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ADTRAN

Configuration Guide

PPP over Frame Relay in AOS

This guide provides an overview of Point-to-Point Protocol (PPP) over Frame Relay (PPPoFR) and its operation in ADTRAN Operating System (AOS) products. Included in this guide are an overview of PPPoFR technology, an in-depth look at how PPPoFR functions, and descriptions of the three main types of PPPoFR usage. Also, included in this guide are PPPoFR configuration information through the AOS command line interface (CLI), PPPoFR configuration examples, and troubleshooting information.

This guide includes the following sections:

Although this guide covers information about PPPoFR, it does not cover in-depth information about either PPP or Frame Relay. You should be familiar with both of these protocols before using PPPoFR. Review the following documents available online at http://kb.adtran.com:

- *Point-to-Point Protocol Configuration Guide* (article number 2523)
- *Frame Relay Configuration Guide* (article number 2350)

PPPoFR Overview

PPPoFR is a protocol cooperation system that enables a router to establish end-to-end PPP communication sessions over a Frame Relay network to a remote peer. PPPoFR operates in three modes: as a PPP session over a single Frame Relay T1 circuit, as a Multilink PPP (MLPPP) session bundle over Frame Relay T1 circuits, and as a PPP session over a Multilink Frame Relay (MFR) bundle of T1 circuits.

PPPoFR is generally employed by service providers that want to provide their customers with a business-class T1 service. In a typical network, PPPoFR is used to provide the link between customer T1 networks and the service provider's asynchronous transfer mode (ATM) networks.

Customer networks sometimes use Frame Relay T1 circuits to connect to the service provider network. Service provider aggregation points are usually connected to an ATM backbone. The customer T1 Frame Relay virtual circuits (VCs) must be converted to ATM VCs in order to be transported across the backbone to a PPP termination point. A digital subscriber link access multiplexer (DSLAM) provides the necessary Frame Relay to ATM service conversion for connection to service providers' core networks. DSLAMs serving as an aggregation point for subscribers can contain T1 access cards, serve as Frame Relay switches, and convert Frame Relay to ATM.

When the customer network attempts to send traffic to the service provider network, the Frame Relay switch (or DSLAM) terminates the customer network's Frame Relay permanent virtual circuit (PVC) and converts it to an ATM VC by using service interworking conversion. The ATM VC is sent from the Frame Relay switch through the service provider's ATM backbone switching network over a high-speed DS3 or OC3 link. This ATM network transports the customer's VC to a service provider edge router over another DS3 or OC3 link and terminates the PPP session used to connect the customer to the service provider network.

PPPoFR is used in the interaction between customer and service provider networks to encapsulate customer PPP session information. The service provider uses the PPP session information to authenticate the client and provide secure and reliable access to the network.

Figure 1 describes PPPoFR in the typical customer/service provider network interaction.

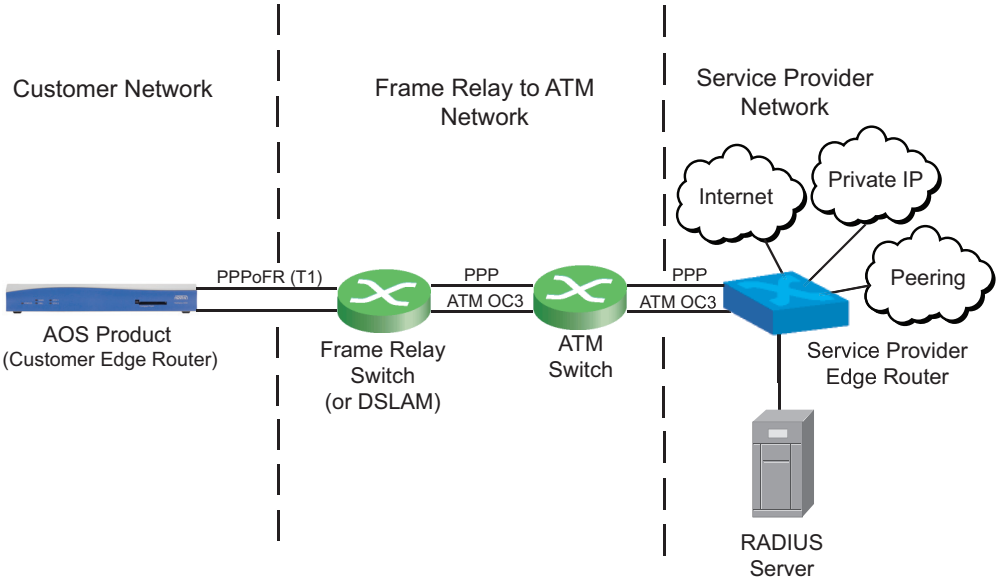

Figure 1. PPPoFR in a Typical Customer/Service Provider Network

PPPoFR Benefits

The PPPoFR feature has many benefits to both customer and service provider networks. Advantages to using PPPoFR include:

- Providing remote user access to corporate Frame Relay networks.
- Supporting reliable end-to-end network sessions.
- Increasing security with PPP support for Password Authentication Protocol (PAP) and Challenge-handshake Authentication Protocol (CHAP) client authentication. Native authentication methods are not supported with Frame Relay alone.
- Providing the ability to monitor link quality.
- Providing the ability for PPP transport over service provider core networks through Frame Relay to ATM service interworking.

There are also benefits to using PPPoFR with multiple links, whether it is MLPPPoFR or PPPoMFR. Both services enable service providers to offer higher bandwidth services using bonded T1 circuits, which provide cost-effective multi-megabit virtual connections that bridge the gap between single T1 and high-speed DS3 circuits, as well as provide redundancy if one of the links should fail. When using bonded T1 circuits, both MLPPP and MFR continue passing traffic on the active links up to the aggregate link capacity and the bonded circuits simplify routing for IP packet forwarding in edge routers by providing a single bundle interface. Using bonded T1 circuits with MLPPPoFR or PPPoMFR also provide packet fragmentation, which helps improve the quality of service (QoS) for realtime sensitive traffic like Voice over IP (VoIP) by controlling packet serialization delay and reducing latency and delay variation.

PPPoMFR bonding provides minimal packet overhead if the Frame Relay switch or DSLAM equipment supports the MFR feature. Only a single Frame Relay to ATM VC is required for Frame Relay/ATM service interworking when using MFR, whereas MLPPP requires multiple VCs to carry customer traffic across the ATM network to the service provider edge router that terminates the MLPPP session.

MLPPP uses a standards-based protocol (based on RFC 1990) that aggregates links into higher-speed bundles with efficient frame mapping, low overhead and packet fragmentation. Using MLPPPoFR allows for these benefits without the need to use switches that support the MFR protocol, although to use this version of PPPoFR, each end of the bundled link must support MLPPP.

PPPoFR Functionality in AOS

The PPPoFR feature in AOS allows PPP to be encapsulated in a Frame Relay frame by supporting cross connection of multiple Layer 2 protocols, and specifically by cross connecting a PPP interface to a Frame Relay interface and sequentially, cross connecting the Frame Relay interface to the intended physical interface.

The PPP packets are handled within the Frame Relay datapath by a newly created Frame Relay PPP (FRPPP) protocol mover. This protocol mover is one of many within the Frame Relay architecture, but more specifically, it is the one that handles PPPoFR packets, as well as provides interface and packet driver exposure to the PPP layer above it.

In the transmit direction, the PPP link passes outbound Frame Relay traffic to the FRPPP protocol mover and adds the Frame Relay 1490 CONTROL byte and the PPPoFR network layer protocol identifier (NLPID) byte to the Frame Relay frame. It then forwards the packet to the Frame Relay VC. When the FRPPP protocol mover receives PPPoFR packets from the Frame Relay VC, it analyzes their header fields to identify them and forward them to the PPP link.

Hardware and Software Requirements and Limitations

PPPoFR is available on all AOS products that support Frame Relay, that have a T1 wide area network (WAN) interface, and that are running AOS Firmware 17.07.01.00 or later. For a complete listing of supported platforms, refer to the *Product Feature Matrix* (article number 2272) available online at http://kb.adtran.com.

PPPoFR Feature Restrictions

- Only single link PPP or MLPPP sessions are supported over Frame Relay.
- Only one data link connection identifier (DLCI) per Frame Relay interface can be configured.
- Only one Frame Relay subinterface per main Frame Relay interface is supported. If configuration of additional subinterfaces per main interface is attempted, an error message is displayed.
- PPPoFR configuration is only available using the CLI.
- Bridging over PPPoFR is not supported.
- PPP Protocol-Field-Compression (PFC) is not supported.
- PPP Address-and-Control-Field-Compression (ACFC) is not supported.

- Only T1 circuits are supported for PPPoFR.

> *When multiple PVCs take different paths within the service provider's network before they are terminated, inherent delay between them results. This causes a significant reduction in user throughput. Due to the nature of this phenomenon, service providers must use extreme caution when designing their networks to ensure virtual circuits going to the same customer take the same path through their network, or that delay is minimized between different paths.*

Multilink PPPoFR and PPP over MFR

Multilink PPPoFR and PPP over MFR configurations support links for 2 to 12 T1 circuits. The maximum number of supported links is determined by the AOS product used for MLPPP or MFR. If more than the maximum number of supported links are configured, an error message is displayed. The following table describes the number of links available on different AOS products.

Table 1. Maximum Links Per AOS Product

AOS Product	Maximum Links Per Bundle
NetVanta 1000 Series Products	2
NetVanta 3200 Series Products	2
NetVanta 3300 Series Products	3
NetVanta 3400 Series Products	2
NetVanta 3450 Series Products	4
NetVanta 4000 Series Products	4 to 8
NetVanta 5000 Series Products	12
NetVanta 6355 Series Products	2
NetVanta 6310/6330 Series Products	2
NetVanta 7000 Series Products	2
Total Access 900(e) Series Products	4

MTU, MRU, and MRRU Buffering Considerations

When using PPPoFR or Multilink PPPoFR, packet buffer sizes must accommodate the additional packet encapsulation needed for PPPoFR operation. AOS products support auto-negotiation for maximum receive units (MRUs) and maximum receive reconstructed units (MRRUs) during PPP Link Control Protocol (LCP) negotiation with the service provider edge router.

The current AOS maximum transmission unit (MTU) range for the PPP interface is **64** to **2100** bytes (**64** to **4600** bytes for the NetVanta 5305) and is a user-configurable value. The MRU value is based on this MTU setting. During LCP negotiation, AOS products accept the remote peers' Config-Request MRU and MRRU options even if they exceed the AOS router's MTU setting. If the received MRU is less than the AOS product's MTU setting, then the AOS product adjusts the MTU to the received MRU value.

MTUs must be set in the PPP interface configuration and not in the Frame Relay subinterface. Attempting to configure the MTU in the Frame Relay subinterface when using PPPoFR results in an error message.

IP Addressing Options

For PPPoFR, the IP address configurations must be configured only on the PPP interface. If an IP address is configured using the Frame Relay subinterface when PPPoFR is enabled, an error message is displayed.

QoS and PPPoFR

QoS policy mechanisms provide traffic classification, priority marking, and bandwidth guarantees. For correct performance, when using QoS with PPPoFR, QoS policies and queuing mechanisms should be applied to either the PPP or Frame Relay interfaces, based on whether or not PPP multilink is configured.

When using WFQ or first-in-first-out (FIFO) queuing, the queueing method must be applied to the interfaces appropriately. Table 2 describes which queuing methods are applied to the PPP and/or Frame Relay interfaces when using PPPoFR.

Table 2. PPPoFR Queuing Methods by Interface

PPPoFR Type	Interface	Queuing Method
PPPoFR over Single T1	PPP	FIFO
	Frame Relay	FIFO or WFQ
Multilink PPPoFR	PPP	FIFO or WFQ
	Frame Relay	FIFO
PPP over MFR	PPP	FIFO
	Frame Relay	FIFO or WFQ

Applying the QoS policy must occur at either the PPP or Frame Relay interface layer for PPPoFR. Depending on the type of PPPoFR being used, QoS policies must be applied to the appropriate interface. During the cross connection between the PPP and Frame Relay interfaces used in PPPoFR, QoS policies are checked for valid assignments. Invalid assignments result in error messages. Table 3 describes to which interface QoS policies should be applied for each PPPoFR type.

Table 3. QoS Policy Application by PPPoFR Type

PPPoFR Type	Interface	QoS Policy Application
PPPoFR over Single T1	PPP	No QoS Policy
	Frame Relay	QoS Policy

Table 3. QoS Policy Application by PPPoFR Type *(Continued)*

PPPoFR Type	Interface	QoS Policy Application
Multilink PPPoFR	PPP	QoS Policy
	Frame Relay	No QoS Policy
PPP over MFR	PPP	No QoS Policy
	Frame Relay	QoS Policy

Configuring PPP over Frame Relay Using the CLI

There is one basic command to configure PPPoFR, and that is the **cross-connect** <*number*> <*from interface*> <*to interface*> command. This command is issued from the PPP Interface Configuration mode, with the <*from interface*> parameter as the Frame Relay subinterface and the <*to interface*> parameter as the PPP interface. Interfaces are specified in the format <*interface type [slot/port | slot/port.subinterface id | interface id | interface id.subinterface id]*>. For example, for a Frame Relay subinterface, use **fr 1.1** and for a PPP interface, use **ppp 1**. The <*number*> parameter identifies the cross connect. Valid number range is **1** to **1024**.

Although there is only one command for enabling PPPoFR, using PPPoFR assumes some other configurations have taken place. The three types of PPPoFR (Single PPPoFR, Multilink PPPoFR, and PPP over MFR) all require certain configurations. Required configurations include:

- That a T1 with a valid time division multiplex (TDM) group has been configured.
- That the PPP interface has been created.
- That a Frame Relay interface has been created and that a Frame Relay subinterface has been created and assigned a DLCI.
- That a cross connection between the main Frame Relay interface and the T1 TDM group exists.

NOTE

*If configuring Multilink PPPoFR, MLPPP must be enabled using the **ppp multilink** command from the PPP Interface Configuration mode. If configuring PPP over MFR, the MFR bundle must be created using the **frame-relay multilink** command from the Frame Relay Interface Configuration mode.*

These configurations are shown in the *PPP over Frame Relay Configuration Examples* on page 9.

For more information about configuring these items, refer to the *Point-to-Point Protocol Configuration Guide* (article number 2523) and the *Frame Relay Configuration Guide* (article number 2350) available online at http://kb.adtran.com.

Configuring PPPoFR for a Single Frame Relay VC

When configuring PPPoFR for a single Frame Relay VC, the **cross-connect** command is entered from the PPP Interface Configuration mode and is used to cross connect the Frame Relay subinterface to the PPP interface. Using the **no** form of this command removes the link between interfaces. Enter the command as follows:


```
(config)#interface ppp 1
(config-ppp 1)#cross-connect 2 fr 1.16 ppp 1
```

The **cross-connect** <*number*> parameter will always be a unique number. In this example, because there must first be a cross connection between the Frame Relay interface and the TDM group, which is named **cross-connect 1**, the PPPoFR cross connection is named **cross-connect 2**.

When you use PPPoFR for a single Frame Relay VC, the following occurs:

1. Any IP address and bridge group are removed from the Frame Relay subinterface.
2. FIFO queuing is enforced on the PPP interface.
3. WFQ is enforced on the Frame Relay interface.
4. Existing QoS policies are applied at the lowest level Layer 2 interface, in this case, the Frame Relay interface.

Configuring Multilink PPPoFR

When configuring Multilink PPPoFR, the **cross-connect** command is entered from the PPP Interface Configuration mode and is used to cross connect a PPP interface to multiple Frame Relay subinterfaces. Using the **no** form of this command removes the link between the interfaces. Enter the command in conjunction with the **ppp multilink** command as follows:

```
(config)#interface ppp 1
(config-ppp 1)#ppp multilink
(config-ppp 1)#cross-connect 3 fr 1.16 ppp 1
(config-ppp 1)#cross-connect 4 fr 2.17 ppp 1
```

Note that these cross connections are numbered **3** and **4**. This is because in order to have Multilink PPPoFR, it is assumed that multiple Frame Relay interfaces have been configured and already cross connected to the appropriate TDM groups, and those are labeled cross connections **1** and **2**.

When you use Multilink PPPoFR, the following occurs:

1. Any IP address and bridge groups are removed from the Frame Relay subinterfaces.
2. WFQ is enforced on the PPP interface.
3. FIFO queuing is enforced on the Frame Relay interface.
4. Existing QoS policies are applied at the PPP interface because it is aggregating bandwidth between multiple physical interfaces.

These actions are repeated for each cross connection between the Frame Relay subinterfaces and the PPP interface.

Configuring PPP over MFR

When configuring PPP over MFR, the **cross-connect** command is entered from the PPP Interface Configuration mode and is used to cross connect a PPP interface to a MFR VC. Using the **no** form of this command removes the link between the interfaces. Enter the command as follows:

(config)**#interface ppp 1**
(config-ppp 1)**#cross-connect 3 fr 1.16 ppp 1**

In this case, the cross connection is numbered **3** because at least two cross connects have already occurred in the MFR configuration.

When you use PPP over MFR, the following occurs:

1. Any IP address and bridge groups are removed from the Frame Relay subinterface.
2. FIFO queuing is enforced on the PPP interface.
3. WFQ is enforced on the Frame Relay interface.
4. Existing QoS policies are applied at the lowest level Layer 2 interface, in this case, the Frame Relay interface.

PPP over Frame Relay Configuration Examples

The following examples describe some of the common real-world applications of PPPoFR. All configuration is accomplished through the CLI. The configuration parameters entered in these examples are sample configurations only. You should configure these applications in a manner consistent with the needs of your particular network. CLI prompts have been removed from the configuration examples to provide you with a method of copying and pasting configurations from this guide into the CLI. Before copying these configurations into your CLI, first make the necessary adjustments to ensure they will function properly in your network.

Single T1 PPPoFR Configuration Example

The following example details the commands used to configure the most common application of PPPoFR, in which a single T1 interface from a customer edge router is used to connect with the service provider network. A QoS policy is applied to the Frame Relay main interface to give VoIP traffic priority. The service provider requires CHAP authentication with a user name of **USERNAME** and a password of **PASSWORD**.

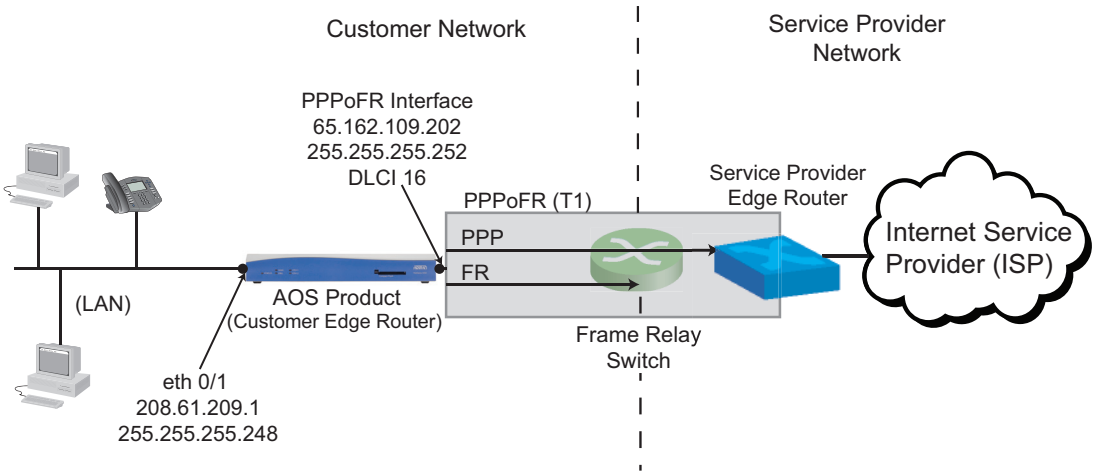

Figure 2. Single T1 PPPoFR Network Diagram

Configure the T1 interface, the Frame Relay interface, and the PPP interface as follows:

```
!
qos map VOIP 10
     match dscp 46 26
     priority 300
!
interface eth 0/1
     ip address 208.61.209.1 255.255.255.248
     no shutdown
!
interface t1 1/1
     tdm-group 1 timeslots 1-24 speed 64
     no shutdown
!
interface fr 1 point-to-point
     frame-relay lmi-type ansi
     qos-policy out VOIP
     no shutdown
     cross-connect 1 t1 1/1 1 frame-relay 1
!
interface fr 1.16 point-to-point
     frame-relay interface-dlci 16
     no ip address
!
interface ppp 1
     ip address 65.162.109.202 255.255.255.252
     ppp chap hostname USERNAME
     ppp chap password PASSWORD
     no shutdown
     cross-connect 2 fr 1.16 ppp 1
!
ip route 0.0.0.0 0.0.0.0 ppp 1
!
```


Multilink PPPoFR Configuration Example

The following example details the commands used to configure PPPoFR in which MLPPP is used. Two separate PVCs are used on different T1 interfaces. A QoS policy is applied to the PPP interface to give VoIP traffic priority. The service provider requires CHAP authentication with a user name of **USERNAME** and a password of **PASSWORD**.

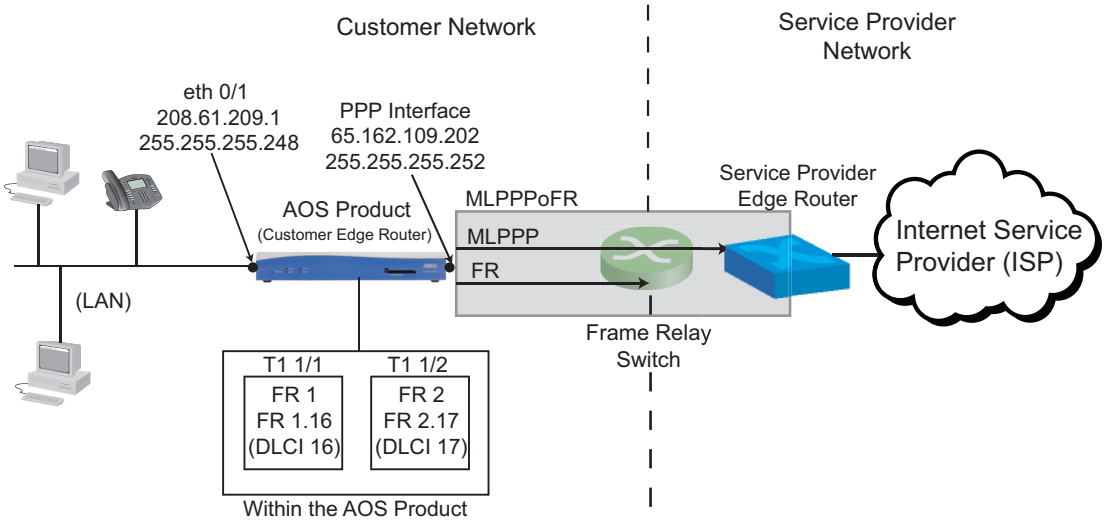

Figure 3. MLPPPoFR Network Diagram

Configure the T1 interfaces, the Frame Relay interfaces, and the PPP interface as follows, making sure to enable multilink on the PPP interface:

```
!
qos map VOIP 10
    match dscp 46 26
    priority 600
!
interface eth 0/1
    ip address 208.61.209.1 255.255.255.248
    no shutdown
!
interface t1 1/1
    tdm-group 1 timeslots 1-24 speed 64
    no shutdown
!
interface t1 1/2
    tdm-group 1 timeslots 1-24 speed 64
    no shutdown
!
interface fr 1 point-to-point
    frame-relay lmi-type ansi
    no shutdown
    cross-connect 1 t1 1/1 1 frame-relay 1
!
```



```
interface fr 1.16 point-to-point
    frame-relay interface dlci 16
    no ip address
!
interface fr 2 point-to-point
    frame-relay lmi-type ansi
    no shutdown
    cross-connect 2 t1 1/2 1 frame-relay 2
!
interface fr 2.17 point-to-point
    frame-relay interface-dlci 17
    no ip address
!
interface ppp 1
    ip address 65.162.109.202 255.255.255.252
    ppp multilink
    qos-policy out VOIP
    ppp chap hostname USERNAME
    ppp chap password PASSWORD
    no shutdown
    cross-connect 3 fr 1.16 ppp 1
    cross-connect 4 fr 2.17 ppp 1
!
ip route 0.0.0.0 0.0.0.0 ppp 1
!
```


PPP over MFR Configuration Example

The following example details the commands used to configure PPPoFR in which MFR is used. A QoS policy is applied to the Frame Relay main interface to give VoIP traffic priority. The service provider requires CHAP authentication with a user name of **USERNAME** and a password of **PASSWORD.**

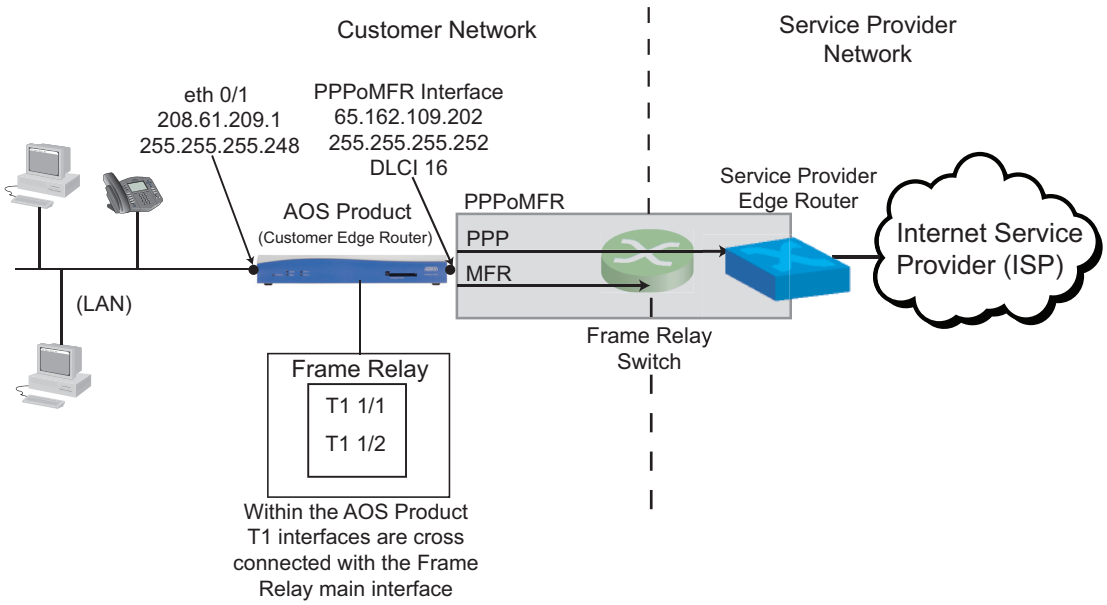

Figure 4. PPPoMFR Network Diagram

Configure the T1 interfaces, the Frame Relay interfaces, and the PPP interface as follows, making sure to create the MFR bundles and associate them properly with the appropriate TDM groups:

```
!
qos map VOIP 10
    match dscp 46 26
    priority 600
!
interface eth 0/1
    ip address 208.61.209.1 255.255.255.248
    no shutdown
!
interface t1 1/1
    tdm-group 1 timeslots 1-24 speed 64
    no shutdown
!
interface t1 1/2
    tdm-group 1 timeslots 1-24 speed 64
    no shutdown
!
interface fr 1 point-to-point
    frame-relay lmi-type ansi
    frame-relay multilink
```



```
    qos-policy out VOIP
    no shutdown
    cross-connect 1 t1 1/1 1 frame-relay 1
    cross-connect 2 t1 1/2 1 frame-relay 1
!
interface fr 1.16 point-to-point
    frame-relay interface dlci 16
    no ip address
!
interface ppp 1
    ip address 65.162.109.202 255.255.255.252
    ppp chap hostname USERNAME
    ppp chap password PASSWORD
    no shutdown
    cross-connect 3 fr 1.16 ppp 1
!
ip route 0.0.0.0 0.0.0.0 ppp 1
!
```


PPP over Frame Relay Command Summary

The following table describes the commands used to configure PPPoFR.

Table 4. PPPoFR Configuration Commands

Prompt	Command	Description
(config-ppp 1)#	**cross-connect** <*number*> <*from interface*> <*to interface*>	Creates the cross connection between the Frame Relay and PPP interfaces. The <*number*> parameter identifies the cross connection. Range is **1** to **1024**. The <*from interface*> for PPPoFR is the Frame Relay subinterface, and the <*to interface*> for PPPoFR is the PPP interface. Interfaces are specified in the format <*interface type [slot/port* | *slot/port.subinterface id* | *interface id* | *interface id.subinterface id]*>. For example, for a Frame Relay interface, use **fr 1.1** and for a PPP interface, use **ppp 1**.
(config-ppp 1)#	**ppp multilink**	Enables MLPPP operation. This command is necessary when configuring PPPoFR for MLPPP.
(config-fr 1)#	**frame-relay multilink**	Enables MFR operation. This command is necessary when configuring PPPoFR for MFR.

Troubleshooting

After configuring PPPoFR, several **show** commands can be issued from the Enable mode prompt in the CLI to assist in troubleshooting. These **show** commands can be helpful in monitoring the status of both Frame Relay and PPP interfaces, as well as in verifying proper network configuration. Table 5 describes these commands.

Table 5. PPPoFR Troubleshooting Commands

Prompt	Command	Description
#	**show frame-relay pvc**	Displays status and statistic information about the PVC for Frame Relay interfaces, and displays the status information for PPPoFR.
#	**show interface ppp** <*interface id*>	Displays status information about the MLPPP bundle and the links that make up that bundle, including link information for the Frame Relay Subinterfaces. The <*interface id*> parameter is the PPP interface number. Valid range is **1** to **1024**.

Show Frame-Relay PVC

Use the **show frame-relay pvc** command to view status and statistic information about the PVCs for Frame Relay interfaces. This output includes status information for PPPoFR, stating whether the cross connection between the PPP and Frame Relay interfaces is in an UP or DOWN state. Enter the command from the Enable mode prompt as follows:

```
>enable
#show frame-relay pvc
Frame Relay Virtual Circuit Statistics for interface FR 1
        Active      Inactive      Deleted      Static
local   1           0             0            1

DLCI=16, DLCI USAGE=LOCAL, PVC STATUS=ACTIVE, INTERFACE=FR 1.1
    MTU: 1500
    input pkts: 498          output pkts: 475          in bytes: 97288
    out bytes: 96339         dropped pkts: 0           in FECN pkts: 0
    in BECN pkts: 0          in DE pkts: 0             out DE pkts: 0
    Creation time: 04-10-2009 09:19:06      Last status change: 00W:00D:03H:53M:50S
    Cross-connected to PPP 1 - UP
```


Show Interface PPP

Use the **show interface ppp** <*interface id*> command to view status information about the MLPPP bundle and the links that make up the bundle, as well as the link information for the Frame Relay subinterfaces used in PPPoFR. With this command, you can view link information for the Frame Relay subinterfaces even if MLPPP is not used. Enter the command from the Enable mode prompt as follows:

```
>enable
#show interface ppp 1
ppp 1 is UP
    Configuration:
        Keep-alive is set (10 sec.)
        Multilink
            MTU=1500, MRRU=1520
        No authentication
        IP is configured
            192.168.2.1 255.255.255.0
    Link thru fr 1.16 is UP; LCP state is OPENED, negotiated MTU is 1500
        Actual Bandwidth is 1536 kbps
        Receive: bytes=21246, pkts=845, errors=57
        Transmit: bytes=36903, pkts=1722, errors=0
        5 minute input rate 48 bits/sec, 0 packets/sec
        5 minute output rate 48 bits/sec, 0 packets/sec
    Link thru fr 2.17 is UP; LCP state is OPENED, negotiated MTU is 1500
        Actual Bandwidth is 1536 kbps
        Receive: bytes=11564, pkts=558, errors=0
        Transmit: bytes=14676, pkts=825, errors=0
        5 minute input rate 48 bits/sec, 0 packets/sec
        5 minute output rate 48 bits/sec, 0 packets/sec
    Bundle Information
        Aggregate Bandwidth is 3072 kbps
        Total receive: bytes=32810, pkts=1403, errors=57
        Total transmit: bytes=51579, pkts=2547, errors=0
        5 minute input rate 96 bits/sec, 0 packets/sec
        5 minute output rate 96 bits/sec, 0 packets/sec
    Queueing method: weighted fair
        HDLC tx ring limit: 2
        Output queue: 0/2/540/64/0 (size/highest/max total/ threshold/drops)
        Conversations: 0/1/256 (active/max active/max total)
    Available Bandwidth 2304 kilobits/sec
        IP is UP, IPCP state is OPENED
        Address=192.168.2.1 Mask=255.255.255.0
        Peer address=192.168.2.2
        IP MTU=1500, Bandwidth=3072 Kbps
        LLDPCP State is OPENED
```


Debug Commands

Several **debug** commands are available for troubleshooting both Frame Relay and PPP interfaces. These commands are documented in detail in the *Point-to-Point Protocol Configuration Guide* (article number 2523) and the *Frame Relay Configuration Guide* (article number 2350) available online at http://kb.adtran.com.

