Application Note

Configure a Dual SIM router to automatically back up to a second SIM card

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1 INTRODUCTION

The configuration detailed in this note causes the Transport to monitor TCP traffic over an active W-WAN GSM connection to a specified IP address. When a problem is detected with the data transfer, the Transport will drop the active connection and activate the secondary W-WAN link using a second SIM card.

Other techniques for monitoring W-WAN connections (such as automatic pings) are available but not detailed in this application note.

It is also possible to monitor other types of traffic such as UDP or ICMP instead of TCP. Again these methods are not detailed in this application note.

1.1 Outline

There will be two distinct methods covered in this application note;

1. The first will be to back-up to a temporary "on demand" W-WAN connection using the second SIM card. Whenever the second SIM card is used, after a specified period of inactivity or after a maximum amount of time has been reached, the backup link will deactivate and the Transport will attempt to use the first SIM card again. This method is useful if it is not desirable to use the back-up SIM card indefinitely. (For example if some functionality is lost or the data charges are higher.)
2. The second method will cause the Transport to give each SIM and associated W-WAN link equal priority. Unless a problem is detected the Transport will permanently keep active whichever SIM card it happens to be using. This method is useful if maintaining a connection to a remote router is a priority.

1.2 Assumptions

This guide has been written for use by technically competent personnel with a good understanding of the communications technologies used in the product and of the requirements for their specific application. It also assumes a basic ability to access and navigate a Digi Transport router.

This application note applies only to;

Model: Digi Transport WR, SR or DR

Firmware versions: All firmware versions

Configuration: This Application Note assumes the Transport router is set to the factory default configuration. Most configuration commands are only shown if they differ from the factory default.

1.3 Corrections

Requests for corrections or amendments to this application note are welcome and should be addressed to: support@digi.com.

Requests for new application notes can be sent to the same address.

1.4 Version

Version Number	Status
1.0	Released

2 CONFIGURATION

2.1 W-WAN Module –SIM 1

2.1.1 Configuration Parameters for SIM 1

The configuration page is located under **Configuration - Interfaces>Mobile>W-WAN Module>SIM 1**

Enter the APN (Access Point Name) and PIN number (if required) for SIM card 1. (Usually these will be provided by your mobile operator.) In the figure 2-1, the APN example is wap.cingular and there is no pin number. These settings will vary depending on the mobile operator.

Table 2-1: SIM 1 Parameters

Parameter	Setting	Description
APN	wap.cingular	Enter the correct APN for your network
PIN	1234	Enter the PIN number for your SIM card (if required)

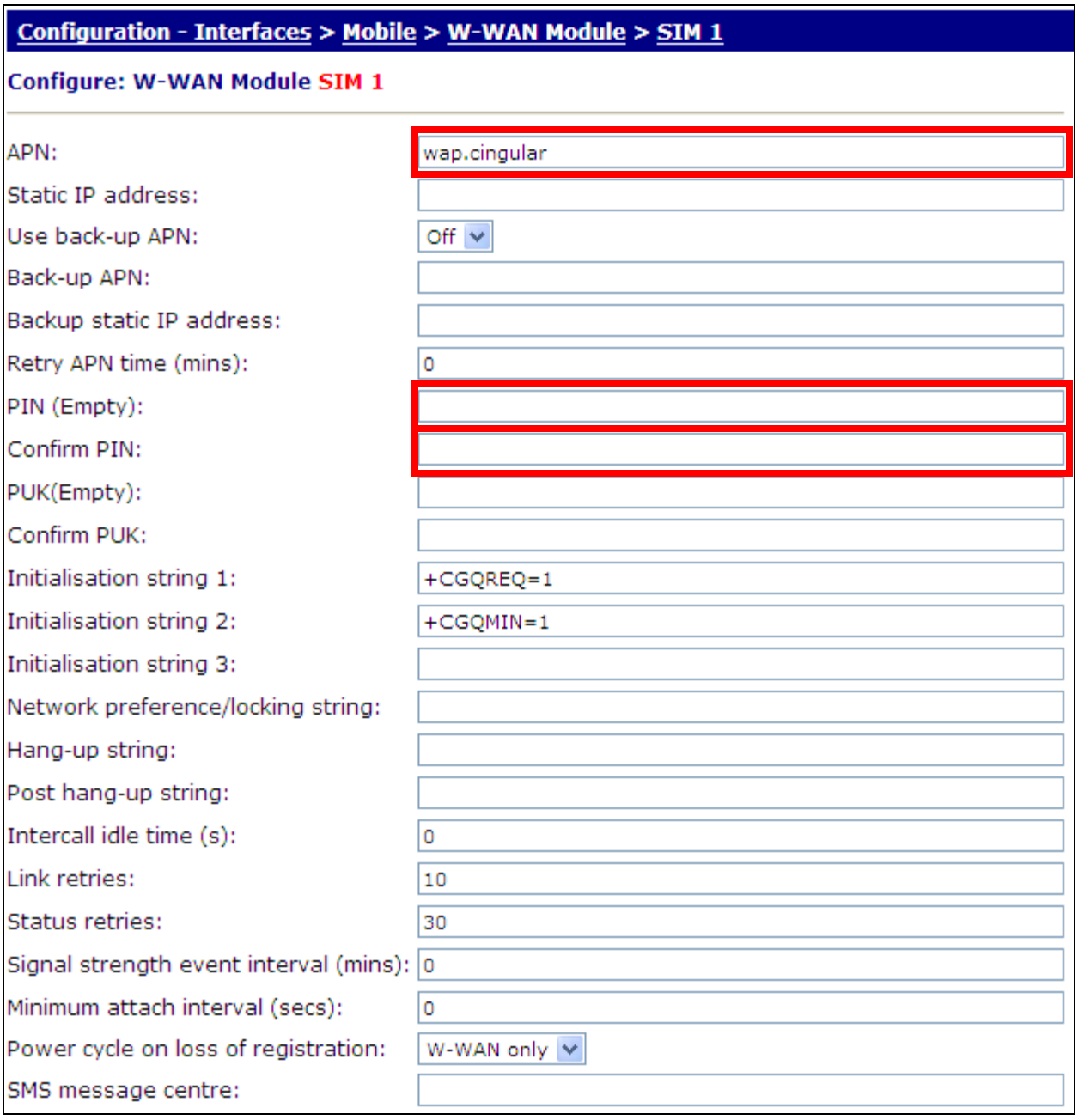

Figure 2-1: SIM 1 Configuration

2.2 W-WAN Module –SIM 2

2.2.1 Configuration Parameters for SIM 1

The configuration page is located under **Configuration - Interfaces>Mobile>W-WAN Module>SIM 2**

The configuration will be the same, although the information will be different if the carrier for SIM 2 differs from SIM 1. Enter the APN (Access Point Name) and PIN number (if required) for SIM card 1. (Usually these will be provided by your mobile operator.) In the figure 2-2, the APN example is wap.cingular and there is no pin number, the same settings for SIM 1. THIS IS CONFIGURATION IS FOR LAB PURPOSES AND IS NOT TYPICAL

Table 2-2: SIM 2 Parameters

Parameter	Setting	Description
APN	wap.cingular	Enter the correct APN for your network
PIN	1234	Enter the PIN number for your SIM card (if required)

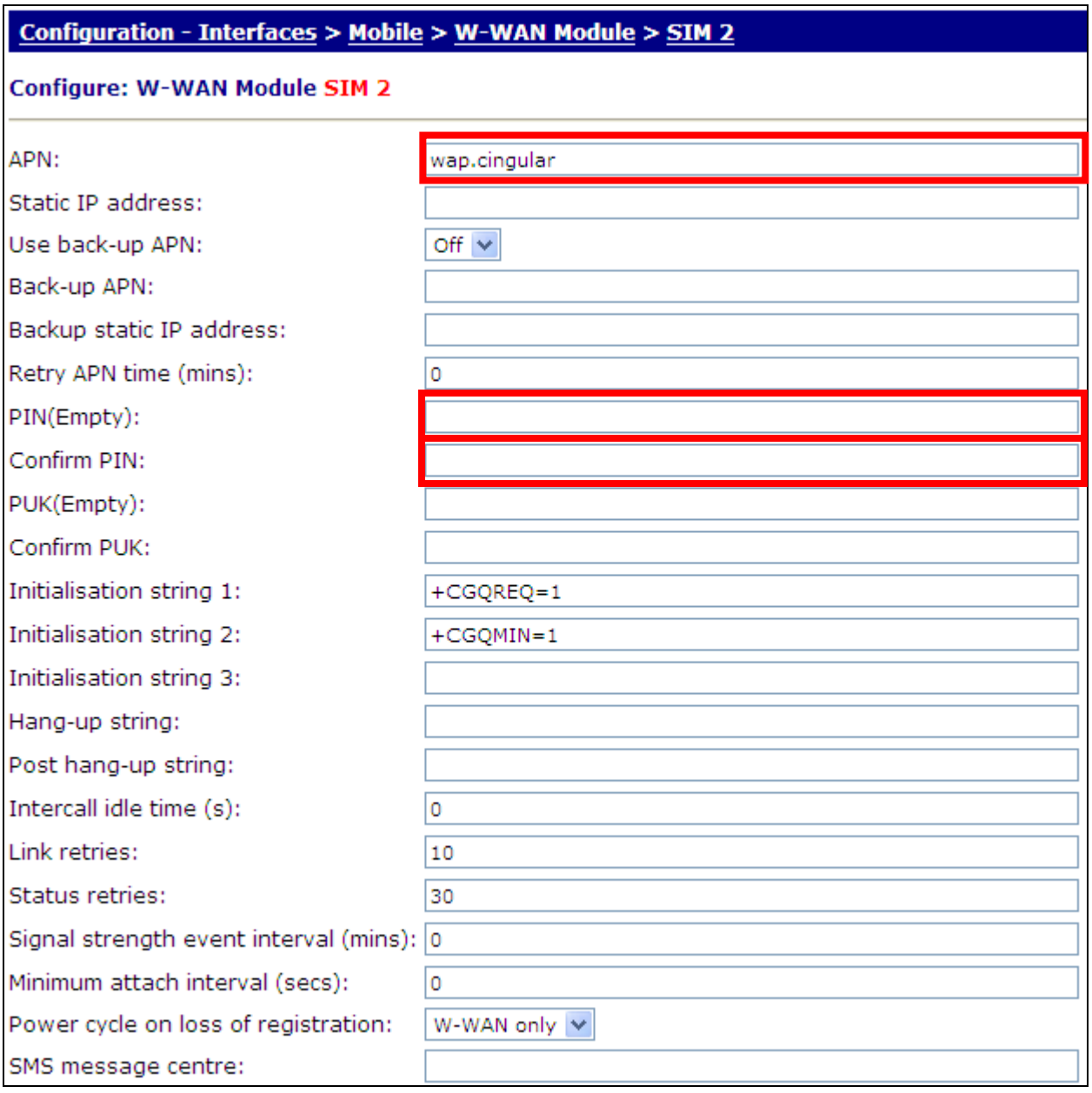

Figure 2-2: SIM 2 Configuration

2.3 Default Routes

2.3.1 Configuration Parameters for Default Route 0

Default route 0 is configured to send packets to non-local network destinations (e.g., Internet, WAN destinations) through PPP 1 by default.

The configuration page is located under **Configuration - Routing > Routing > Default Route 0**

The configuration will be the same, although the information will be different if the carrier for SIM 2 differs from SIM 1. Enter the APN (Access Point Name) and PIN number (if required) for SIM card 1. (Usually these will be provided by your mobile operator.) In the figure 2-2, the APN is wap.cingular and there is no pin number, the same settings for SIM 1. THIS IS CONFIGURATION IS FOR LAB PURPOSES AND IS NOT TYPICAL

Table 2-3: Default Route 0 Parameters

Parameter	Setting	Description
Interface:	PPP	Identifies the interface type to be associated with default route 0
Interface #:	1	Identifies the instance number of the interface to be associated with default route 0

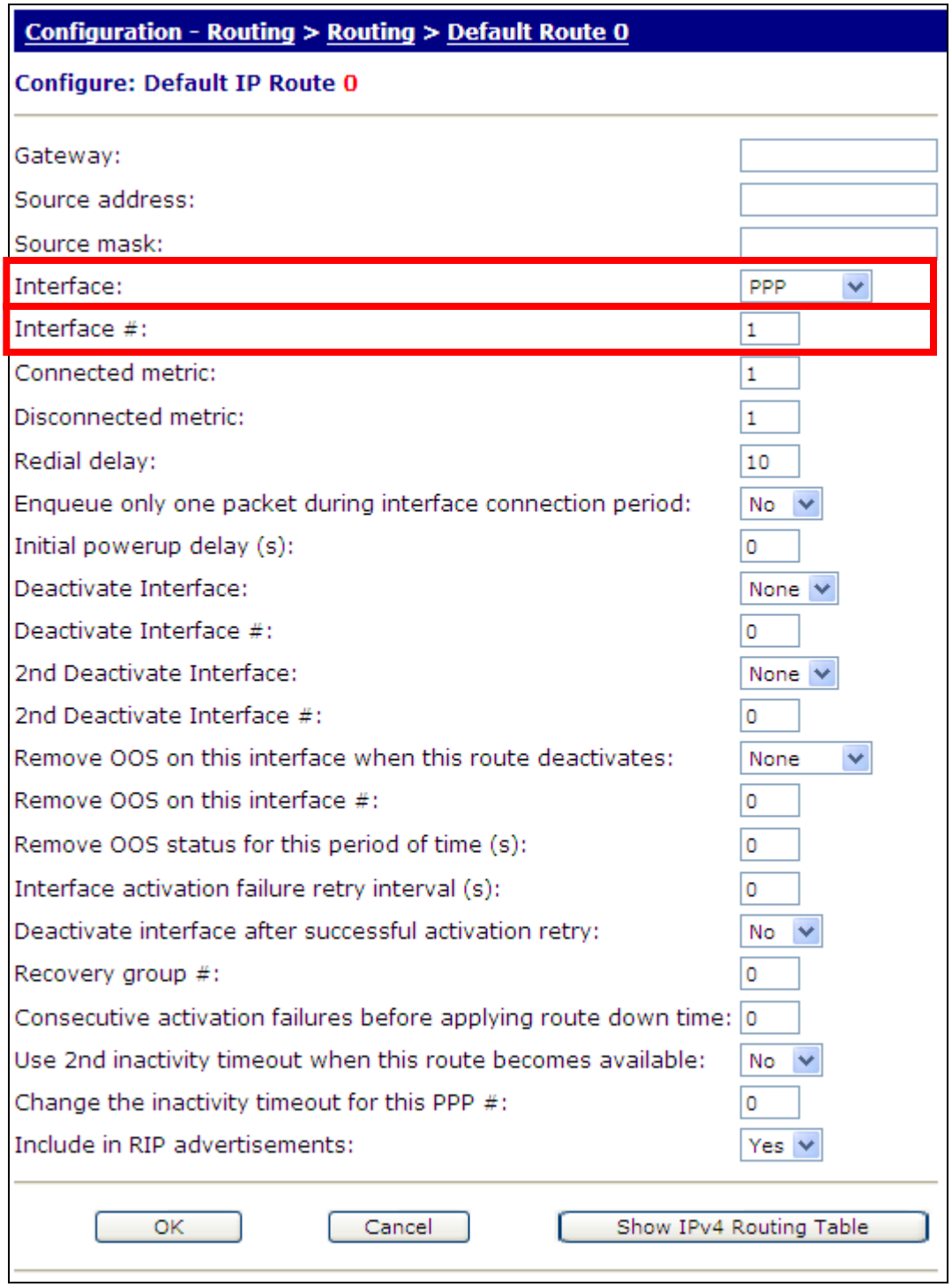

Figure 2-3: Default Route 0 Configuration

2.3.2 Configuration Parameters for Default Route 1

Default Route 1 is not set to any interface by default. It will need to be configured for W-WAN using SIM 2.

The configuration page is located under **Configuration - Routing > Routing > Default Route 1**

The biggest differences are the interface number and the Initial Power Up Delay (s) setting to prevent conflicts between the two SIM connections.

Table 2-4: Default Route 1 Parameters

Parameter	Setting	Description
Interface:	PPP	Identifies the interface type to be associated with default route 0
Interface #:	1	Identifies the instance number of the interface to be associated with default route 0
Initial Power Up Delay (s):	120	Delays activation of the PPP 2 link after power-up for two minutes (recommended).

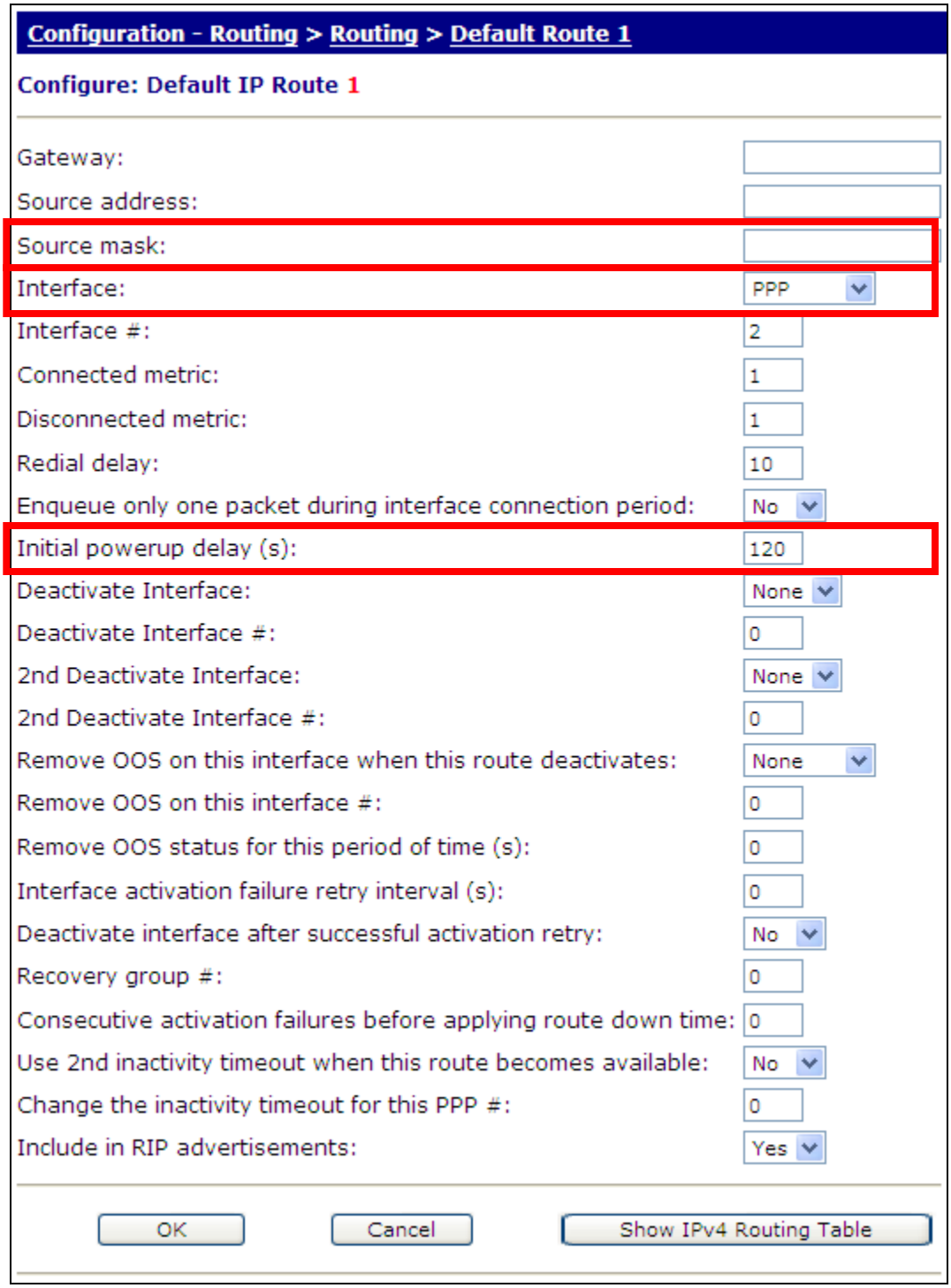

Figure 2-4: Default Route 1 Configuration

2.4 PPP 1 Interface Configuration for SIM 1

2.4.1 PPP 1 Standard Page

The configuration page is located under **Configuration - Interfaces > PPP > PPP 0 - 4 > PPP 1 > Standard.**

PPP 1 is configured for W-WAN SIM 1 by default, but there are a few more parameters to configure to support failover. The following table and figures show these parameters and their settings:

Table 2-5: PPP 1 Standard Parameters

Parameter	Setting	Description
Dial-out number:	*98*1#	Dial string to attach to the GSM network
Use W-WAN/external modem:	Any W-WAN channel	Configures the router to use any W-WAN channel
W-WAN SIM:	SIM 1	Configures the W-WAN link on PPP 1 to use SIM card 1
Username:	Username	Username provided by the mobile carrier
Password:		Password provided by the mobile carrier
Confirm Password:		Same as above
Always On Mode:	ON	Auto activates PPP 1 and keeps the link up
Firewall:	ON	Activates the Firewall/Stateful Route Inspection on PPP 1
Local IP Address:	0.0.0.0	Requests an IP address from the mobile carrier

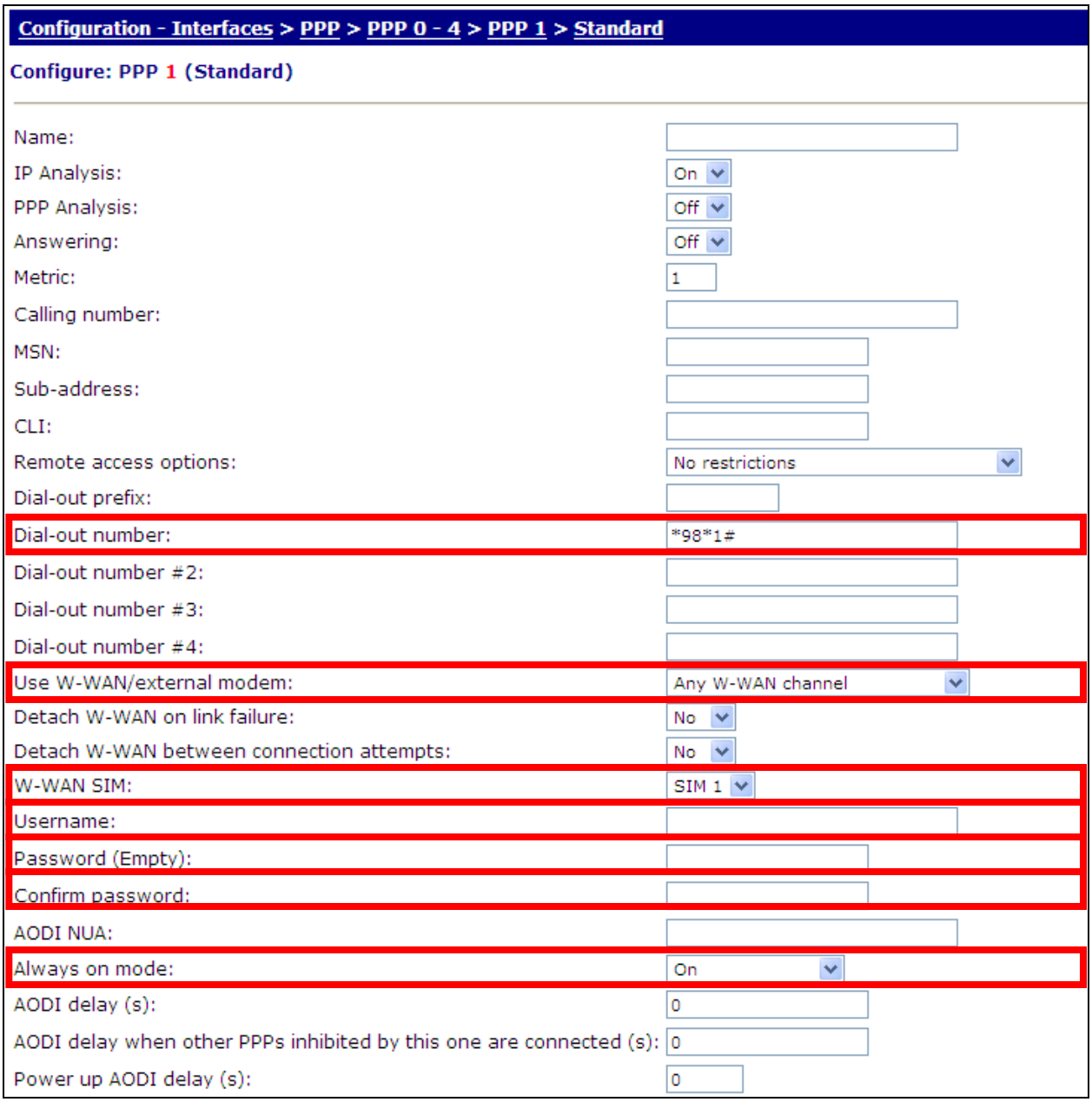

Figure 2-5: PPP 1 - Standard Configuration (Part 1)

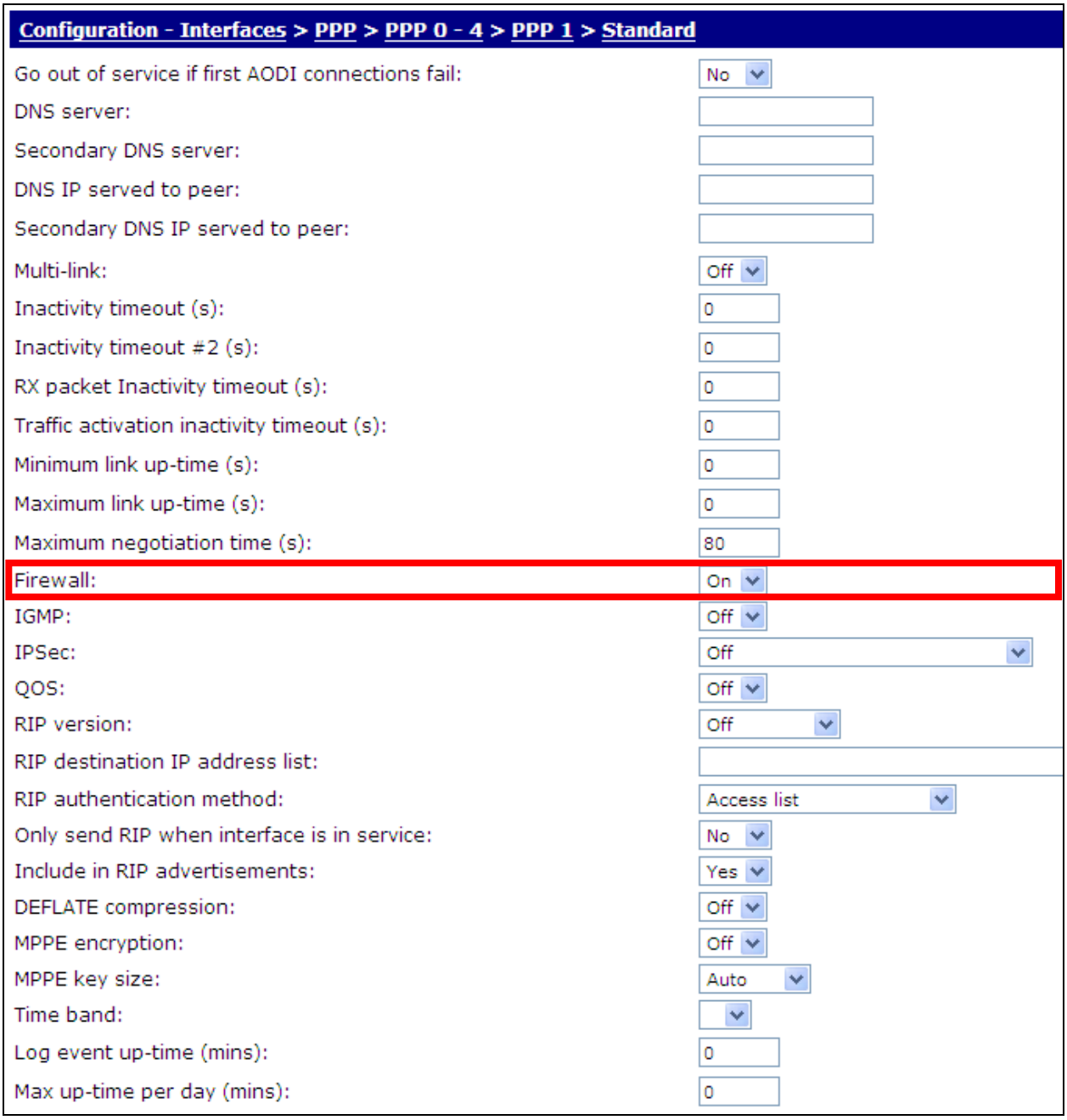

Figure 2-6: PPP 1 - Standard Configuration (Part 2)

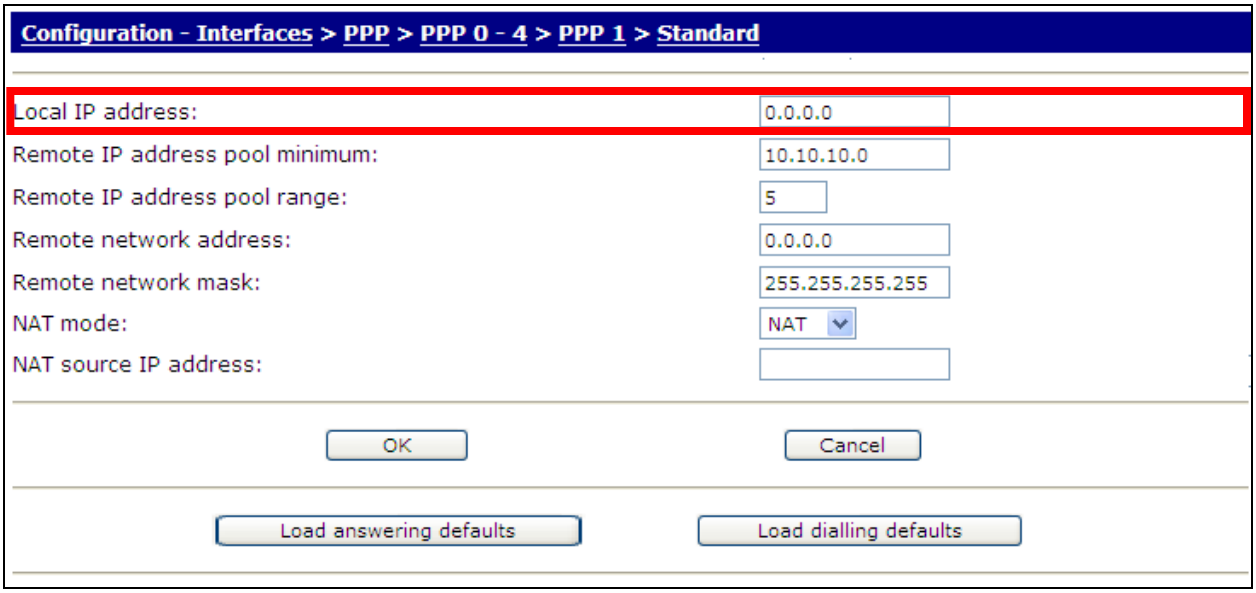

Figure 2-7: PPP 1 - Standard Configuration (Part 3)

2.4.2 PPP 1 Advanced Settings

The configuration page is located under **Configuration - Interfaces > PPP > PPP 0 - 4 > PPP 1 > Advanced.**

The following table shows the parameters and their settings, and the figures show other parameters that need to be enabled:

Table 2-6: PPP 1 Standard Parameters

Parameter	Setting	Description
Auto-activation attempts allowed:	5	Allows PPP 1 a total of 5 activation attempts before the PPP 2 link can override it
Inhibit auto-activation when these PPPs are active:	2	Configures PPP 1 to inhibit PPP 2 from raising its W-WAN link whilst PPP 1 is active

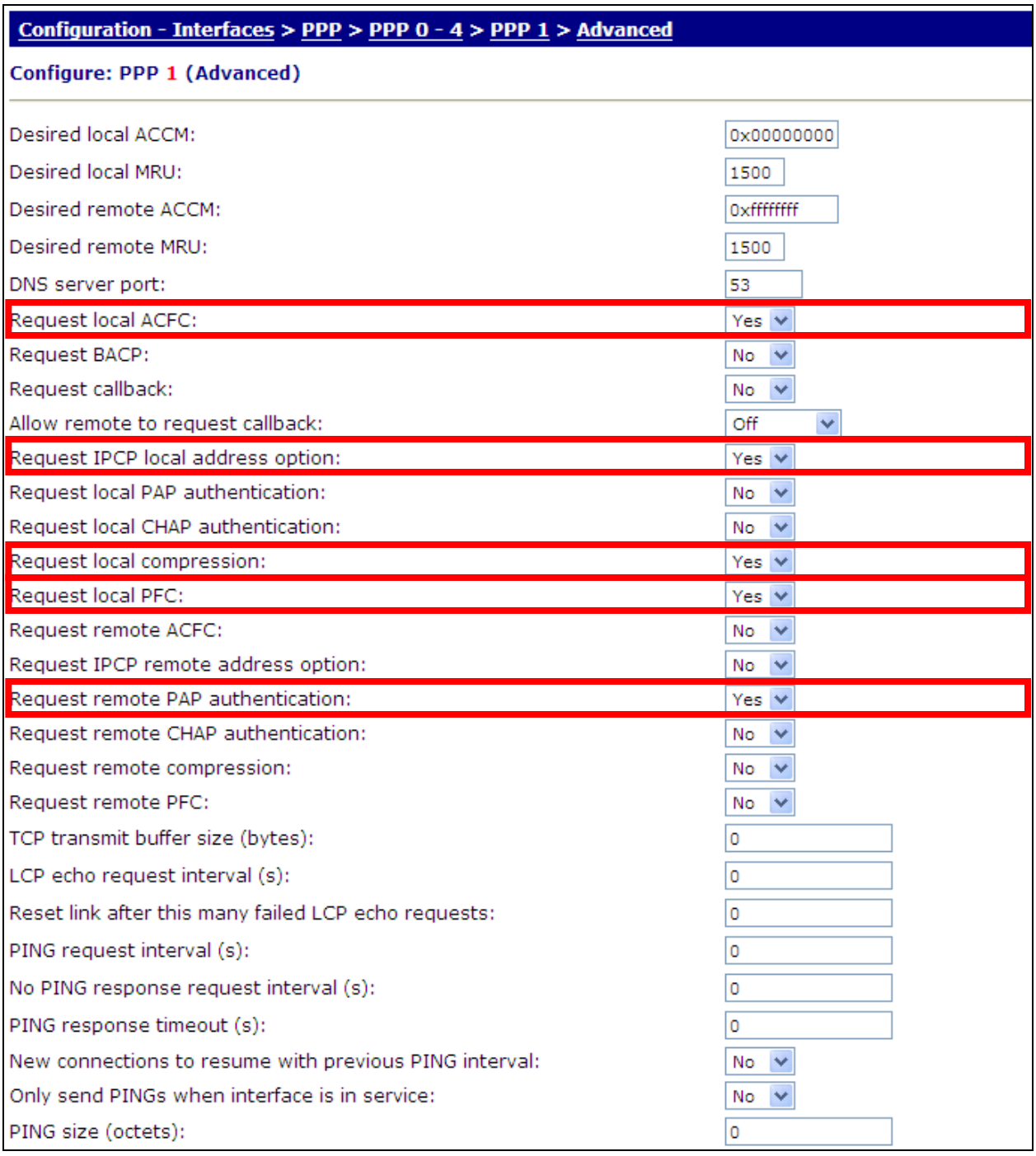

Figure 2-8: PPP 1 - Advanced Configuration (Part 1)

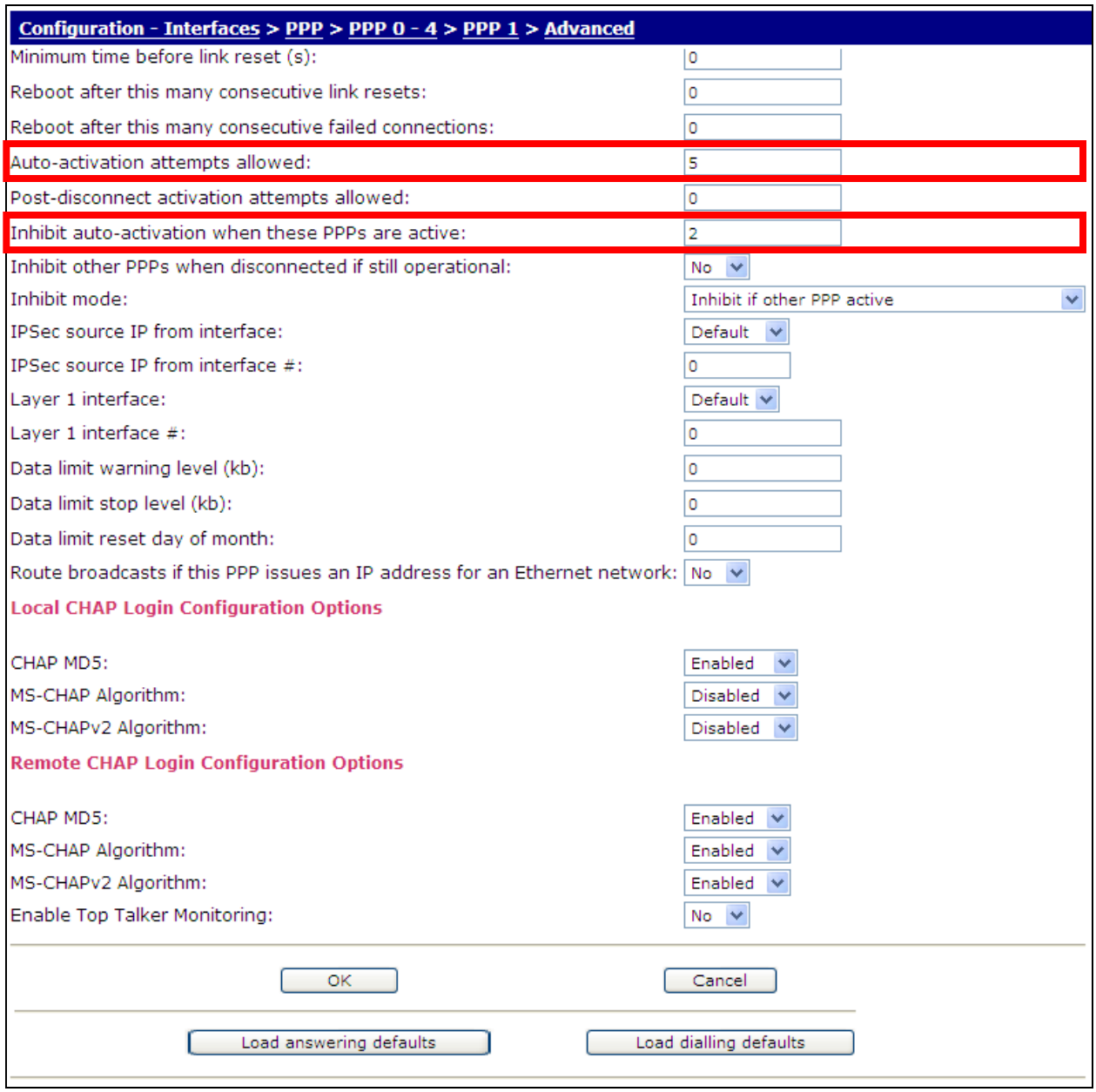

Figure 2-9: PPP 1 - Advanced Configuration (Part 2)

Important Note

The following pages (22 to 24 inclusive) show how to configure PPP 2 Standard for the two different methods of failover to SIM 2 mentioned in the "Outline" section 1.1.

Page 24 (section 2.7) onwards is required for both methods.

2.5 PPP 2 Interface Configuration for SIM 2 –Method 1

Method 1 ONLY: Fall back to temporary W-WAN connection on SIM 2. After a specified amount of link up-time or inactivity the Transport will attempt to raise the W-WAN connection on SIM 1.

2.5.1 PPP 2 Standard Parameter Configuration

The configuration page is located under **Configuration - Interfaces > PPP > PPP 0 - 4 > PPP 2 > Standard.**

The parameters are basically the same, with a few exceptions. The following table shows all parameters, and the figure shows only the different settings. To see the other settings, refer to Figures 2-5 through 2-7.

Table 2-7: PPP 1 Standard Parameters

Parameter	Setting	Description
Dial-out number:	*98*1#	Dial string to attach to the GSM network
Use W-WAN/external modem:	Any W-WAN channel	Configures the router to use any W-WAN channel
W-WAN SIM:	**SIM 2**	**Configures the W-WAN link on PPP 2 to use SIM card 2**
Username:	Username	Username provided by the mobile carrier
Password:		Password provided by the mobile carrier
Confirm Password:		Same as above
Always On Mode:	ON	Auto activates PPP 2 and keeps the link up
Inactivity Timeout (s):	**120**	**Causes the Transport to drop this W-WAN link after a specified period of inactivity on the link (variable)**
Maximum link up-time (s):	**1200**	**Caused the Transport to drop this W-WAN link after it has been active for a specified period of time (variable)**
Firewall:	ON	Activates the Firewall/Stateful Route Inspection on PPP 2
Local IP Address:	0.0.0.0	Requests an IP address from the mobile carrier

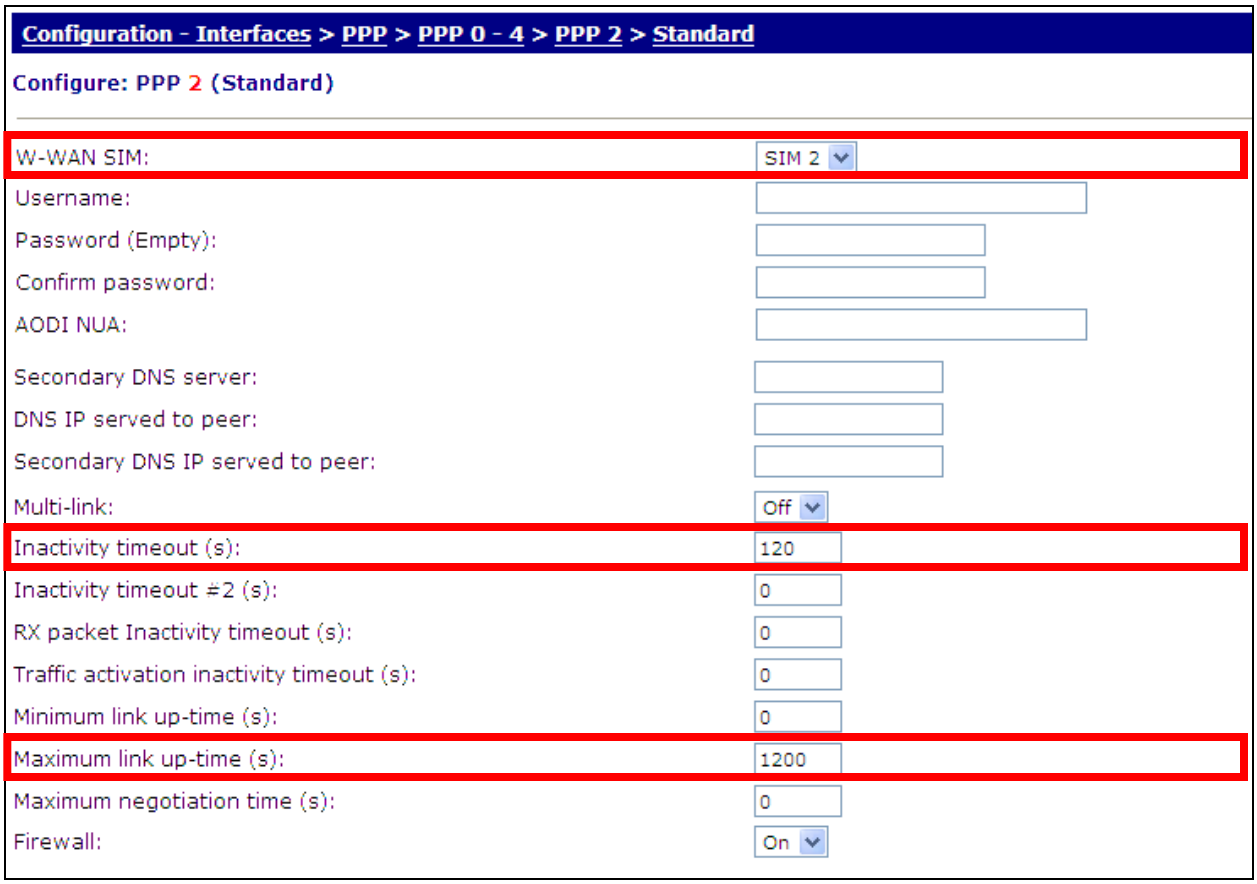

Figure 2-10: PPP 2 Standard Configuration

2.6 PPP 2 Interface Configuration for SIM 2 –Method 2

Method 2 ONLY: Fall back to permanent W-WAN connection on SIM 2. The Transport will continue to use SIM 2 until such a time when a problem is detected on that link. The Transport will then attempt to raise the W-WAN connection on SIM 1.

2.6.1 PPP 2 Standard Parameter Configuration

The configuration page is located under **Configuration - Interfaces > PPP > PPP 0 - 4 > PPP 2 > Standard.**

The parameters are the same as PPP 1's configuration as listed below in Table 2-8, with the exception of the W-WAN SIM being set to SIM 2.

Table 2-8: PPP 1 Standard Parameters

Parameter	Setting	Description
Dial-out number:	*98*1#	Dial string to attach to the GSM network
Use W-WAN/external modem:	Any W-WAN channel	Configures the router to use any W-WAN channel
W-WAN SIM:	**SIM 2**	**Configures the W-WAN link on PPP 2 to use SIM**

		card 2
Username:	Username	Username provided by the mobile carrier
Password:		Password provided by the mobile carrier
Confirm Password:		Same as above
Always On Mode:	ON	Auto activates PPP 2 and keeps the link up
Firewall:	ON	Activates the Firewall/Stateful Route Inspection on PPP 2
Local IP Address:	0.0.0.0	Requests an IP address from the mobile carrier

2.7 PPP 2 Advanced Parameter Configuration for SIM 2 – Methods 1 & 2

The following is required for both methods:

2.7.1 PPP 2 Advanced Settings

The configuration is the same as PPP 1's advanced settings (e.g., Request local ACFC, Request IPCP local address option, etc.) and should be referred to when configuring PPP 2 Advanced. The difference is in the **Inhibit auto-activation when these PPPs are active** setting, which is set to "1" as shown in Table 2-9.

Table 2-9: PPP 1 Standard Parameters

Parameter	Setting	Description
Auto-activation attempts allowed:	5	Allows PPP 2 a total of 5 activation attempts before the PPP 1 link can override it
Inhibit auto-activation when these PPPs are active:	1	Configures PPP 2 to inhibit PPP 1 from raising its W-WAN link whilst PPP 2 is active

2.8 Stateful Route Inspection

SRI or Stateful Route Inspection is a passive error detection technique. All Transport routers come with a powerful stateful firewall. In addition to the blocking of un-authorized traffic, the firewall can be used to monitor traffic on a particular interface and flag routes as OOS (out of service) or even deactivate PPP links. In the context of W-WAN problem detection, the firewall can be used to deactivate a PPP link to the W-WAN network and cause it to re-negotiate, thus potentially fixing the problem detected. For the purpose of this application note all traffic shall be allowed to pass through the firewall unhindered.

This configuration will cause the Transport to send the data through a standby interface, which will be a W-WAN link using a second SIM card. Both SIM cards can be registered with the same or different GSM providers.

To detect a problem on a current W-WAN link, the Transport is configured to monitor traffic to a frequently used host over that connection. If the connection to that host fails (e.g. suffers packet loss) the Transport will drop the current W-WAN link and raise another link using the second SIM card.

2.9 Configuring the Firewall

The firewall requires three rules.

1. Monitor traffic to the host on PPP 1
2. Monitor traffic to the host on PPP 2
3. Pass all other traffic (This is due to the firewall's default action of blocking all traffic unless specified)

The firewall can be configured in one of two ways.

1. Write the rules directly using the Transport web user interface by browsing to **Configuration - Security > FireWall**
2. Create a text file with the rules called "fw.txt" and upload it to the Transport via FTP.

This document shows the first method. For instructions on the second method, refer to the **Digi Transport User Guide**.

2.9.1 Firewall Stateful Route Inspection Rules

The rules are as follows

Rule 1. pass out break end on ppp 1 proto tcp from any to <Host IP Address> flags s!a inspect-state oos 1 t=5 c=2 d=2

Rule 2. pass out break end on ppp 2 proto tcp from any to <Host IP Address> flags s!a inspect-state oos 1 t=5 c=2 d=2

Rule 3. Pass

- The first rule monitors tcp traffic on PPP 1 (when active) to the host IP address.
- The second rule monitors tcp traffic on PPP 2 (when active) to the host IP address.
- The third rule allows all other traffic to pass unhindered

Figure 2-11 shows the WebUI version of the configuration. The IP address is an example public IP.

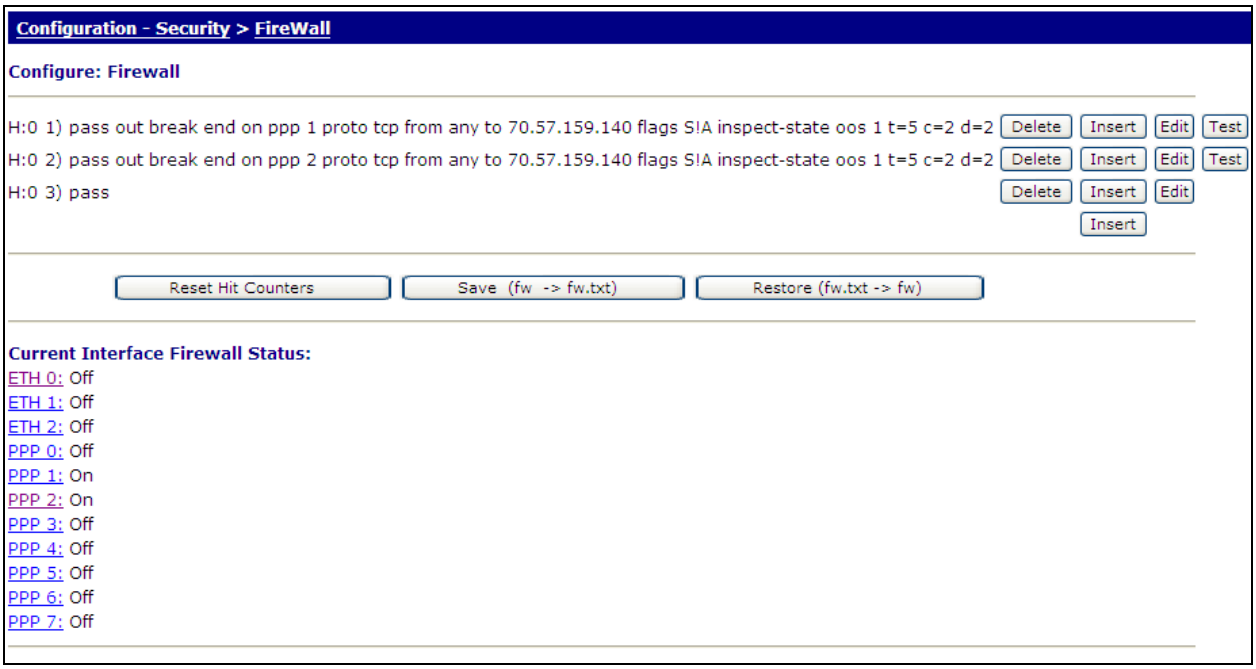

Figure 2-11: Firewall Rules

2.9.2 Inspect-State with Out of Service Option

This option allows the stateful inspect engine to mark as ***out of service*** any routes associated with the specified interface.

oos 1 marks the route out of service for 1 second, enabling the second default route to come in to service.

t=5 specifies the length of time in seconds the unit will wait for a TCP connection to the host to be successful.

c=2 specifies the number of times the rule must expire before the route is marked as out of service, meaning two TCP connections in a row to the host IP address will have to fail.*

d=2 specifies the number of times the rule must expire before the PPP interface is deactivated, meaning two TCP connections in a row to the host IP address will have to fail.*

The rule will also expire (triggering interface deactivation and SIM switching) if 10 TCP retransmit packets in a row are seen to leave the PPP interface with no reply received.

Note: **c=n and **d=n** should be the same value*

3 STATUS AND TESTING

The Status menu of the Transport's web interface is a useful tool for giving the user a definitive view of the router's current state. The Event Log is also an essential tool when testing the failover process. The status is found by browsing to **Diagnostics–Status**, and then choosing the particular interface such as **Mobile**, **PPP**, etc.

3.1 Status

3.1.1 Status: Mobile

Figure 3-1 is the status of the mobile/W-WAN module.

Diagnostics - Status > Mobile

Results of Last Module Status Poll:
Outcome: Got modem status OK:
Time: 9 Jun 2009 16:30:07

SIM status	READY
Signal strength	-91 dBm
Manufacturer	Sierra Wireless, Inc.
Model	MC8775
IMEI	352678014991092
IMSI	310410199340535
Firmware	H1_1_9_3MCAP C:/WS/FW/H1_1_9_3MCAP/MSM6280/SRC 2007/12/12 11:49:21
GPRS Attachment Status	Attached
GPRS Registration	Registered, home network
GSM Registration	Registered, home network lac:B3AD ci:9D2D
Network	0,0,"",2
Radio Access Technology	UMTS
Network Technology	HSDPA

Figure 3-1: Mobile Status

3.2 Status: PPP

Figure 3-2 is the status of PPP 1. PPP 2 would be inactive at this point, as PPP 1 is associated with the higher priority default route.

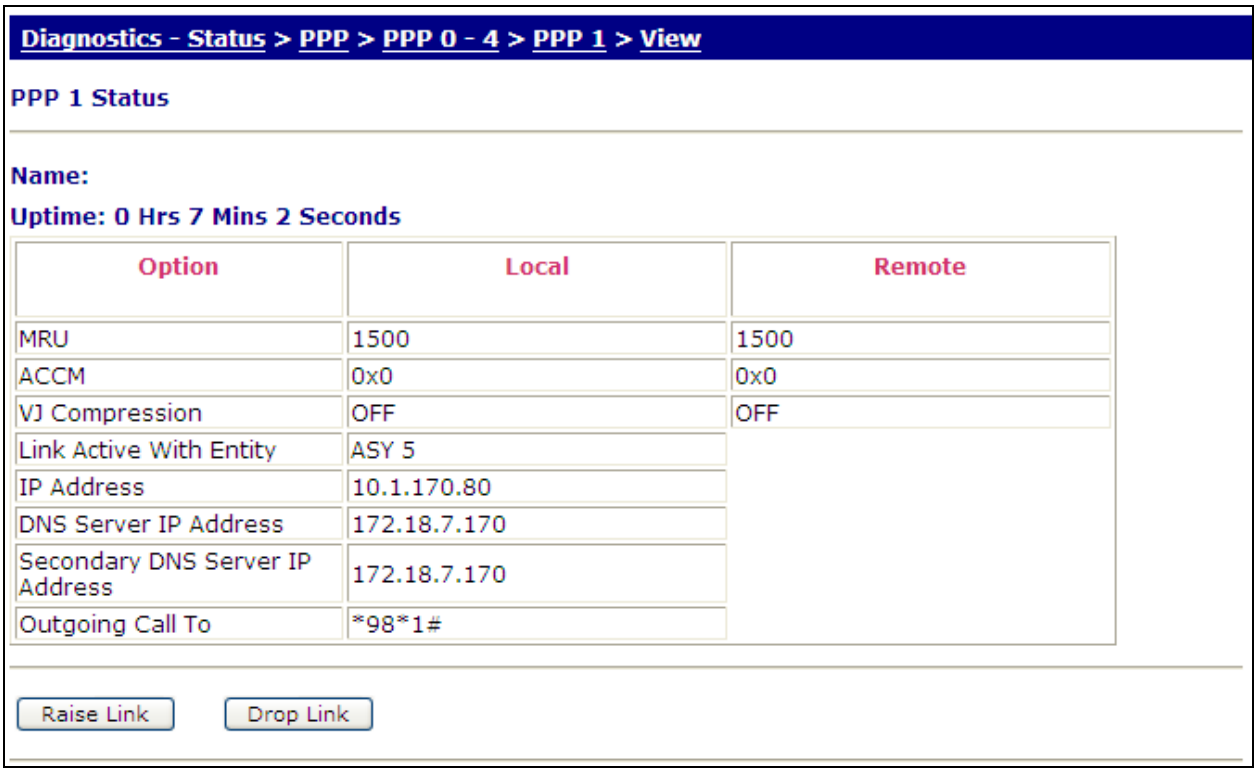

Figure 3-2: PPP 1 Status

3.3 Testing

There were two methods used to test the failover process:

3.3.1 Test 1: The W-WAN link is Unable to Activate

This test is performed by removing the antenna, causing the signal strength to drop too low to allow a connection. Without the antenna, the Transport should be unable to raise a link.

The following figure shows the events in the Event Log as the router fails over from SIM 1 to SIM 2. Note: The Event Log displays the most recent entry on top, so this should be read from the bottom of the figure.

NOTE: The log refers to "GPRS link", but is referring to GSM.

```
16:56:36, 09 Jun 2009,GPRS link failed -> power cycle,New SIM
16:56:36, 09 Jun 2009,Modem disconnected on asy 5,23
16:56:36, 09 Jun 2009,GPRS SIM 2 present
16:56:36, 09 Jun 2009,GPRS using SIM 2 (present)
16:56:35, 09 Jun 2009,Modem disconnected on asy 5,Normal Breakdown
16:56:33, 09 Jun 2009,Default Route 0 Out Of Service,Activation
16:56:33, 09 Jun 2009,PPP 1 Out Of Service,Activation
16:56:33, 09 Jun 2009,PPP 1 down,Rebooting
```

Figure 3-3: Test 1 Event Log

These entries show PPP 1 being take out of service and the switch to SIM 2. Because the antenna is not connected, SIM 2 will not be able to connect either.

3.3.2 Test 2: TCP Connection Fails over W-WAN

This test can be accomplished two ways:

1. Disconnect the host specified in the firewall rule
2. Change the host IP address to a non-existent address

For this Application Note, the second method was used.

The PPP 1 rule was changed from:

pass out break end on ppp 1 proto tcp from any to 70.57.159.140 flags S!A inspect-state oos 1 t=5 c=2 d=2

To:

pass out break end on ppp 1 proto tcp from any to 172.16.1.1 flags S!A inspect-state oos 1 t=5 c=2 d=2

To activate the failure of TCP packets to pass over PPP 1, a web browser was used, pointing to the host address ***172.16.1.1***.

To verify this test, both the Event Log and the firewall counters were used. Prior to trying to access 172.16.1.1 via HTTP, the counters were the following:

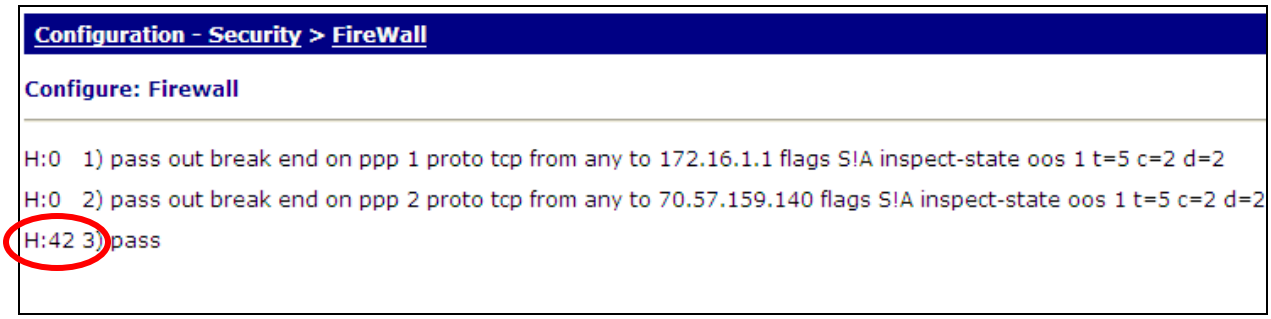

Figure 3-4: Firewall Counters Prior to Passing TCP Traffic Over PPP 1

Notice only rule #3 has any traffic.

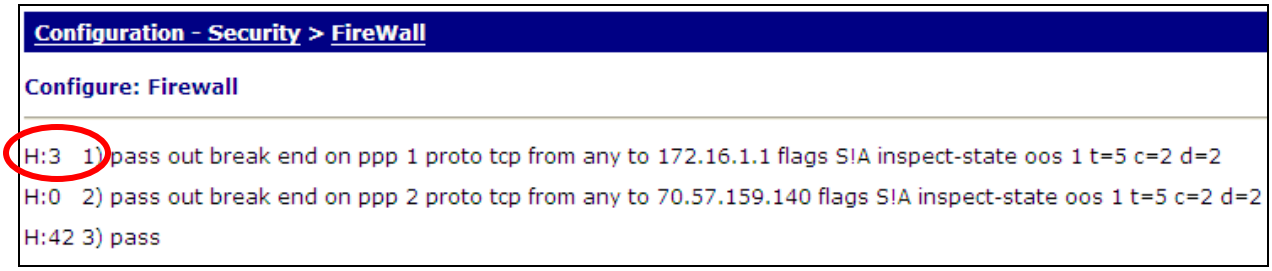

Figure 3-5: Firewall Counters After to Passing TCP Traffic Over PPP 1

Once an HTTP connection to 172.16.1.1 was attempted, the firewall shows three packets were sent out PPP 1.

The Event Log shows the process by which the firewall takes PPP 1 out of service and brings up PPP 2:

```
17:42:38, 09 Jun 2009,PPP 2 up
17:42:35, 09 Jun 2009,PPP 2 Start IPCP
17:42:35, 09 Jun 2009,PPP 2 Start AUTHENTICATE
17:42:35, 09 Jun 2009,PPP 2 Start LCP
17:42:35, 09 Jun 2009,PPP 2 Start
17:42:35, 09 Jun 2009,Modem connected on asy 5
17:42:34, 09 Jun 2009,Modem dialing on asy 5 #:*98*1#
17:42:28, 09 Jun 2009,GSM Registration On
17:42:28, 09 Jun 2009,GPRS Registration On
17:42:28, 09 Jun 2009,GPRS Attachment On
17:42:24, 09 Jun 2009,PPP 2 down,LL disconnect
17:42:21, 09 Jun 2009,GPRS Attachment Off
17:42:14, 09 Jun 2009,PPP 2 down,LL disconnect
17:42:14, 09 Jun 2009,Modem disconnected on asy 5,18
17:42:13, 09 Jun 2009,Modem dialing on asy 5 #:*98*1#
17:41:52, 09 Jun 2009,GPRS link failed -> power cycle,New SIM
17:41:52, 09 Jun 2009,GPRS SIM 2 present
17:41:52, 09 Jun 2009,GPRS using SIM 2 (present)
17:41:50, 09 Jun 2009,Modem disconnected on asy 5,Normal Breakdown
17:41:48, 09 Jun 2009,PPP 1 down,Firewall Request
17:41:48, 09 Jun 2009,Default Route 0 Out Of Service,Firewall
17:41:48, 09 Jun 2009,PPP 1 Out Of Service,Firewall
```

Figure 3-6: Test 2 Event Log