above the threshold + 1 (*overrun*), the packet is dropped and the oldest packet in the queue is sent. Under normal conditions, the buffer fill level will be the same as the buffer threshold and the received packet will be added to the buffer, sending the oldest packet in the queue at the same time.

This is disabled by default.

*Syntax:*

```
L2TP-group 1 config> elastic-store <0..2>
```

<0..2>            Elastic store buffer threshold (0 = deactivated)

*Example:*

```
L2TP-group 1 config> elastic-store 2
L2TP-group 1 config>
```

### 2.4.4.5 HELLO

We use this command to specify a time interval between L2TP tunnel maintenance or HELLO, packets. A tunnel is considered down when there is no response to three consecutive HELLO packets. An attempt is made every second if no response is received to the HELLO packet.

Valid time interval values range from 9 to 1000 seconds. The default time interval for sending HELLO packets is 60 seconds. We cannot disable the sending of HELLO packets.

Keep in mind that if several groups share the same L2TP tunnel (i.e., they start a session with the same IP address), the group that initiates the L2TP tunnel will be the one to set the HELLO interval value for the L2TP tunnel. To avoid confusion, we recommend setting the same HELLO interval in all groups going to the same device.

*Syntax:*

```
L2TP-group 1 config> hello <time_in_seconds>
```

*time\_in\_seconds*    Time interval for sending HELLO maintenance packets.

*Example:*

```
L2TP-group 1 config> hello 120
L2TP-group 1 config>
```

#### 2.4.4.6 HIDE-AVPS

This command tells the device to try to encrypt the AVPS sent over the network whenever possible. Thus, the data sent is protected from malicious attacks by other network users, thereby increasing the security level.

This is disabled by default.

*Syntax:*

```
L2TP-group 1 config> hide-avps
L2TP-group 1 config>
```

*Example:*

```
L2TP-group 1 config> hide-avps
L2TP-group 1 config>
```

#### 2.4.4.7 HOLDOFF

When persistence is configured for a group using the **persist** command, the *holdoff* command indicates the time that must elapse before a session is reestablished after it has been dropped, and the interval between each failed attempt to restore the session and the next.

This command is only effective when the **persist** command is configured for the group. The default is 10 seconds.

*Syntax:*

```
L2TP-group 1 config> holdoff <time_in_seconds>
```

*time\_in\_seconds* Length of time that the router must wait before attempting to reestablish an L2TP session.

*Example:*

```
L2TP-group 1 config> holdoff 60
L2TP-group 1 config>
```

#### 2.4.4.8 HOSTNAME

Specifies the local *host* name sent via L2TP for the purposes of identifying the router during the tunnel negotiation and establishment phase.

To allow the remote device to verify the host name, we must configure the remote device group with the same name using the **terminate-from** command.

If we don't specify a name with the *hostname* command, the global *hostname* configured in the router will be sent.

*Syntax:*

```
L2TP-group 1 config> hostname <hostname>
```

*hostname* Local name, between 1 and 32 characters, sent in packets that negotiate L2TP tunnel establishment and that identify the router in the remote device.

*Example:*

```
L2TP-group 1 config> hostname ESTACION-ATOCHA
L2TP-group 1 config>
```

#### 2.4.4.9 INITIATE-TO

This command establishes the L2TP tunnel destination IP address. This address must match the LNS IP address we want to connect to.

*Syntax:*

```
L2TP-group 1 config>initiate-to <lms-address>
```

*Ins-address* LNS IP address used to initiate the L2TP tunnel.

**Example:**

```
L2TP-group 1 config> initiate-to 172.24.75.16
L2TP-group 1 config>
```

#### 2.4.4.10 INTERFACE [GROUP]

This command allows us to associate one of the router's interfaces with the group or, using the GROUP option, to associate another L2TP group with the group. In the case of *pseudowires*, this is the interface through which circuit emulation is performed.

By default, there is no interface associated with the L2TP group.

**Syntax:**

```
L2TP-group 1 config>interface [<interface> | group <group-number>]
```

*interface* Device interface name associated with the group and, therefore, with the L2TP session as well.

*group-number* L2TP group number associated with the group and, therefore, with the L2TP session as well.

**Example:**

```
L2TP-group 1 config>interface ser0/0
L2TP-group 1 config>interface group 2
L2TP-group 1 config>
```

#### 2.4.4.11 LISTEN-ADDR

This command configures the source address carried by both control and data L2TP packets when leaving the device. This is a very useful command when using the VRRP protocol because it allows us to give the L2TP packet the virtual router address as source instead of the packets leaving with the main address of the outgoing interface. The destination address that we configure in the remote router will be the address we configured with the *listen-addr* command in the local router. This command is also useful when we want to use *loopback* interfaces as the L2TP packet source and destination.

By default, the L2TP packet source address is the main address of the L2TP packet outbound interface.

**Syntax:**

```
L2TP-group 1 config>listen-addr <ip-address>
```

*ip-address* Outgoing L2TP packet source address, both control and data.

**Example:**

```
L2TP-group 1 config>listen-addr 192.168.1.1
L2TP-group 1 config>
```

#### 2.4.4.12 LOOPBACK

This command places the L2TP tunnel in loopback mode so that it transmits all the data it receives as if it were a mirror. This mode is especially useful when checking tunnel performance. The LOOPBACK command from the L2TP configuration menu must be used when testing L2TP tunnels that run over a G703 interface channel(s). This is because the G703 interface channel(s) can't be placed in loopback mode from the G703 Interface configuration menu.

By default, *loopback* is disabled.

**Syntax:**

```
L2TP-group 1 config>loopback
```

**Example:**

```
L2TP-group 1 config>loopback
L2TP-group 1 config>
```

### 2.4.4.13 MAXFAIL

We use this command to specify the maximum number of attempts to reestablish the session defined by the group. We use the **holdoff** command to define the time interval between each retry.

The default is five retries. The **persist** command must be configured for this command to take effect.

*Syntax:*

```
L2TP-group 1 config>maxfail <attempts-number>
```

*attempts-number* Number of session reestablishment attempts.

*Example:*

```
L2TP-group 1 config>maxfail 300
L2TP-group 1 config>
```

### 2.4.4.14 MULTICAST-ADDR

We use this command to configure the multicast IP address for a static multipoint tunnel. In order for static multipoint tunnels to work properly, we need to enable IGMP proxy on the router and configure the the router's outgoing interface for L2TP packets (the interface connected to the IP network) as an *upstream* interface.

The address must be multicast, i.e., it must be between 224.0.0.0 and 239.255.255.255. The interface associated with the L2TP protocol for this group must be assigned with the **multicast-ifc** command.

*Syntax:*

```
L2TP-group 1 config>multicast-addr <ip-address>
```

*ip-address* The multicast IP address where the L2TP data packets are sent in a static multipoint tunnel.

*Example:*

```
L2TP-group 1 config>multicast-addr 224.99.99.10
L2TP-group 1 config>
```

### 2.4.4.15 MULTICAST-GRP / MULTICAST-IFC

These commands are used to indicate the interface(s) associated with a static multipoint tunnel (using the MULTICAST-IFC command) and the L2TP group(s) associated with a static multipoint tunnel (using the MULTICAST-GRP command). There is a single associated interface (or L2TP group) on the transmitter side of a multicast tunnel, while there may be more than one at the receiver ends. In these, multicast traffic received through the L2TP tunnel are sent by all associated interfaces (or L2TP groups) configured with these commands. We can have a maximum of fifteen interfaces associated with a static multipoint tunnel and a maximum of five groups.

We can differentiate the router transmitting the multicast packets from the other devices because it has been configured with a group that has the same associated interface (or L2TP group) and the same *pseudowire* identifier but where the **multipoint** command appears. The routers receiving the multicast packets will open dynamic tunnels to this group, configured with the **multipoint** command, to send traffic upstream (as a static multipoint tunnel can only transmit data downstream).

With static tunnels, we need to configure the tunnel/session identifiers using the **static** command. Please see the description below on the **static** command.

*Syntax:*

```
L2TP-group 1 config>multicast-ifc <ifc-name>
L2TP-group 1 config>multicast-grp <group-number>
```

*ifc-name* Name of the interface associated with a multicast static tunnel.

*group-number* Number of the L2TP group associated with a multicast static tunnel.

*Example:*

```
L2TP-group 1 config>multicast-ifc serial0/0
L2TP-group 1 config>multicast-ifc serial0/1
```

```
L2TP-group 1 config>multicast-grp 2
L2TP-group 1 config>
```

#### 2.4.4.16 MULTIPPOINT

The *multipoint* command lets us configure a dynamic multipoint tunnel. Using this command we allow the router to accept tunnels on a single associated interface (or L2TP group). Traffic received through the tunnels will be sent by the associated interface (or L2TP group).

As mentioned in the previous command's description, this command allows the remote ends of a static multipoint tunnel to open dynamic tunnels for routing upstream L2TP traffic, one between each remote router and the central router. The remote router configuration will be like a group configuration for a point-to-point tunnel.

**Syntax:**

```
L2TP-group 1 config>multipoint
```

**Example:**

```
L2TP-group 1 config>multipoint
L2TP-group 1 config>
```

#### 2.4.4.17 NO

This command removes the configuration information for any of the other L2TP group configuration commands.

**Syntax:**

```
L2TP-group 1 config>no [accept-dialin | destination-port | domain | holdoff |
hostname | hide-avps | initiate-to | interface [group]| listen-addr | maxfail |
multicast-addr | mlticast-grp | multicast-ifc | multipoint | persist | pseudowire|
request-dialin | sequencing | session-limit | static | strict-ip-check | terminate-
from | tie-breaker | timeout | timeslot | tunnel-password]
```

**Example:**

```
L2TP-group 1 config>no tunnel-password
L2TP-group 1 config>
```

#### 2.4.4.18 PERSIST

This command tells the router to re-establish a session if it goes down.

We use the **maxfail** command to specify the number of times the router will attempt to reestablish a session. The **holdoff** command is used to specify a time interval between attempts.

**Syntax:**

```
L2TP-group 1 config>persist
```

**Example:**

```
L2TP-group 1 config>persist
L2TP-group 1 config>
```

#### 2.4.4.19 PSEUDOWIRE

This command lets us define the L2TP link as *pseudowire*. At the same time, a distinguishing identifier is assigned to the *pseudowire*.

By default, this command is not enabled.

**Syntax:**

```
L2TP-group 1 config>pseudowire <pseudowire-name>
```

*pseudowire-name* Pseudowire identifier, between 1 and 32 characters.

**Example:**

```
L2TP-group 1 config>pseudowire RTT
L2TP-group 1 config>
```

### 2.4.4.20 REQUEST-DIALIN

Marks this group as a LAC group, i.e., it receives PPP calls and tunnels them over L2TP to an LNS device. It also lets us initiate sessions when the group is a *pseudowire* group.

**Syntax:**

```
L2TP-group 1 config> request-dialin
```

**Example:**

```
L2TP-group 1 config> request-dialin
L2TP-group 1 config>
```

### 2.4.4.21 SEQUENCING

We use this command when we want to include sequencing numbers on the data packets of a pseudowire L2TP session. We can also use it to enable the out-of-sequence packet queue with a window size of 10 packets. Thus, packets are put back in the correct order if the network has reordered them.

By default, this command is disabled.

**Syntax:**

```
L2TP-group 1 config>sequencing
```

**Example:**

```
L2TP-group 1 config>sequencing
L2TP-group 1 config>
```

### 2.4.4.22 SESSION-LIMIT

With this command we can specify the maximum number of sessions for a group.

By default, the group is configured with an unlimited number of sessions.

**Syntax:**

```
L2TP-group 1 config>session-limit <max-sessions>
```

*max-sessions*      The maximum number of sessions for an L2TP group is between 1 and 1024.

**Example:**

```
L2TP-group 1 config>session-limit 10
L2TP-group 1 config>
```

### 2.4.4.23 STATIC

This command allows us to define a tunnel and a session as static. All we have to do is to enter the the tunnel and session identifiers. The tunnel and session identifiers must be unique. This is because tunnels with the same ID, and sessions within a tunnel with the same ID, are regarded as unique by the L2TP protocol.

Unlike the case with dynamic tunnels, local and remote identifiers are the same in static tunnels. So we need to configure the same tunnel and session identifiers at both ends of a static tunnel for them to communicate. The router is responsible for making sure these identifiers cannot be assigned to dynamic tunnels.

By default, this command is disabled.

**Syntax:**

```
L2TP-group 1 config>static tid <tunnel-id> sid <session-id>
```

*tunnel-id*          Static tunnel identifier. Valid values are between 1 and 65535.

*session-id*        Static session identifier. Valid values are between 1 and 65535.

**Example:**

```
L2TP-group 1 config>static tid 1 sid 10
```

```
L2TP-group 1 config>
```

#### 2.4.4.24 STRICT-IP-CHECK

This command tells the router to reject any data packets arriving via an L2TP session whose source address does not match the one negotiated when the session was established.

By default this is disabled.

*Syntax:*

```
L2TP-group 1 config>strict-ip-check
```

*Example:*

```
L2TP-group 1 config>strict-ip-check
L2TP-group 1 config>
```

#### 2.4.4.25 TERMINATE-FROM

This command tells the router to only accept connections from a particular device. For this, we indicate the name of the router that will be allowed to establish the L2TP connections. We can enter the name at the remote end using the **hostname** command from the group definition submenu, or by default for all groups using the router's global *hostname* command.

This is disabled by default (all routers are allowed to connect regardless of their name).

*Syntax:*

```
L2TP-group 1 config>terminate-from hostname <peername>
```

*peername*            Name of the remote device that has permission to set up L2TP connections. Valid values are between 1 and 32 characters.

*Example:*

```
L2TP-group 1 config>terminate-from hostname ESTACION-CENTRAL
L2TP-group 1 config>
```

#### 2.4.4.26 TIE-BREAKER

If we have a point-to-point *pseudowire* where both ends can initiate the tunnel/session at the same time (LAC to LAC), and we only want one tunnel and one session opened for the same group, we must enable the *tie-breaker* feature. We use this command to enable the *tie-breaker* feature which prevents tunnels and sessions between two devices being duplicated for the same group. The two ends are competing to open a tunnel and only one of the two wins the *tie-break*; the loser is forced to remove the tunnel that it was trying to open and continue the negotiation of the winning tunnel. The procedure for session negotiation is the same.

This is disabled by default. It only has an affect on *pseudowire* groups and when both ends are able to start the negotiation (**accept-dialin** and **request-dialin** are configured on both devices).

*Syntax:*

```
L2TP-group 1 config>tie-breaker
```

*Example:*

```
L2TP-group 1 config>tie-breaker
L2TP-group 1 config>
```

#### 2.4.4.27 TIMEOUT

We can use this command to specify a timeout value for the out-of-sequence packet queue. This queue is used to put packets back in order and is enabled through the **sequencing** command. When the *timeout* expires, the packets in the queue are sent and the awaited packet is assumed lost. In other words, this value is the maximum length of time waited for a packet until it is considered lost. Choose this value carefully so that the queue works properly and does not consider out-of-order packets lost, or wait too long for lost packets that are never going to arrive.

Default is 25 ms.

*Syntax:*

```
L2TP-group 1 config>timeout <timeout-in-ms>
```

*timeout-in-ms* Maximum wait time for out-of-sequence packets. Valid values are between 1 and 5000 milliseconds.

*Example:*

```
L2TP-group 1 config>timeout 50
L2TP-group 1 config>
```

#### 2.4.4.28 TIMESLOT

This command allows us to assign a *pseudowire* with an Nx64 kbps channel from a 2048 kbps E1 link. To do so we just have to indicate the chosen channel number between 1 and 32.

The interface associated with the *pseudowire* must be an E1 at 2048 kbps for this command to be effective.

*Syntax:*

```
L2TP-group 1 config>timeslot <timeslot-number>
```

*timeslot-number* The number of the E1 interface channel assigned to the *pseudowire*.

*Example:*

```
L2TP-group 1 config>timeslot 12
L2TP-group 1 config>
```

#### 2.4.4.29 TUNNEL-PASSWORD

Configures the password to use for authentication with the other end of the L2TP tunnel. This is optional. If we don't configure a password with this command, a password won't be used to set up the L2TP tunnel.

#### 2.4.4.30 EXIT

Finalizes group configuration

*Syntax:*

```
L2TP-group 1 config>exit
```

*Example:*

```
L2TP-group 1 config>exit
L2TP config>
```

### 2.4.5 NO GROUP

Removes an existing L2TP group configuration.

*Syntax:*

```
L2TP config>no group <group-number>
```

*group-number* Number of the group that we want to configure. 120 L2TP groups are currently supported, numbered from 1 to 120 inclusive.

*Example:*

```
L2TP config>no group 2
L2TP config>
```

**Command history:**

Release	Modification
10.09.27	This command was modified as of version 10.09.27 to increase the maximum number of L2TP groups supported to 120.
11.00.06	This command was modified as of version 11.00.06 to increase the maximum number of



<b>Release</b>	<b>Modification</b>
11.01.01	L2TP groups supported to 120. This command was modified as of version 11.01.01 to increase the maximum number of L2TP groups supported to 120.

## 2.4.6 EXIT

Finalizes the L2TP protocol configuration.

*Syntax:*

```
L2TP config>exit
```

*Example:*

```
L2TP config>exit  
Config>
```

## Chapter 3 L2TP monitoring

### 3.1 Monitoring tools

L2TP has the following monitoring mechanisms:

- (1) L2TP protocol menu within the Teldat Router monitoring process.
- (2) L2TP subsystem events.
- (3) UDP subsystem event.

Here are the commands to execute to access the L2TP protocol monitoring menu:

```
*PROCESS 3
+PROTOCOL L2TP
L2TP+
```

Within this menu are several commands that show information about L2TP operations. We will now list each one while providing a brief explanation of the information shown and giving some practical examples.

```
*PROCESS 3
Console Operator
+PROTOCOL L2TP
L2TP+?
  activate           Reactivate the L2TP protocol
  clear-session      Clear established L2TP session statistics
  pattern-insertion  Execute insertion and verifications of patterns
  session-info       Provide detailed information on the established L2TP
                    sessions
  shutdown           Temporarily disables the L2TP protocol
  stop-session       Stop established L2TP sessions
  tunnel-info        Display a general operating summary on the L2TP protocol
  exit              Exit L2TP monitoring menu
L2TP+
```

### 3.2 TUNNEL-INFO all

This command provides a summary of the overall functioning of the L2TP protocol. We can also run the same command by typing *tunnel-info*.

The data shown are:

- First, the total number of tunnels that are currently active on the device.
- Second, the total number of active sessions.
- Next, the following parameters are listed for each tunnel:
  - RemoteIP: remote node IP address used to establish the tunnel.
  - LocalIP: local node IP address used to establish the tunnel.
  - Port: remote node port used to establish the tunnel.
  - RemoteName: remote node name used to establish the tunnel.
  - State: the tunnel state. The possible states are:
    - Idle: no activity.
    - wait-ctl-rep: waiting for control response.
    - wait-ctl-con: waiting for incoming connection.
    - Established: established.
    - rec-stop-ccn: received stop request.
    - sent-stop-ccn: sent stop request.

A detailed explanation of L2TP machine states is provided in RFC 2661.

- LocalID: local tunnel identifier.
- RemoteID: remote tunnel identifier.
- Sessions: number of sessions established through the tunnel.
- Group: the configuration group number that negotiates the tunnel.
- Multicast: the multicast address used by the tunnel is shown if it is a multicast tunnel.
- Static: if it is a static tunnel, *static* will be displayed.
- Next, the following parameters are listed for each tunnel session.

Pseudowire: *pseudowire* identifier.

Interface: interface (or L2TP group) associated with the *pseudowire*.

Sequencing: indicates whether the sequencing number and packet ordering features are enabled for the session.

LNS/LAC: indicates the type of machine for the session; LAC if we initiate the negotiation.

LocalID: local session identifier.

RemoteID: remote session identifier .

State: session state. The possible states are:

idle: not active.

wait-tunnel: waiting for the tunnel to establish.

wait-reply: waiting for a reply from the other end.

wait-conn: waiting for connection notification.

established: established.

A detailed explanation of L2TP machine states is provided in RFC 2661.

- LastChange: time since the last session state change.
- Events: indicates whether session events are displayed when L2TP events logging is enabled. The values are *show* or *hide*.
- Encaps: statistics on the number of packets sent by the device through the tunnel.
- Decaps: statistics on the number of packets received through the tunnel.
- Missed: statistics on the number of packets that have not come through the tunnel and that have been given up for lost.
- Dropped: statistics on the number of discarded packets, both transmission and reception.

```
L2TP+tunnel-info all

Number of L2TP Tunnels: 2
Number of L2TP Sessions: 2

RemoteIP:224.165.15.20 LocalIP:172.24.80.1 Port:1701
RemoteName:unknown State:established
LocalID:2 RemoteID:2 Sessions:1
group 3, multicast:224.165.15.20, static

Pseudowire:CTC Interface:serial0/1 Sequencing:on
LNS LocalID:20 RemoteID:20 State:established
LastChange:1w1d22h34m26s Events:Show
encaps:0 decaps:0 missed:0 dropped:0
```

```

RemoteIP:172.24.80.7 LocalIP:172.24.80.1 Port:1701
RemoteName:ESTACION-CENTRAL State:established
LocalID:13882 RemoteID:11667 Sessions:1
group 2

Pseudowire:AUX1 Interface:serial0/0 Sequencing:on
LNS LocalID:14988 RemoteID:50862 State:established
LastChange:1w1d22h32m49s Events:Show
encaps:198481 decaps:3134 missed:0 dropped:0
L2TP+

```

### 3.3 TUNNEL-INFO summary

This command provides a summary of the overall functioning of the L2TP protocol.

The following data are displayed:

- First, the total number of tunnels currently active on the device.
- Second, the total number of active sessions.
- Next, the following parameters are listed for each tunnel.
  - LocalID: local tunnel identifier.
  - RemoteID: remote tunnel identifier.
  - Sessions: number of sessions established through the tunnel.
  - RemoteName: remote node name used to establish the tunnel.
  - RemoteAddress: remote node IP address used to establish the tunnel.
  - Port: remote node port used to establish the tunnel.
  - State: the tunnel state. The possible values are:
    - Idle: not active.
    - wait-ctl-rep: waiting for control response.
    - wait-ctl-con: waiting for incoming connection.
    - Established: established.
    - rec-stop-ccn: stop request received.
    - sent-stop-ccn: stop request sent.

A detailed explanation of L2TP machine states is provided in RFC 2661.

The following output shows the results of running this command on a device configured with two L2TP sessions established through a tunnel:

```

L2TP+tunnel-info summary

Number of L2TP Tunnels: 1
Number of L2TP Sessions: 2

LocalID RemoteID Sessions RemoteName RemoteAddress Port State
 32158   5937         2   gafotas 172.24.75.205 1701 established
L2TP+

```

### 3.4 TUNNEL-INFO state

This command is very similar to the previous one but also provides information on how long the tunnel has been in its current state.

The following data are shown:

- First, the total number of tunnels currently active on the device.

- Second, the total number of active sessions.
- Next, the following parameters are listed for each tunnel.
  - LocalID: local tunnel identifier.
  - RemoteID: remote tunnel identifier.
  - RemoteName: remote node name used to establish the tunnel.
  - State: the tunnel state. The possible values are:
    - Idle: not active.
    - wait-ctl-rep: waiting for control response.
    - wait-ctl-con: waiting for incoming connection.
    - Established: established.
    - rec-stop-ccn: stop request received.
    - sent-stop-ccn: stop request sent.

A detailed explanation of L2TP machine states is provided in RFC 2661.

- Last-Chg: length of time that the tunnel has been in its current state.

The following output shows the results of running this command on a tunnel that has been in an established state for 7 minutes and 22 seconds:

```
L2TP+tunnel-info state

Number of L2TP Tunnels: 1
Number of L2TP Sessions: 2

LocalID RemoteID RemoteName State      Last-Chg
  32158    5937    gafotas established  7m22s

L2TP+
```

## 3.5 TUNNEL-INFO pseudowire

This command is similar to the “*tunnel-info all*” command but allows us to display only the session data that we are interested in.

To filter the tunnel information, we place one of the following after the *pseudowire* identifier: the *pseudowire* session ID for the session we want to view, a word or fragment of a word contained in the *pseudowire* identifier, or the asterisk character (\*) if we want all sessions regardless of the *pseudowire* identifier.

After entering the *pseudowire* identifier, we can filter by *peer name*. That is, we can view only those sessions established with a particular device. We can enter the full name of the remote device, a word contained in the remote device name, or the asterisk character (\*) if we want to view all sessions regardless of the device.

### Syntax:

```
L2TP+tunnel-info pseudowire <pseudowire-name> <peer-name>
L2TP+tunnel-info pseudowire ?
  <1..32 chars>    Pseudowire name (* = all)
L2TP+tunnel-info pseudowire * ?
  <1..32 chars>    Peer name (* = all)

L2TP+
```

### Example 1:

```
L2TP+tunnel-info pseudowire AUX CENTRAL

Number of L2TP Tunnels: 2
Number of L2TP Sessions: 2

RemoteIP:172.24.80.7 LocalIP:172.24.80.1 Port:1701
RemoteName:ESTACION-CENTRAL State:established
LocalID:13882 RemoteID:11667 Sessions:1
```

```
group 2

Pseudewire:AUX1 Interface:serial0/0 Sequencing:on
LNS LocalID:14988 RemoteID:50862 State:established
LastChange:1w1d22h32m49s Events:Show
encaps:198481 decaps:3134 missed:0 dropped:0

L2TP+
```

**Example 2:**

```
L2TP+tunnel-info pseudewire AUX *

Number of L2TP Tunnels: 2
Number of L2TP Sessions: 2

pseudewire (all = *)[*]? AUX
remote name (all = *)[*]?

RemoteIP:172.24.80.7 LocalIP:172.24.80.1 Port:1701
RemoteName:ESTACION-CENTRAL State:established
LocalID:13882 RemoteID:11667 Sessions:1
group 2

Pseudewire:AUX1 Interface:serial0/0 Sequencing:on
LNS LocalID:14988 RemoteID:50862 State:established
LastChange:1w1d22h32m49s Events:Show
encaps:198481 decaps:3134 missed:0 dropped:0

L2TP+
```

**Note**

Please note that the filter is case sensitive.

## 3.6 TUNNEL-INFO event-filter

This command allows us to filter the L2TP event logging system to show only those events relating to a particular session(s).

This command has the same syntax as the previous command and only activates session events that meet the filter condition. In the same way as in the above command, we can use the asterisk character (\*).

**Syntax:**

```
L2TP+tunnel-info event-filter <pseudewire-name> <peer-name>
L2TP+tunnel-info event-filter ?
<1..32 chars> Pseudewire name (* = all)
L2TP+tunnel-info event-filter * ?
<1..32 chars> Peer name (* = all)

L2TP+
```

**Example 1:**

```
L2TP+tunnel-info event-filter AUX CENTRAL

Number of L2TP Tunnels: 2
Number of L2TP Sessions: 2

RemoteIP:172.24.80.7 LocalIP:172.24.80.1 Port:1701
RemoteName:ESTACION-CENTRAL State:established
LocalID:13882 RemoteID:11667 Sessions:1
group 2

Pseudewire:AUX1 Interface:serial0/0 Sequencing:on
LNS LocalID:14988 RemoteID:50862 State:established
LastChange:1w1d22h32m49s Events:Show
```

```
encaps:198481   decaps:3134   missed:0   dropped:0
```

```
L2TP+
```

When we run the `tunnel-info all` command, we will see that the `Events` field for a session not meeting the filter condition has changed from `show` to `hide`.

### Example 2:

```
L2TP+tunnel-info all

Number of L2TP Tunnels: 2
Number of L2TP Sessions: 2

RemoteIP:224.165.15.20 LocalIP:172.24.80.1 Port:1701
RemoteName:unknown State:established
LocalID:2 RemoteID:2 Sessions:1
group 3, multicast:224.165.15.20, static

    Pseudewire:CTC Interface:serial0/1 Sequencing:on
    LNS LocalID:20 RemoteID:20 State:established
    LastChange:1w1d22h34m26s Events:Hide
    encaps:0          decaps:0          missed:0          dropped:0

RemoteIP:172.24.80.7 LocalIP:172.24.80.1 Port:1701
RemoteName:ESTACION-CENTRAL State:established
LocalID:13882 RemoteID:11667 Sessions:1
group 2

    Pseudewire:AUX1 Interface:serial0/0 Sequencing:on
    LNS LocalID:14988 RemoteID:50862 State:established
    LastChange:1w1d22h32m49s Events:Show
    encaps:198481   decaps:3134   missed:0   dropped:0

L2TP+
```

## 3.7 SESSION-INFO

This command provides detailed information about the established L2TP sessions.

The following data are shown:

- First, the total number of tunnels currently active on the device.
- Second, the total number of active sessions.
- Next, the following parameters are listed for each session.
  - Type: session type, LAC or LNS
  - LocalID: local session identifier.
  - RemoteID: remote session identifier.
  - TunnelID: name of the remote tunnel to which the session belongs.
  - State: session state. The possible values are:
    - Idle: not active.
    - wait-tunnel: waiting for the tunnel to establish.
    - wait-reply: waiting for a response from the other end.
    - wait-conn: waiting for connection notification.
    - Established: established.

A detailed explanation of L2TP machine states is provided in RFC 2661.

- Last-Chg: length of time that the session has been in its current state.

- Pseudowire: *pseudowire* identifier.

The following output shows the results of running this command on a device with two LAC sessions:

```
L2TP+session-info

Number of L2TP Tunnels: 1
Number of L2TP Sessions: 2

Type LocalID RemoteID TunnelID State      Last-Chg      Pseudowire
LAC   46166      190      32158 established 34m43s        CTC
LAC   14513      191      32158 established 34m30s        AUX1

L2TP+
```

### 3.8 STOP-SESSION

This command closes all established L2TP sessions, or a specific session if we enter an optional parameter.

A session is identified by the tunnel identifier of the tunnel it belongs to and its local session identifier, separated by a blank space. For example, the identifier for the second session of the device used as an example in the previous section is "32158/14513".

**Syntax:**

```
L2TP+stop-session <tunnel-id> <session-id>
L2TP+stop-session ?
  <1..65535>      Tunnel local identifier
  <cr>            Stop all
L2TP+stop-session <tunnel-id> ?
  <1..65535>      Session local identifier

L2TP+
```

To close this session, enter:

```
L2TP+stop-session 32158/14513
Sent close request for tunnel ID 32158, session ID 14513

L2TP+
```

If the session does not exist, the device sends an Invalid session ID message:

```
L2TP+stop 1/2
Invalid session ID

L2TP+
```



#### Note

When a tunnel closes its last established session, the tunnel through which the session is established also closes. So the stop-session command also serves to close L2TP tunnels, closing all active sessions.

As shown below, we can also use this command without any parameters to close all established sessions and L2TP tunnels:

```
L2TP+stop-session

Stopping all established L2TP sessions...
Stopping session 32305 of tunnel 53119...
Stopping session 12124 of tunnel 53119...

L2TP+
```

### 3.9 CLEAR-SESSION

We use this command to run statistics (*encaps*, *decaps*, *missed* and *dropped*) on all established L2TP sessions, or on a specific session if we enter an optional parameter.

A session is identified by the local identifier of the tunnel it belongs to and its local session identifier, separated by a



blank space. For example, the identifier for the second session of the device used as an example in the section on *SESSION-INFO* is "32158/14513".

**Syntax:**

```
L2TP+clear-session <tunnel-id> <session-id>
L2TP+clear-session ?
  <1..65535>   Tunnel local identifier
  <cr>         Clear all
L2TP+clear-session <tunnel-id> ?
  <1..65535>   Session local identifier
L2TP+
```

To run statistics on this session, enter:

```
L2TP+clear-session 32158/14513

Clearing statistics for tunnel ID 32158, session ID 14513
L2TP+
```

If the session does not exist on the device, an Invalid session ID message is returned:

```
L2TP+clear-session 1/2
Invalid session ID
L2TP+
```

As shown below, we can also use this command without any parameters to close all established sessions and L2TP tunnels.

```
L2TP+clear-session

Clearing all L2TP sessions statistics...
L2TP+
```

## 3.10 SHUTDOWN

This command temporarily disables L2TP to prevent it from trying to establish any new sessions or responding to tunnel/session negotiation requests from remote devices. Running this command will close all tunnels and sessions that are currently active on the device.

Run the *activate* command to re-enable L2TP.

```
L2TP+shutdown

Stopping all established L2TP sessions...
L2TP+
```

## 3.11 ACTIVATE

This command complements the *shutdown* command and allows us to re-enable L2TP so that tunnels and sessions are negotiated/established as usual.

```
L2TP+activate
L2TP+
```

## 3.12 PATTERN-INSERTION

This command allows us to insert and verify patterns, both on the side of the tunnel associated with the *pseudowire* as well as on the device's physical interface associated with the *pseudowire*. This command allows us to fully test the link, from the physical interface drivers to the connection with the remote device.

**Syntax:**

```
L2TP+pattern-insertion <pseudowire-name> <peer-address> <pattern-len> <flag-char> <pattern-dir>
L2TP+pattern-insertion ?
  <1..32 chars>   Pseudowire name
L2TP+pattern-insertion <pseudowire-name> ?
  <a.b.c.d>       IPv4 peer address
L2TP+pattern-insertion <pseudowire-name> <peer-address> ?
```

```

<10..65535>  pattern length (bytes)
<cr>         Default length 20 bytes, flag char 0x7E, pattern direction
              through tunnel
L2TP+ pattern-insertion <pseudowire-name> <peer-address> <pattern-len> ?
<hex 0..ff>  flag character (hexadecimal)
<cr>         Default flag char 0x7E, pattern direction through tunnel
L2TP+ pattern-insertion <pseudowire-name> <peer-address> <pattern-len> <flag-char> ?
<0..1>      pattern direction (0 = through tunnel, 1 = interface)
<cr>         Default pattern direction through tunnel

```

*pseudowire-name* Pseudowire identifier between 1 and 32 characters.

*peer-address* IP address of the remote device being tested.

*pattern-len* Test pattern length.

*flag-char* Flag character in hexadecimal.

*pattern-dir* If this is 0, the test pattern is sent to the L2TP tunnel. If it is 1, it is sent to the interface associated with the pseudowire.



#### Note

When the pseudowire is associated with another L2TP group rather than a physical interface, the test pattern CANNOT be sent to the interface, i.e., the *pattern-dir* CANNOT be 1.

#### Examples:

Pattern insertion on the L2TP tunnel with negative results:

```

L2TP+pattern-insertion CTC 172.24.80.7 50 7e 0
.....
PATTERN INSERTION ERROR: Fail to establish CTC, 172.24.80.7
L2TP+

```

Pattern insertion on the L2TP tunnel with positive results:

```

L2TP+pattern-insertion CTC 172.24.80.7 50 7e 0
.
PATTERN INSERTION SUCCESS: CTC, 172.24.80.7
L2TP+

```

Pattern insertion on the interface associated with the L2TP *pseudowire* with negative results:

```

L2TP+pattern-insertion CTC 172.24.80.7 50 7e 1
.
PATTERN INSERTION ERROR: Fail to establish CTC, 172.24.80.7
L2TP+

```

Pattern insertion on the interface associated with the L2TP *pseudowire* with positive results:

```

L2TP+pattern-insertion CTC 172.24.80.7 50 7e 1
.
PATTERN INSERTION SUCCESS: CTC, 172.24.80.7
L2TP+

```



#### Note

To perform the tests correctly, we need to insert a loop on the interface associated with the pseudowire. This must be on the remote side if we are applying it to the tunnel, and on the local side if we are applying it to the interface associated with the pseudowire. In this way, we get the inserted pattern back and the device can check it.

## 3.13 EXIT

The **EXIT** command allows us to exit L2TP monitoring and return to the general system monitoring menu. We will see the + message, shown below, when we have left L2TP monitoring:

```

L2TP+exit
+

```

## Chapter 4 L2TP configuration examples

### 4.1 Configuring LAC and LNS for PPP

LAC configuration:

```
; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
add device ppp 1
set data-link sync serial0/1
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 172.24.78.142 255.255.0.0
;
exit
;
;
network pppl
; -- Generic PPP User Configuration --
  ip address 192.168.10.1 255.255.255.0
;
  ppp
; -- PPP Configuration --
  authentication pap
  authentication allowed-user oscar@japon.jp ciphred-pwd 0x93839296CFBA3197
  lcp echo-req off
  exit
;
  base-interface
; -- Base Interface Configuration --
  base-interface serial0/1 link
;
  exit
;
  l2tp
; -- L2TP Configuration --
  lac enable
  exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 1
; -- L2TP group configuration --
  initiate-to 172.24.78.141
  domain japon.jp
  request-dialin
  exit
;
exit
;
dump-command-errors
end
; --- end ---
```

LNS configuration:

```
; Showing System Configuration for access-level 15 ...
```

```

log-command-errors
no configuration
set hostname LNS
add device ppp 1
add device l2tp 1
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 172.24.78.141 255.255.0.0
;
exit
;
;
network ppp1
; -- Generic PPP User Configuration --
  ip address 192.168.10.2 255.255.255.0
;
  ppp
; -- PPP Configuration --
  authentication pap
  authentication allowed-user oscar@japon.jp ciphred-pwd 0x93839296CFBA3197

  ipcp remote address fixed 192.168.10.1
  exit
;
  base-interface
; -- Base Interface Configuration --
  base-interface l2tpl link
;
  exit
;
exit
;
;
network l2tpl
; -- L2TP (virtual) Interface Configuration --
  type lns
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 1
; -- L2TP group configuration --
  accept-dialin
  exit
;
exit
;
dump-command-errors
end
; --- end ---

```

## 4.2 Configuring LAC-CI for PPP

LAC configuration:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname LAC-CI
add device ppp 1

```

```

add device l2tp 1
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 172.24.78.142 255.255.0.0
;
exit
;
;
network pppl
; -- Generic PPP User Configuration --
  ip address unnumbered
;
  ppp
; -- PPP Configuration --
  authentication sent-user oscar@japon.jp ciphered-pwd 0x93839296CFBA3197
  ipcp local address assigned
  exit
;
  base-interface
; -- Base Interface Configuration --
  base-interface l2tp1 link
;
  exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 1
; -- L2TP group configuration --
  initiate-to 172.24.78.141
  domain japon.jp
  request-dialin
  exit
;
exit
;
dump-command-errors
end
; --- end ---

```

LNS configuration (the maximum number of simultaneous tunnels is 4):

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname LNS
add device ppp 1
add device l2tp 1
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 172.24.78.141 255.255.0.0
;
exit
;
;
network pppl
; -- Generic PPP User Configuration --
  ip address 192.168.10.2 255.255.255.0
;
  ppp
; -- PPP Configuration --

```

```

authentication pap
authentication allowed-user oscar@japon.jp ciphared-pwd 0x93839296CFBA3197

ipcp remote address fixed 192.168.10.1
exit
;
base-interface
; -- Base Interface Configuration --
base-interface l2tp1 link
;
exit
;
l2tp
; -- L2TP Configuration --
lns enable
lns max-tunnels 4
;
exit
;
;
network l2tp1
; -- L2TP (virtual) Interface Configuration --
type lns
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
enable
;
group 1
; -- L2TP group configuration --
accept-dialin
exit
;
exit
;
dump-command-errors
end
; --- end ---

```

### 4.3 Dynamic point-to-point L2TP pseudowire

This example displays a typical dynamic point-to-point L2TP tunnel *pseudowire* configuration.

Both tunnel endpoints are configured to provide LAC and LNS functions so that either end can initiate the tunnel negotiation. We could also configure one of them as a LAC and the other as an LNS so that we always have the same device starting the negotiation.

Local end configuration:

```

protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
enable
;
group 1
; -- L2TP group configuration --
pseudowire AUX
initiate-to 10.10.44.65
request-dialin
accept-dialin
persist
interface serial0/0
maxfail 500
holdoff 120
tie-breaker
sequencing

```

```

        listen-addr 10.10.47.242
    exit
;
exit

```

Remote end configuration:

```

protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
    enable
;
    group 1
; -- L2TP group configuration --
        pseudowire AUX
            initiate-to 10.10.47.242
            request-dialin
            accept-dialin
            persist
            interface serial0/1
            maxfail 500
            holdoff 120
            tie-breaker
            sequencing
        exit
;
exit

```

## 4.4 Static multipoint L2TP pseudowire

This example displays a typical static multipoint L2TP tunnel *pseudowire* configuration together with a dynamic multipoint tunnel configuration for upstream traffic.

Configuration at the control center:

```

protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
    enable
;
    group 1
; -- L2TP group configuration --
        multicast-addr 224.99.99.11
        pseudowire RTE
        static tid 1 sid 10
        multicast-ifc serial3/0
        sequencing
        listen-addr 10.10.47.241
    exit
;
    group 2
; -- L2TP group configuration --
        multipoint
        pseudowire RTE
        accept-dialin
        interface serial3/0
        sequencing
        listen-addr 10.10.47.241
    exit
;

```

**In the remote device, group 1** corresponds to the static multipoint tunnel and is configured with the following: the multicast address that the packets are sent to through the tunnel (224.99.99.11), the *pseudowire* identifier (RTE), the tunnel (1) and static session (10) identifiers, the interface associated with the *pseudowire* (serial3/0), a listening address for L2TP packets (10.10.47.241), and sequence numbering and packet reordering are enabled. The *accept-dialin*, *request-dialin*, *persist*, *holdoff* and *maxfail* commands are not configured because they do not make sense in static tunnels.

**Group 2** corresponds to the dynamic multipoint tunnel configuration used to route upstream traffic from the remote devices to the control center equipment. The *multipoint* and *accept-dialin* commands are configured so that it can

accept connections from different routers simultaneously. The same *pseudowire* identifier (RTE), associated interface (serial3/0), and listening address (10.10.47.241) are also configured and, of course, sequence numbering is enabled.

Remote device configuration:

```
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 1
; -- L2TP group configuration --
  multicast-addr 224.99.99.11
  pseudowire RTE
  static tid 1 sid 10
  multicast-ifc serial3/0
  sequencing
  exit
;
  group 2
; -- L2TP group configuration --
  request-dialin
  initiate-to 10.10.47.241
  persist
  pseudowire RTE
  interface serial3/0
  maxfail 300
  sequencing
  exit
;
```

In the remote device, **group 1** corresponds to the static multipoint tunnel and is configured with the following: the multicast address that receives the packets (224.99.99.11), the *pseudowire* identifier (RTE), tunnel (1) and static session (10) identifiers, the interface associated with the pseudowire (serial3/0) and sequence numbering is enabled. The *accept-dialin*, *request-dialin*, *persist*, *holdoff* and *maxfail* commands are not configured because they do not make sense in static tunnels.

The *request-dialin* command is configured for **Group 2** because the device must negotiate the dynamic multipoint tunnel with the control center equipment. It has the address of the main device with which it must negotiate setting up the tunnel (10.10.47.241), the *persist* command prompting it to renegotiate the session should it go down, the same *pseudowire* identifier (RTE) and associated interface (serial3/0) as group 1, the maximum number of failures to renegotiate a session (300), and sequence numbering. In this case, the *holdoff* command makes sense and if we don't configure it, the 10 second default will be used. The *accept-dialin* makes no sense here as the control center equipment can never start negotiating a dynamic multipoint tunnel.

## 4.5 Configuration example for multiple pseudowires

A typical configuration of a railway infrastructure service is shown below where various devices with various *pseudowires* are used. Two of these are the control center devices and the rest are remote or station devices. The schema is as follows:



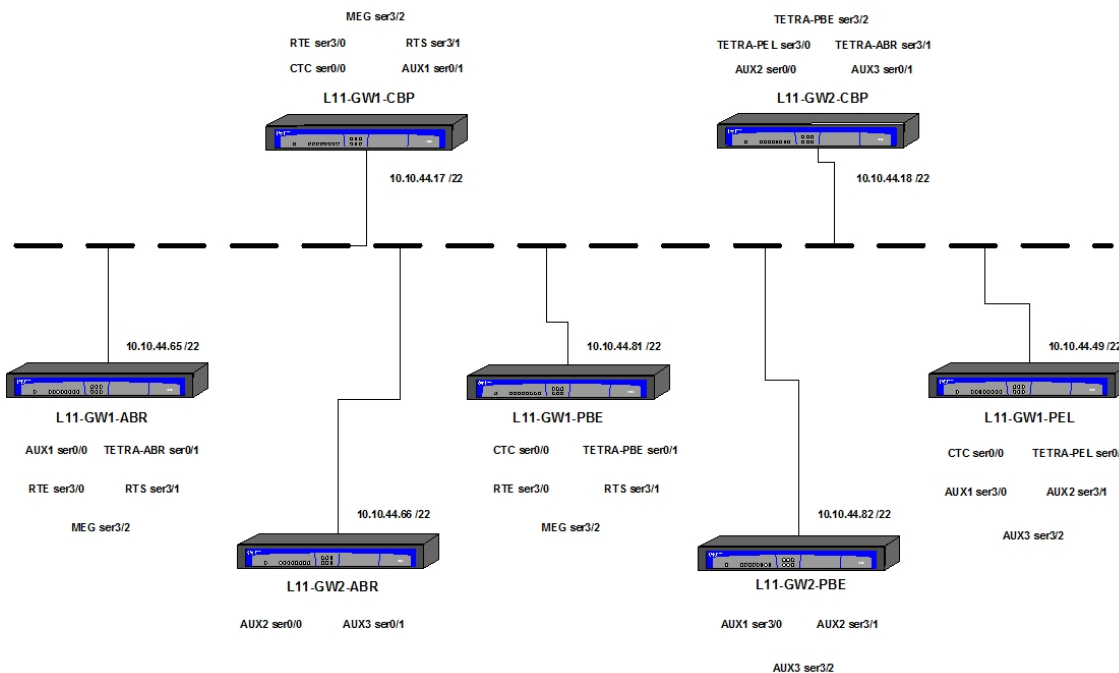


Fig. 4: Pseudowire configuration example

The following types of services typical in a railway infrastructure have been configured on the devices:

- Station Radio telephony (point-to-multipoint, broadcast-collection).  
RTE data channel (V24/V28 DCE, 4800bps, 8bit, asynchronous).
- Security radio telephony (point-multipoint, broadcast-collection).  
RTE data channel (V24/V28 DCE, 4800bps, 8bit, asynchronous).
- Megaphone (point-multipoint, broadcast-collection).  
Megaphone data (V24/V28 DCE, 4800bps, 8bit asynchronous).
- Remote control (CTC) (point-multipoint data, broadcast-collection, V36 DCE with line termination, 9600bps, 8bit asynchronous).
- TETRA telephony (point-to-point data, X21 DCE, 64kbps, 8bit synchronous).
- Auxiliary services (AUX1, AUX2, AUX3) (point-to-point data, V24/V28 DCE, 9600bps, 8bit synchronous).

VRRP has been configured on the control center devices to allow us to install a replica backup device. Thus, a virtual router is created and we must now configure the *pseudowires* in the main device through the *listen-addr* command and set up access lists to avoid problems when it comes to establishing tunnel and sessions between the main routers and the backup ones.

Control center equipment L11-CBP-GW1:

```
; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-CBP-GW1"
;
set data-link async serial0/0
set data-link async serial0/1
;
set data-link async serial3/0
set data-link async serial3/1
set data-link async serial3/2
;
feature access-lists
; -- Access Lists user configuration --
access-list 100
description "Deny L2TP output with no virtual source"
```

```

;
    entry 1 default
    entry 1 permit
    entry 1 source address 10.10.47.241 255.255.255.255
    entry 1 destination port-range 1701 1701
    entry 1 protocol udp
;
    entry 2 default
    entry 2 deny
    entry 2 destination port-range 1701 1701
    entry 2 protocol udp
;
    entry 3 default
    entry 3 permit
;
exit
;
access-list 101
    description "Deny L2TP input with virtual source"
;
    entry 1 default
    entry 1 deny
    entry 1 source address 10.10.47.0 255.255.255.0
;
    entry 2 default
    entry 2 permit
;
exit
;
exit
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
    ip access-group 101 in
    ip access-group 100 out
;
    ip address 10.10.44.17 255.255.252.0
;
    ip vrrp 1 ip 10.10.47.241
    ip vrrp 1 priority 60
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
    description CTC
    speed 9600
    char-mask c000
    ignore-cd
    ignore-dsr
exit
;
;
network serial0/1
; -- Interface Asynchronous Serial Line. Configuration --
    description AUX1
    speed 9600
    char-mask c000
    ignore-dsr
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
    description RTE-DAT

```

```
speed 4800
char-mask c000
ignore-cd
ignore-dsr
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
description RTS-DAT
speed 4800
char-mask c000
ignore-cd
ignore-dsr
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
description MEG-DAT
speed 4800
char-mask c000
ignore-cd
ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
route 0.0.0.0 0.0.0.0 10.10.44.1
;
classless
;
proxy-igmp
; -- IGMP proxy user configuration --
enable
upstream ethernet0/0 default
exit
;
vrrp
; -- Virtual Router Redundancy Protocol configuration --
accept-vip-packets
;
exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
enable
;
group 1
; -- L2TP group configuration --
multicast-addr 224.99.99.11
pseudowire RTE
static tid 1 sid 10
multicast-ifc serial3/0
sequencing
listen-addr 10.10.47.241
exit
;
group 2
; -- L2TP group configuration --
multipoint
pseudowire RTE
accept-dialin
```

```
interface serial3/0
sequencing
listen-addr 10.10.47.241
exit
;
group 3
; -- L2TP group configuration --
multicast-addr 224.99.99.22
pseudowire RTS
static tid 2 sid 20
multicast-ifc serial3/1
sequencing
listen-addr 10.10.47.241
exit
;
group 4
; -- L2TP group configuration --
multipoint
pseudowire RTS
accept-dialin
interface serial3/1
sequencing
listen-addr 10.10.47.241
exit
;
group 5
; -- L2TP group configuration --
multicast-addr 224.99.99.33
pseudowire MEG-DAT
static tid 3 sid 30
multicast-ifc serial3/2
sequencing
listen-addr 10.10.47.241
exit
;
group 6
; -- L2TP group configuration --
multipoint
pseudowire MEG-DAT
accept-dialin
interface serial3/2
sequencing
listen-addr 10.10.47.241
exit
;
group 7
; -- L2TP group configuration --
multicast-addr 224.99.99.44
pseudowire CTC
static tid 4 sid 40
multicast-ifc serial10/0
sequencing
listen-addr 10.10.47.241
exit
;
group 8
; -- L2TP group configuration --
multipoint
pseudowire CTC
accept-dialin
interface serial10/0
sequencing
listen-addr 10.10.47.241
exit
;
group 12
; -- L2TP group configuration --
```

```

pseudowire AUX1-ABR
  initiate-to 10.10.44.65
  request-dialin
  accept-dialin
  persist
  interface serial0/1
  maxfail 500
  tie-breaker
  sequencing
  listen-addr 10.10.47.241
exit
;
exit
;
dump-command-errors
end
; --- end ---

```

### Control center equipment L11-CBP-GW2:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-CBP-GW2"
;
set data-link async serial0/0
set data-link async serial0/1
;
set data-link sync serial3/0
set data-link sync serial3/1
set data-link sync serial3/2
;
feature access-lists
; -- Access Lists user configuration --
  access-list 100
    description "Deny L2TP output with no virtual "
;
    entry 1 default
    entry 1 permit
    entry 1 source address 10.10.47.242 255.255.255.255
    entry 1 destination port-range 1701 1701
    entry 1 protocol udp
;
    entry 2 default
    entry 2 deny
    entry 2 destination port-range 1701 1701
    entry 2 protocol udp
;
    entry 3 default
    entry 3 permit
;
  exit
;
  access-list 101
    description "Deny L2TP input with virtual source"
;
    entry 1 default
    entry 1 deny
    entry 1 source address 10.10.47.0 255.255.255.0
;
    entry 2 default
    entry 2 permit
;
  exit
;
exit
;
exit
;

```

```
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip access-group 101 in
  ip access-group 100 out
;
  ip address 10.10.44.18 255.255.252.0
;
  ip vrrp 2 ip 10.10.47.242
  ip vrrp 2 priority 60
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX2
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
network serial0/1
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX3
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
  description TETRA-PEL
  dce-external-clock 2048000
  x21
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
  description TETRA-ABR
  dce-external-clock 2048000
  x21
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
  description TETRA-PBE
  dce-external-clock 2048000
  x21
exit
;
;
protocol ip
; -- Internet protocol user configuration --
  route 0.0.0.0 0.0.0.0 10.10.44.1
;
  classless
;
  proxy-igmp
; -- IGMP proxy user configuration --
  enable
  upstream ethernet0/0 default
exit
```

```
;
 vrrp
; -- Virtual Router Redundancy Protocol configuration --
   accept-vip-packets
;
  exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 9
; -- L2TP group configuration --
    pseudowire TETRA-PEL
    accept-dialin
    interface serial3/0
    sequencing
    listen-addr 10.10.47.242
  exit
;
  group 10
; -- L2TP group configuration --
    pseudowire TETRA-ABR
    accept-dialin
    interface serial3/1
    sequencing
    listen-addr 10.10.47.242
  exit
;
  group 11
; -- L2TP group configuration --
    pseudowire TETRA-PBE
    accept-dialin
    interface serial3/2
    sequencing
    listen-addr 10.10.47.242
  exit
;
  group 13
; -- L2TP group configuration --
    pseudowire AUX2-PBE
    initiate-to 10.10.44.82
    request-dialin
    accept-dialin
    persist
    interface serial10/0
    maxfail 500
    tie-breaker
    sequencing
    listen-addr 10.10.47.242
  exit
;
  group 14
; -- L2TP group configuration --
    pseudowire AUX3-PEL
    initiate-to 10.10.44.49
    request-dialin
    accept-dialin
    persist
    interface serial10/1
    maxfail 500
    tie-breaker
    sequencing
    listen-addr 10.10.47.242
```

```

    exit
;
exit
;
dump-command-errors
end
; --- end ---

```

#### Remote device L11-ABR-GW1:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-ABR-GW1"
;
set data-link async serial0/0
set data-link sync serial0/1
;
set data-link async serial3/0
set data-link async serial3/1
set data-link async serial3/2
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
    ip address 10.10.44.65 255.255.252.0
;
exit
;
;
network ethernet0/1
; -- Ethernet Interface User Configuration --
    no ip address
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
    description AUX1
    speed 9600
    char-mask c000
    ignore-dsr
exit
;
;
network serial0/1
; -- Interface Asynchronous Serial Line. Configuration -
description TETRA-ABR
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
    description RTE-DAT
    speed 4800
    char-mask c000
    ignore-cd
    ignore-dsr
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
    description RTS-DAT
    speed 4800
    char-mask c000

```



```
ignore-cd
ignore-dsr
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
description MEG-DAT
speed 4800
char-mask c000
ignore-cd
ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
route 0.0.0.0 0.0.0.0 10.10.44.1
;
classless
;
proxy-igmp
; -- IGMP proxy user configuration --
enable
upstream ethernet0/0 default
exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
enable
;
group 1
; -- L2TP group configuration --
multicast-addr 224.99.99.11
pseudowire RTE
static tid 1 sid 10
multicast-ifc serial3/0
sequencing
exit
;
group 2
; -- L2TP group configuration --
request-dialin
initiate-to 10.10.47.241
persist
pseudowire RTE
interface serial3/0
maxfail 300
sequencing
exit
;
group 3
; -- L2TP group configuration --
multicast-addr 224.99.99.22
pseudowire RTS
static tid 2 sid 20
multicast-ifc serial3/1
sequencing
exit
;
group 4
; -- L2TP group configuration --
;
request-dialin
```

```

    initiate-to 10.10.47.241
    persist
    pseudowire RTS
    interface serial3/1
    maxfail 300
    sequencing
  exit
;
  group 5
; -- L2TP group configuration --
  multicast-addr 224.99.99.33
  pseudowire MEG-DAT
  static tid 3 sid 30
  multicast-ifc serial3/2
  sequencing
  exit
;
  group 6
; -- L2TP group configuration --
  request-dialin
  initiate-to 10.10.47.241
  persist
  pseudowire MEG-DAT
  interface serial3/2
  maxfail 300
  sequencing
  exit
;
  group 10
; -- L2TP group configuration --
  pseudowire TETRA-ABR
  request-dialin
  initiate-to 10.10.47.242
  persist
  interface serial0/1
  maxfail 300
  sequencing
  exit
;
  group 12
; -- L2TP group configuration --
  pseudowire AUX1-ABR
  initiate-to 10.10.47.241
  request-dialin
  accept-dialin
  persist
  interface serial0/0
  maxfail 300
  tie-breaker
  sequencing
  exit
;
exit
;
dump-command-errors
end
; --- end ---

```

#### Remote device L11-ABR-GW2:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-ABR-GW2"
;
set data-link async serial0/0
set data-link async serial0/1

```

```
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 10.10.44.66 255.255.252.0
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX2
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
network serial0/1
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX3
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
  route 0.0.0.0 0.0.0.0 10.10.44.1
;
  classless
;
  proxy-igmp
; -- IGMP proxy user configuration --
  enable
  upstream ethernet0/0 default
  exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 13
; -- L2TP group configuration --
; Tunnel deactivated, no initiate-to
  pseudowire AUX2
  request-dialin
  accept-dialin
  persist
  interface serial0/0
  maxfail 300
  tie-breaker
  sequencing
  exit
;
  group 14
; -- L2TP group configuration ---
; Tunnel deactivated, no initiate-to
  pseudowire AUX3
  request-dialin
  accept-dialin
  persist
  interface serial0/1
```

```

    maxfail 300
    tie-breaker
    sequencing
  exit
;
exit
;
dump-command-errors
end
; --- end ---

```

#### Remote device L11-PBE-GW1:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-PBE-GW1"
;
set data-link async serial0/0
set data-link sync serial0/1
;
set data-link async serial3/0
set data-link async serial3/1
set data-link async serial3/2
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 10.10.44.81 255.255.252.0
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
  description CTC
  speed 9600
  char-mask c000
  ignore-cd
  ignore-dsr
  ignore-cts
exit
;
;
network serial0/1
; -- Interface Asynchronous Serial Line. Configuration --
  description TETRA-PBE
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
  description RTE-DAT
  speed 4800
  char-mask c000
  ignore-cd
  ignore-dsr
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
  description RTS-DAT
  speed 4800
  char-mask c000
  ignore-cd
  ignore-dsr

```

```
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
description MEG-DAT
speed 4800
char-mask c000
ignore-cd
ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
route 0.0.0.0 0.0.0.0 10.10.44.1
;
classless
;
proxy-igmp
; -- IGMP proxy user configuration --
enable
upstream ethernet0/0 default
exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
enable
;
group 1
; -- L2TP group configuration --
multicast-addr 224.99.99.11
pseudowire RTE
static tid 1 sid 10
multicast-ifc serial3/0
sequencing
exit
;
group 2
; -- L2TP group configuration --
request-dialin
initiate-to 10.10.47.241
persist
pseudowire RTE
interface serial3/0
maxfail 300
sequencing
exit
;
group 3
; -- L2TP group configuration --
multicast-addr 224.99.99.22
pseudowire RTS
static tid 2 sid 20
multicast-ifc serial3/1
sequencing
exit
;
group 4
; -- L2TP group configuration --
request-dialin
initiate-to 10.10.47.241
persist
pseudowire RTS
```

```

    interface serial3/1
    maxfail 300
    sequencing
    exit
;
    group 5
; -- L2TP group configuration --
    multicast-addr 224.99.99.33
    pseudowire MEG-DAT
    static tid 3 sid 30
    multicast-ifc serial3/2
    sequencing
    exit
;
    group 6
; -- L2TP group configuration --
    request-dialin
    initiate-to 10.10.47.241
    persist
    pseudowire MEG-DAT
    interface serial3/2
    maxfail 300
    sequencing
    exit
;
    group 7
; -- L2TP group configuration --
    multicast-addr 224.99.99.44
    pseudowire CTC
    static tid 4 sid 40
    multicast-ifc serial0/0
    sequencing
    exit
;
    group 8
; -- L2TP group configuration --
    request-dialin
    initiate-to 10.10.47.241
    persist
    pseudowire CTC
    interface serial0/0
    maxfail 300
    sequencing
    exit
;
    group 11
; -- L2TP group configuration --
    pseudowire TETRA-PBE
    request-dialin
    initiate-to 10.10.47.242
    persist
    interface serial0/1
    maxfail 300
    sequencing
    exit
;
exit
;
dump-command-errors
end
; --- end ---

```

#### Remote device L11-PBE-GW2:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration

```

```
set hostname "L11-PBE-GW2"
;
set data-link async serial3/0
set data-link async serial3/1
set data-link async serial3/2
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
  ip address 10.10.44.82 255.255.252.0
;
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX1
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX2
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
  description AUX3
  speed 9600
  char-mask c000
  ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
  route 0.0.0.0 0.0.0.0 10.10.44.1
;
  classless
;
  proxy-igmp
; -- IGMP proxy user configuration --
  enable
  upstream ethernet0/0 default
  exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
  enable
;
  group 12
; -- L2TP group configuration --
; Tunnel deactivated, no initiate-to
  pseudowire AUX1
  request-dialin
  accept-dialin
  persist
```

```

interface serial3/0
maxfail 300
tie-breaker
sequencing
exit
;
group 13
; -- L2TP group configuration --
pseudowire AUX2-PBE
initiate-to 10.10.47.242
request-dialin
accept-dialin
persist
interface serial3/1
maxfail 300
tie-breaker
sequencing
exit
;
group 14
; -- L2TP group configuration --
; Tunnel deactivated, no initiate-to
pseudowire AUX3
request-dialin
accept-dialin
persist
interface serial3/2
maxfail 300
tie-breaker
sequencing
exit
;
exit
;
dump-command-errors
end
; --- end ---

```

#### Remote device L11-PEL-GW1:

```

; Showing System Configuration for access-level 15 ...

log-command-errors
no configuration
set hostname "L11-PEL-GW1"
;
set data-link async serial0/0
set data-link sync serial0/1
;
set data-link async serial3/0
set data-link async serial3/1
set data-link async serial3/2
;
;
network ethernet0/0
; -- Ethernet Interface User Configuration --
ip address 10.10.44.49 255.255.252.0
;
exit
;
;
network serial0/0
; -- Interface Asynchronous Serial Line. Configuration --
description CTC
speed 9600
char-mask c000
ignore-cd
ignore-dsr

```



```
    ignore-cts
exit
;
;
network serial0/1
; -- Interface Synchronous Serial Line. Configuration --
    description TETRA-PEL
exit
;
;
network serial3/0
; -- Interface Asynchronous Serial Line. Configuration --
    description AUX1
    speed 9600
    char-mask c000
    ignore-dsr
exit
;
;
network serial3/1
; -- Interface Asynchronous Serial Line. Configuration --
    description AUX2
    speed 9600
    char-mask c000
    ignore-dsr
exit
;
;
network serial3/2
; -- Interface Asynchronous Serial Line. Configuration --
    description AUX3
    speed 9600
    char-mask c000
    ignore-dsr
exit
;
;
protocol ip
; -- Internet protocol user configuration --
    route 0.0.0.0 0.0.0.0 10.10.44.1
;
    classless
;
    proxy-igmp
; -- IGMP proxy user configuration --
    enable
    upstream ethernet0/0 default
    exit
;
exit
;
;
protocol l2tp
; -- Layer 2 Tunneling Protocol user configuration --
    enable
;
    group 7
; -- L2TP group configuration --
    multicast-addr 224.99.99.44
    pseudowire CTC
    static tid 4 sid 40
    multicast-ifc serial0/0
    sequencing
    exit
;
    group 8
; -- L2TP group configuration --
```

```
request-dialin
initiate-to 10.10.47.241
persist
pseudowire CTC
interface serial0/0
maxfail 300
sequencing
exit
;
group 9
; -- L2TP group configuration --
pseudowire TETRA-PEL
request-dialin
initiate-to 10.10.47.242
persist
interface serial0/1
maxfail 300
sequencing
exit
;
group 12
; -- L2TP group configuration --
; Tunnel deactivated, no initiate-to
pseudowire AUX1
request-dialin
accept-dialin
persist
interface serial3/0
maxfail 300
tie-breaker
sequencing
exit
;
group 13
; -- L2TP group configuration -
; Tunnel deactivated, no initiate-to
pseudowire AUX2
request-dialin
accept-dialin
persist
interface serial3/1
maxfail 300
tie-breaker
sequencing
exit
;
group 14
; -- L2TP group configuration --
pseudowire AUX3-PEL
initiate-to 10.10.47.242
request-dialin
accept-dialin
persist
interface serial3/2
maxfail 300
tie-breaker
sequencing
exit
;
exit
;
dump-command-errors
end
; --- end ---
```