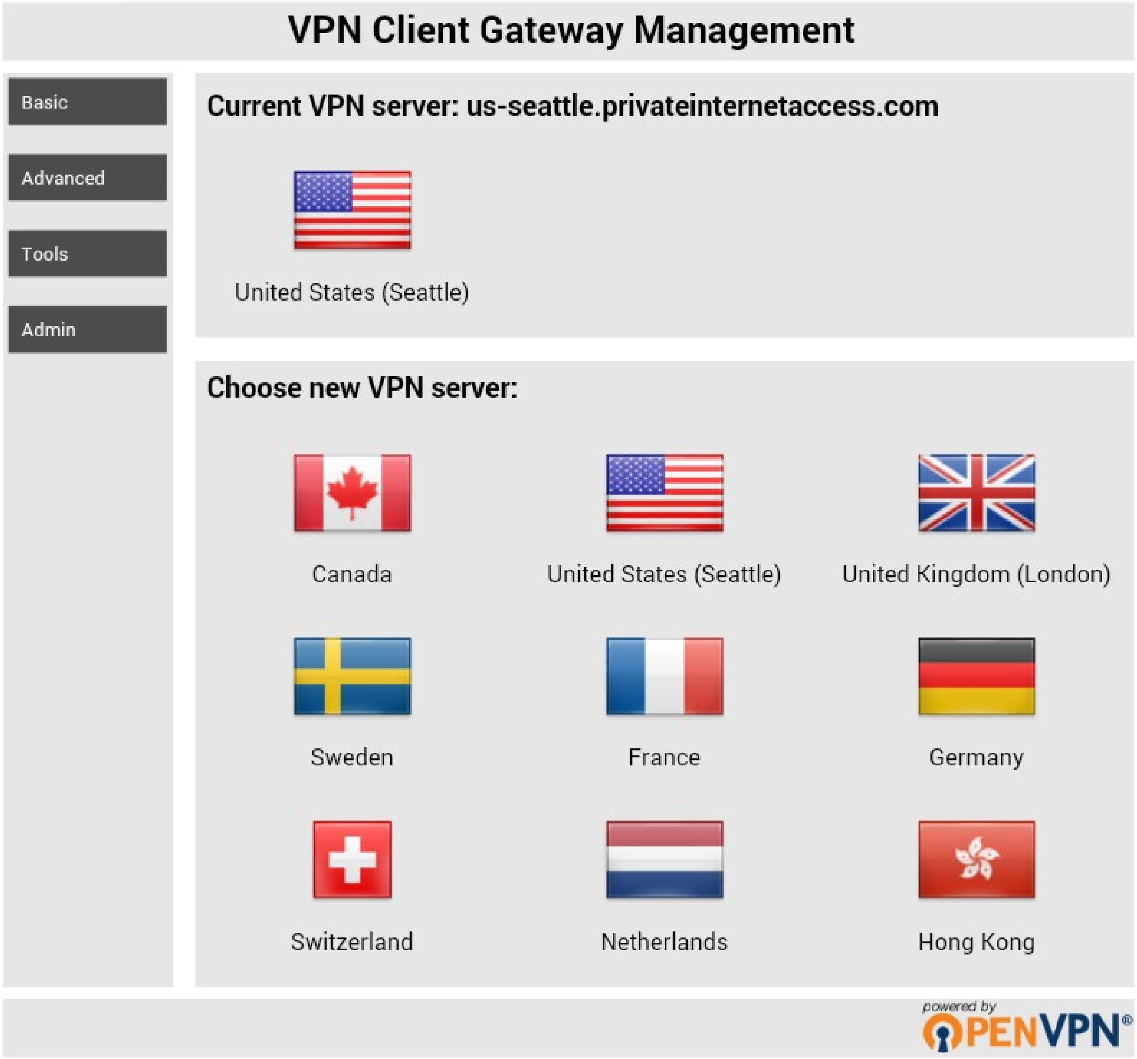
Pi-Powered VPN Client Gateway

with Web based Management Interface

Installation and Configuration Guide

v1.1



VPN Client Gateway Management

Current VPN server: us-seattle.privateinternetaccess.com

United States (Seattle)

Choose new VPN server:

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Pi-Powered VPN Gateway Setup

Introduction

Most VPN service providers offer several servers to connect to around the world. When I first started using a VPN, I configured OpenVPN on my main home network router. To change which VPN server I was connecting to, I'd edit the OpenVPN server setting on the router admin page and restart the service.

To simplify the process of switching servers, I developed a set of web pages and scripts to allow me to change the VPN server just by opening a web page and clicking on a country flag. This solution worked well, but as it was implemented using optware packages on a router running Tomato firmware, it wasn't a very portable solution; anyone who wanted this functionality would have to purchase a router that supports open source firmware. After a recent router upgrade I decided to port the solution to the Raspberry Pi which offers a much better development environment and much lower cost than a router. The new version is easy to set up and has an improved user interface; I can set it up for friends and family who may not have much technical knowledge.

Using this guide and the associated files, you can set up your own VPN client gateway running on a Raspberry Pi.

*Note: to date, this solution has only been tested with the Private Internet Access VPN provider. It could be modified to work with other providers supporting openvpn service, but that is beyond the scope of this guide.

Requirements

- Raspberry Pi B or B+
- Private Internet Access VPN account
- 8GB (suggested minimum) SD card
- Raspbian operating system image

Part 1: Install the operating system

Prepare the SD card

The Raspberry Pi expects a boot loader and operating system on the SD card. In order to use the Pi, you must first install the operating system. For this implementation we’ll use Raspbian (a Debian build optimized for the Pi hardware). Download the Raspbian image; links are provided at the following website:

http://www.raspberrypi.org/downloads

Now we’ll write the disk image to the SD card. There are several tools that can be used to do this, e.g. flashnull and Win32DiskImager for Windows. This guide covers using the Linux **dd** utility. Care must be taken when using **dd** as it will overwrite any data on the target disk. You could potentially wipe out the data on your PC's hard drive. For additional guides on preparing SD cards for the Pi, visit the following web page:

http://www.raspberrypi.org/documentation/installation/installing-images/

*Note: the following operations will overwrite any data stored on the SD card.

First, find the disk name of the SD card on your PC:

1. run the fdisk command. Observe the disk names displayed, e.g. /dev/sda, /dev/sdb, /dev/sdc etc.:

   ```
   sudo fdisk -l
   ```

2. insert the SD card in your PC flash reader/writer, and run the fdisk command again. The SD card will now appear with a disk name, e.g. /dev/sdd

3. Unmount the SD card if needed (it may have been auto-mounted). Example:

   ```
   umount /dev/sdd1 /dev/sdd2
   ```

Now write the Raspbian image to the SD card:

```
sudo dd bs=4M if=2015-02-16-raspbian-wheezy.img of=/dev/sdd
```

If the write fails, try using a 1M block size. This will take significantly longer:

```
sudo dd bs=1M if=2015-02-16-raspbian-wheezy.img of=/dev/sdd
```

This operation will take several minutes to complete.

Perform initial setup

Now that the SD card has been prepared, we'll boot up the Pi and perform the initial OS configuration:

1. connect the HDMI cable, Ethernet cable, and USB keyboard to the Pi.
2. insert the SD card into the slot on the Pi.
3. connect the 5v power supply.

*Note: the HDMI cable must be connected *before* booting the Pi, otherwise the display will remain blank until the next reboot.

The Pi will boot and then automatically run the Raspbian setup utility. Perform the following actions:

- Expand filesystem
- Change user password
- Enable boot to command line
- Advanced Settings
    - A2 - set hostname
    - A3 - Memory split (leave at default 64)
    - A4 - enable SSH

Select Finish -> Reboot to complete the initial configuration and reboot the Pi.

Configure network

At the login prompt, log in using the username ‘pi’ and the password you entered in the setup utility. Run ifconfig to view the Pi's IP address:

```
ifconfig eth0
```

You can now log in to your Pi via ssh from your desktop PC, e.g.:

```
ssh -l pi 10.1.2.50
```

Assign a static IP address

Edit the file /etc/network/interfaces:

```
sudo nano /etc/network/interfaces
```

Here is an example /etc/network/interfaces with static IP:

```
auto lo

iface lo inet loopback
iface eth0 inet static
address 10.1.2.50
netmask 255.255.255.0
network 10.1.2.0
broadcast 10.1.2.255
gateway 10.1.2.1

allow-hotplug wlan0
iface wlan0 inet manual
wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf
iface default inet dhcp
```

Modify the settings to match your network.

Modify DNS settings

Edit the file /etc/resolv.conf. Set the nameservers to the loopback address and 8.8.8.8 (google's DNS server). We'll install the dnsmasq DNS forward in the next section of this guide.

```
sudo nano /etc/resolv.conf
```

The file should look like this:

```
nameserver 127.0.0.1
nameserver 8.8.8.8
```

Reboot the Pi:

```
sudo reboot
```

After the Pi has rebooted, verify that the static IP address is being used.

*Note: remember to reserve the Pi's IP address in your home network router to prevent conflicts.

Update Raspbian

Run the following commands to update the Raspbian OS and supporting software to the latest release:

```
sudo apt-get update
```

```
sudo apt-get upgrade
```

The upgrade operation will take several minutes.

Part 2: Install and configure supporting services

Now that the base OS is installed, we will install and configure the supporting services needed for this project. These services include a DNS forwarder, openvpn, and logrotate.

Install the DNS forwarder

The DNS forwarder will accept DNS requests from clients and forward them to real name servers (e.g. Google's 8.8.8.8). This will prevent DNS leaks when clients are using the Pi as a router/gateway:

```
sudo apt-get install dnsmasq
```

Edit /etc/dnsmasq.conf. Uncomment the domain-needed and bogus-priv settings:

```
sudo nano /etc/dnsmasq.conf
```

Uncomment the domain-needed and bogus-priv settings:

```
# Never forward plain names (without a dot or domain part)
domain-needed
# Never forward addresses in the non-routed address spaces.
bogus-priv
```

Uncomment the ‘interface’ setting, set it to eth0:

```
# If you want dnsmasq to listen for DHCP and DNS requests only on
# specified interfaces (and the loopback) give the name of the
# interface (eg eth0) here.
# Repeat the line for more than one interface.
interface=eth0
```

Install openvpn

For this project, we'll use openvpn to provide virtual private network connections. This guide assumes the use of the Private Internet Access VPN service.

Install openvpn:

```
sudo apt-get install openvpn
```

Download the openvpn configuration files from the Private Internet Access site:

```
wget --no-check-certificate 
https://www.privateinternetaccess.com/openvpn/openvpn.zip
```

Extract the files in the pi user's home folder:

```
unzip openvpn.zip -d /home/pi/openvpn
```

Copy the files Certificate Revocation List and Certificate Authority certificate files to /etc/openvpn:

```
sudo cp openvpn/crl.pem openvpn/ca.crt /etc/openvpn
```

Create the file /etc/openvpn/auth.txt. This file will contain your Private Internet Access login credentials:

```
sudo nano /etc/openvpn/auth.txt
```

Sample contents:

```
p8213552
svpa214S
```

The first line is your user name, the second line is your password.

Create the file /etc/openvpn/server.conf:

```
sudo nano /etc/openvpn/server.conf
```

The file contents should be as follows:

```
client
dev tun0
proto udp
remote us-west.privateinternetaccess.com 1194
resolv-retry infinite
nobind
persist-key
persist-tun
redirect-gateway
ca ca.crt
tls-client
remote-cert-tls server
auth-user-pass auth.txt
comp-lzo
verb 1
reneg-sec 0
crl-verify crl.pem
```

Copy this file to a template (the template will be used by the VPN switcher script):

```
sudo cp /etc/openvpn/server.conf /etc/openvpn/server.conf.template
```

Change ownership of the openvpn configuration files:

```
sudo chown www-data:www-data /etc/openvpn/server.conf 
/etc/openvpn/server.conf.template
```

Now restart the openvpn service:

```
sudo service openvpn restart
```

If you want to follow the connection process in the logs, open another ssh session and execute the following command:

```
sudo tail -f /var/log/syslog
```

Any openvpn connection errors will be shown.

Configure logrotate

To prevent log files from eating up disk space, we'll use logrotate. This service comes pre-installed in the Raspbian build.

Edit the logrotate configuration file:

```
sudo nano /etc/logrotate.conf
```

I would suggest changing the rotate frequency to daily, and the backlogs to 4. Here is what the top section of the file should look like:

```
# see "man logrotate" for details
# rotate log files daily
daily

# keep 4 days worth of backlogs
rotate 4
```

Configure iptables

The firewall used by Raspbian is configured using iptables. It allows or blocks connections based on a set of rules. In order to allow the forwarding, http, and dns connections needed for this project we'll start with a working set of iptables rules. A script to load these rules is included with the files distributed with this document.

Make the script executable:

```
sudo chmod +x ./vpn_client_gw_script.fw
```

Run the script to load the rules:

```
sudo ./vpn_client_gw_script.fw
```

To save these rules so that they reload at boot time, we'll use the iptables-persistent utility.

Install iptables-persistent:

```
sudo apt-get install iptables-persistent
```

During the installation, the program will prompt you to save the current iptables rules (ipV4 and ipV6). Acknowledge both prompts. The iptables rules are now saved and will be re-loaded at boot time.

Refer to Appendix A for further information on the iptables rules.

Enable IP forwarding

```
sudo nano /etc/sysctl.conf
```

Uncomment the following setting:

```
net.ipv4.ip_forward = 1
```

Part 3: Install web server, php, and web page files

In this section of the guide, we'll install and configure the webserver and related services to allow switching between VPN exit points via a web page.

Install the web server

We'll use the lighttpd web server for this project:

```
sudo apt-get install lighttpd
```

In order to run scripts via the web server, we'll use php:

```
sudo apt-get install php5-common php5-cgi php5 php5-curl
```

Enable the php CGI module in lighttpd:

```
sudo lighty-enable-mod fastcgi-php
```

then force lighttpd to reload its configuration:

```
sudo service lighttpd force-reload
```

Change web root folder permissions

We now need to set permissions on the /var/www directory.

Change the directory owner and group:

```
sudo chown www-data:www-data /var/www
```

allow the group to write to the directory:

```
sudo chmod 775 /var/www
```

Add the pi user to the www-data group:

```
sudo usermod -a -G www-data pi
```

Now log out and log back in to pick up the group permissions.

Test web server and php installation

To test the lighttpd and php installation, we'll create a simple php script that displays the php system info:

```
nano /var/www/phpinfo.php
```

The file contents should be as follows:

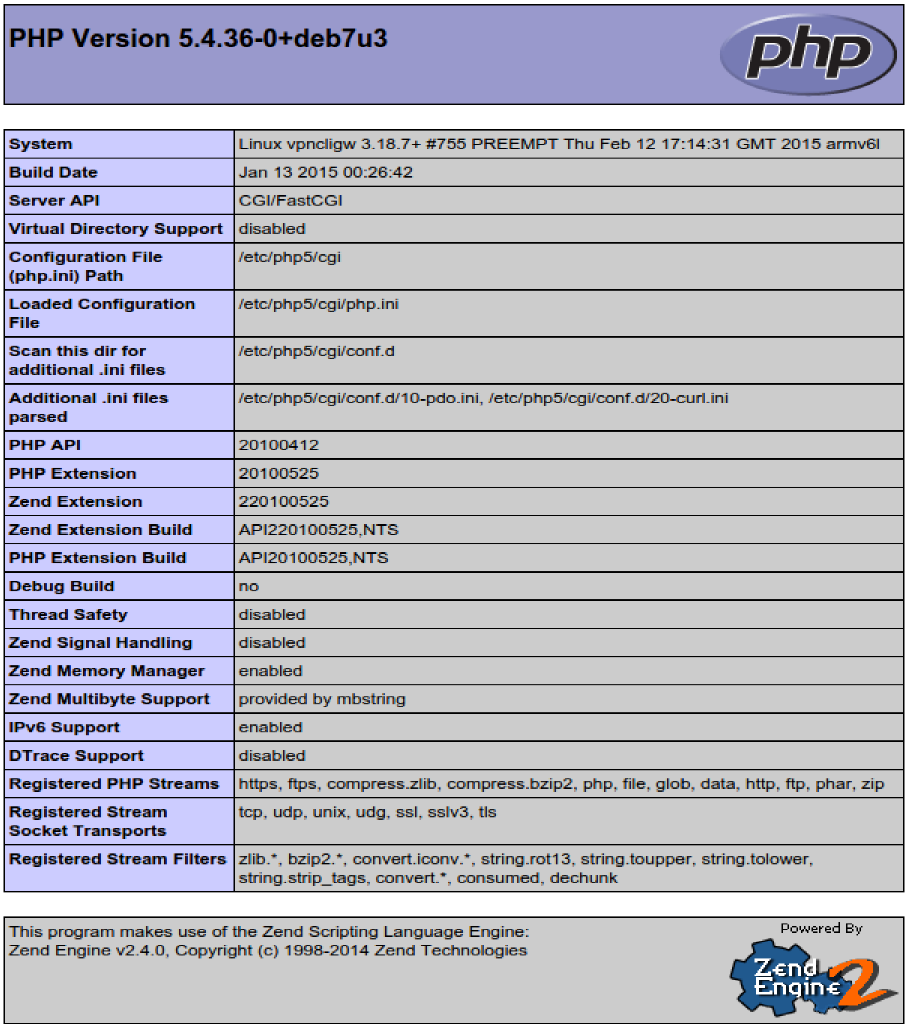
```
<?php
phpinfo();
?>
```

Now we can try to run this script from a web browser on a PC. To call the script, enter the following url:

http://10.1.2.50/phpinfo.php

of course changing the IP address to the address of your Pi.

The web page should update and display the php system info, similar to this:



PHP Version 5.4.36-0+deb7u3

System	Linux vpncligw 3.18.7+ #755 PREEMPT Thu Feb 12 17:14:31 GMT 2015 armv6l
Build Date	Jan 13 2015 00:26:42
Server API	CGI/FastCGI
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/etc/php5/cgi
Loaded Configuration File	/etc/php5/cgi/php.ini
Scan this dir for additional .ini files	/etc/php5/cgi/conf.d
Additional .ini files parsed	/etc/php5/cgi/conf.d/10-pdo.ini, /etc/php5/cgi/conf.d/20-curl.ini
PHP API	20100412
PHP Extension	20100525
Zend Extension	220100525
Zend Extension Build	API220100525,NTS
PHP Extension Build	API20100525,NTS
Debug Build	no
Thread Safety	disabled
Zend Signal Handling	disabled
Zend Memory Manager	enabled
Zend Multibyte Support	provided by mbstring
IPv6 Support	enabled
DTrace Support	disabled
Registered PHP Streams	https, ftps, compress.zlib, compress.bzip2, php, file, glob, data, http, ftp, phar, zip
Registered Stream Socket Transports	tcp, udp, unix, udg, ssl, sslv3, tls
Registered Stream Filters	zlib.*, bzip2.*, convert.iconv.*, string.rot13, string.toupper, string.tolower, string.strip_tags, convert.*, consumed, dechunk

This program makes use of the Zend Scripting Language Engine:
Zend Engine v2.4.0, Copyright (c) 1998-2014 Zend Technologies

Add www-data user permissions

Some functions require the www-data user to be able to run commands as root. We'll grant this permission using the sudoers file.

Edit the file /etc/sudoers.d/sudoers:

```
sudo nano /etc/sudoers.d/sudoers
```

Add the following lines:

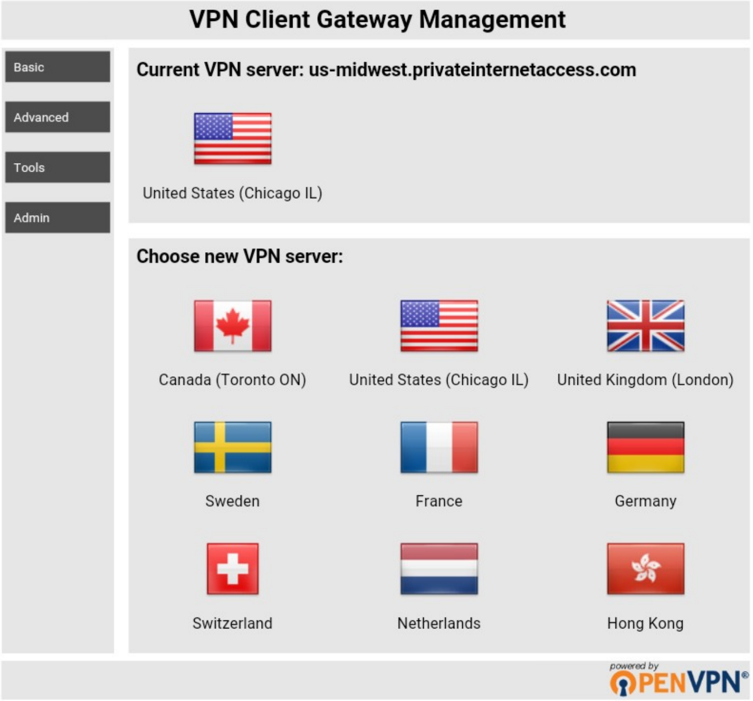
```
www-data ALL=(root) NOPASSWD: /usr/sbin/service
www-data ALL=(root) NOPASSWD: /usr/sbin/update-rc.d
www-data ALL=(root) NOPASSWD: /sbin/shutdown
www-data ALL=(root) NOPASSWD: /sbin/iptables
www-data ALL=(root) NOPASSWD: /sbin/iptables-save
www-data ALL=(root) NOPASSWD: /bin/su
```

Install VPN gateway management web page files

Extract the vpn_client_gw_www.tar.gz file to /var/www:

```
sudo su www-data -c 'tar -xvf vpn_client_gw_www.tar.gz -C /var/www/'
```

That concludes the installation process, you should now be able to access the VPN client gateway management page by accessing the url http://10.1.2.50 (replacing the IP address with the address of your Pi). You should see the following web page:



VPN Client Gateway Management

Current VPN server: us-midwest.privateinternetaccess.com

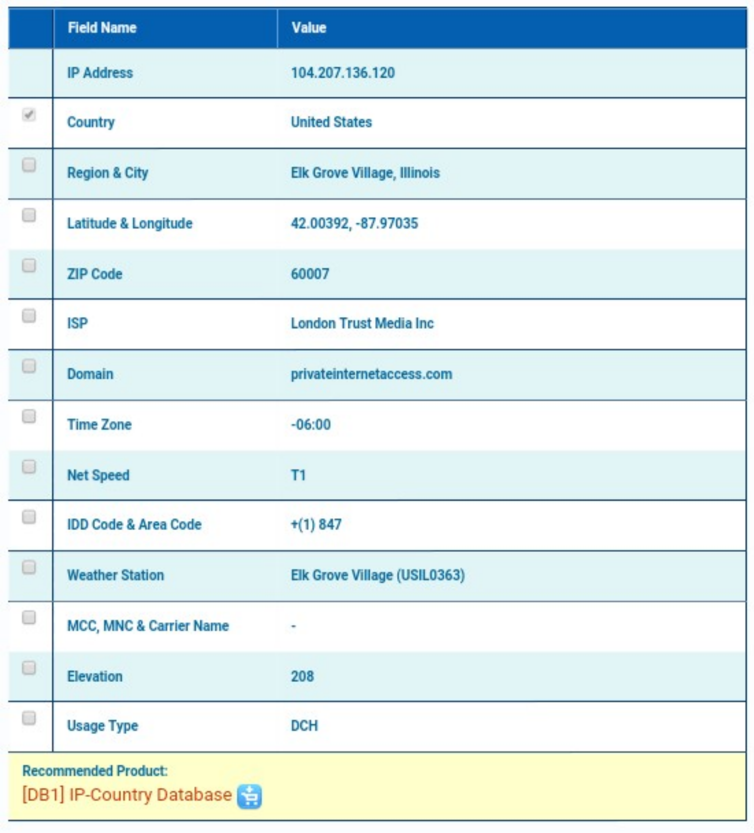
Choose new VPN server:

Part 4: Test the VPN gateway

On a client device (tablet or PC) set the gateway and DNS server to the IP address of the Pi, e.g. 10.1.2.50

Open a browser and access the following URL:
http://ip2location.com

Review the location information table, in particular the Country and Region/City values. They should show that you are connecting from the U.S.. Here is a sample from my setup:



	Field Name	Value
	IP Address	104.207.136.120
☑	Country	United States
□	Region & City	Elk Grove Village, Illinois
□	Latitude & Longitude	42.00392, -87.97035
□	ZIP Code	60007
□	ISP	London Trust Media Inc
□	Domain	privateinternetaccess.com
□	Time Zone	-06:00
□	Net Speed	T1
□	IDD Code & Area Code	+(1) 847
□	Weather Station	Elk Grove Village (USIL0363)
□	MCC, MNC & Carrier Name	-
□	Elevation	208
□	Usage Type	DCH

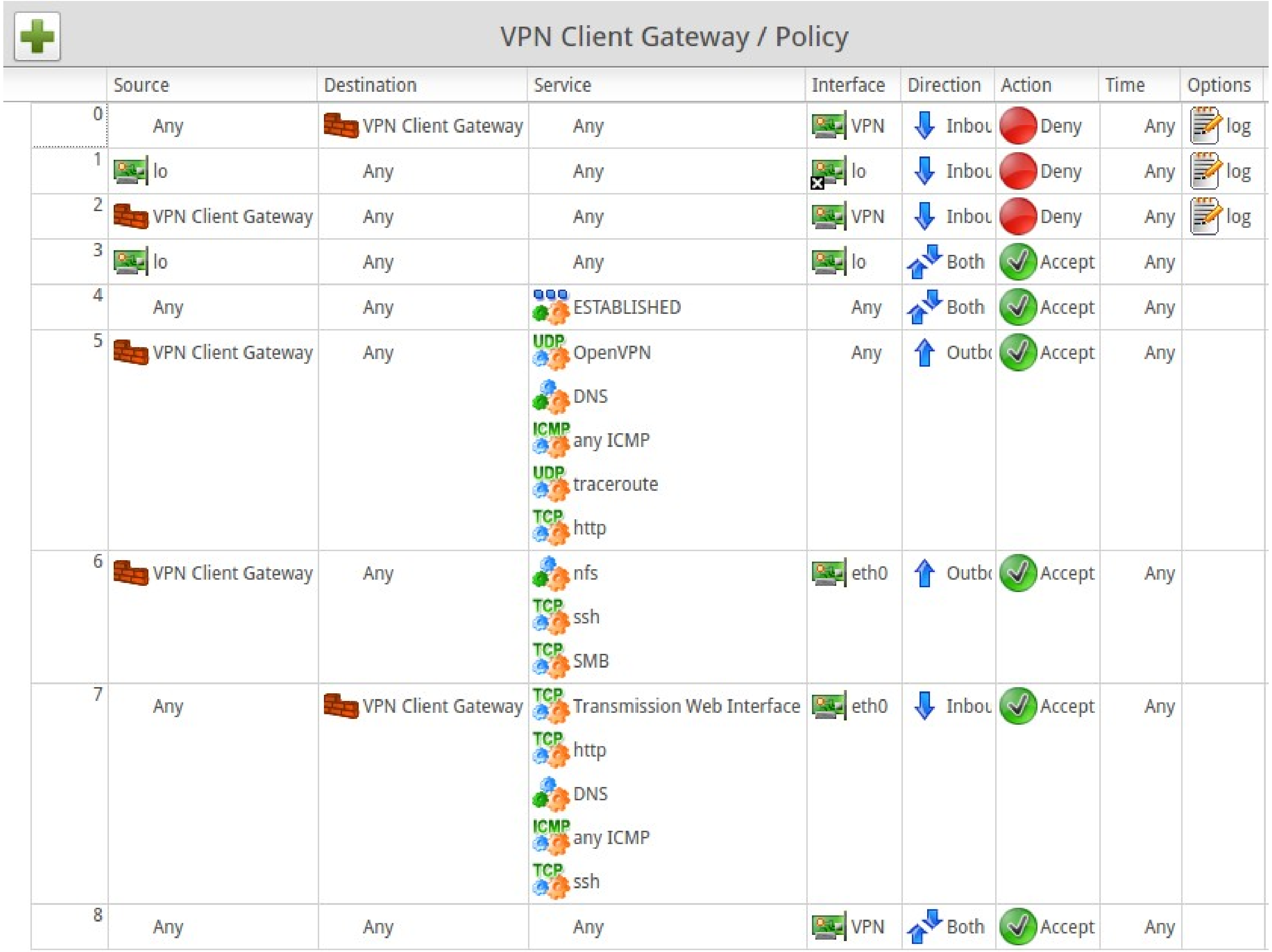
Recommended Product:
[DB1] IP-Country Database

Select a new VPN exit point and then refresh the ip2location.com page. The page should update to display your new IP geo-location.

*Note: it may take several seconds for the vpn client to reconnect to the new location.

Appendix A: Additional iptables info

The set of iptables rules supplied with this document were generated using Firewall Builder. If you need to make changes to the firewall rules, you can use this application to do so. The application can be downloaded from www.fwbuilder.org. The Firewall Builder project file is included in the files distributed with this document (vpn_client_gw.fwb). Here is a screenshot taken from Firewall Builder showing how the rules are organized in a grid type view:



VPN Client Gateway / Policy

	Source	Destination	Service	Interface	Direction	Action	Time	Options
0	Any	VPN Client Gateway	Any	VPN	Inbou	Deny	Any	log
1	lo	Any	Any	lo	Inbou	Deny	Any	log
2	VPN Client Gateway	Any	Any	VPN	Inbou	Deny	Any	log
3	lo	Any	Any	lo	Both	Accept	Any	
4	Any	Any	ESTABLISHED	Any	Both	Accept	Any	
5	VPN Client Gateway	Any	OpenVPN DNS any ICMP traceroute http	Any	Outb	Accept	Any	
6	VPN Client Gateway	Any	nfs ssh SMB	eth0	Outb	Accept	Any	
7	Any	VPN Client Gateway	Transmission Web Interface http DNS any ICMP ssh	eth0	Inbou	Accept	Any	
8	Any	Any	Any	VPN	Both	Accept	Any	

After making your rule changes, you will need to compile the firewall rules and deploy them to the Pi. Once the rules are updated on the Pi, save the new iptables so that they will be loaded at boot time:

```
sudo su -c 'iptables-save > /etc/iptables/rules.v4'
```

Appendix B: Configuring the list of VPN servers

The VPN Gateway Management web page builds the table of available servers dynamically. The list of servers is read from the XML configuration file /var/www/vpnmgmt/vpnservers.xml

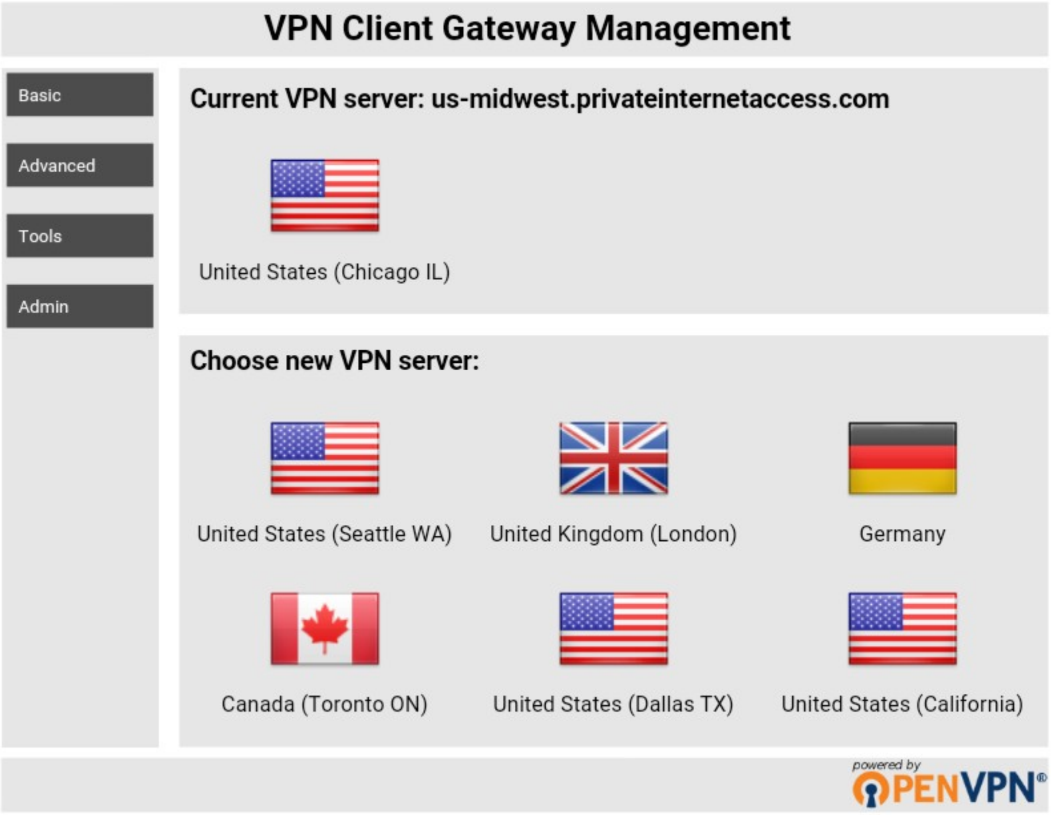
The section <basicvpnservers> contains the list of VPN servers that will be shown on the Basic view of the management web page.

You can change the order in which the servers are displayed by changing their order in this section. You can also remove servers and add additional ones to the basic view. Note that any servers added to this section *must* exist in the <vpnservers> section.

As an example, if we change <basicvpnservers> to this:

```
<basicvpnservers>
        <servername>us-seattle.privateinternetaccess.com</servername>
        <servername>uk-london.privateinternetaccess.com</servername>
        <servername>germany.privateinternetaccess.com</servername>
        <servername>ca-toronto.privateinternetaccess.com</servername>
        <servername>us-texas.privateinternetaccess.com</servername>
        <servername>us-california.privateinternetaccess.com</servername>
</basicvpnservers>
```

the management web page looks like this:



VPN Client Gateway Management

Current VPN server: us-midwest.privateinternetaccess.com

United States (Chicago IL)

Choose new VPN server:

United States (Seattle WA)

United Kingdom (London)

Germany

Canada (Toronto ON)

United States (Dallas TX)

United States (California)

Appendix C: Disabling VPN

In some instances you may wish to disable VPN so that traffic for your devices is routed via your normal ISP internet connection rather than via your VPN connection. There are two ways to accomplish this using the VPN Client Gateway; the first is to use the Disable / Enable VPN button on the Admin view, and the second is to define a special vpnserver entry in the file 'vpnservers.xml'.

Here is an example of the latter method:

I live in Canada. Let's say that when watching Canadian media, I want that traffic streamed via my regular ISP internet connection instead of via VPN. To allow this, I'll define the following vpnserver in vpnservers.xml:

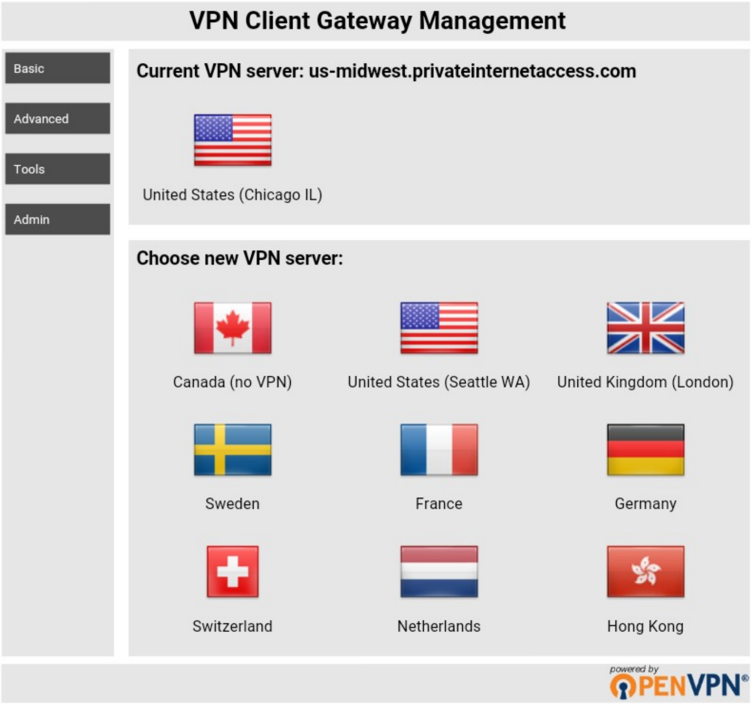
```
<vpnserver>
     <servername>none</servername>
     <countryname>Canada</countryname>
     <regionname>no VPN</regionname>
</vpnserver>
```

*Note that the servername **none** is a special keyword that tells the VPN Client Gateway to stop the VPN service and forward traffic via your normal ISP connection.

Then I'll include this server in the basicvpnservers list:

```
<basicvpnservers>
        <servername>none</servername>
        <servername>us-seattle.privateinternetaccess.com</servername>
        <servername>uk-london.privateinternetaccess.com</servername>
        <servername>sweden.privateinternetaccess.com</servername>
        <servername>france.privateinternetaccess.com</servername>
        <servername>germany.privateinternetaccess.com</servername>
        <servername>swiss.privateinternetaccess.com</servername>
        <servername>nl.privateinternetaccess.com</servername>
        <servername>hk.privateinternetaccess.com</servername>
</basicvpnservers>
```

Now my VPN Gateway management page looks like this:



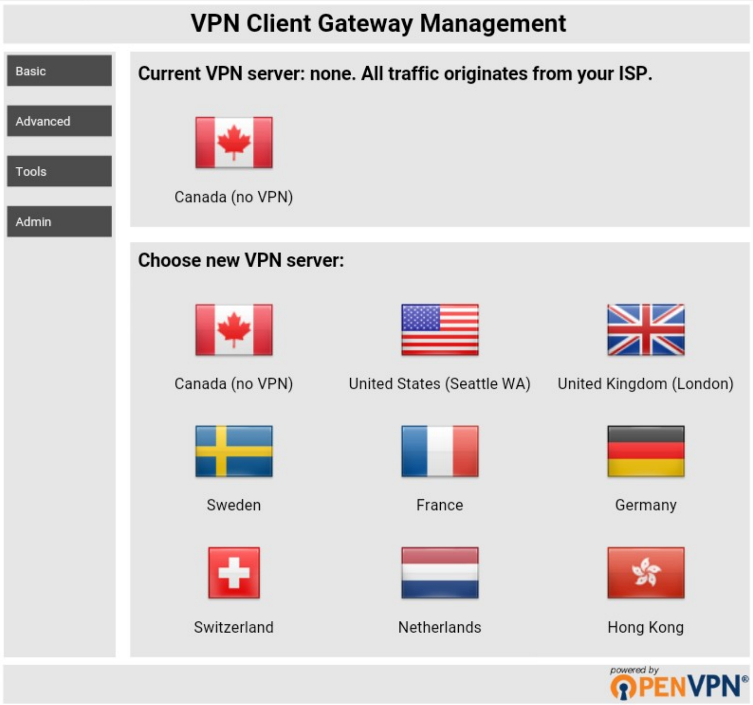
VPN Client Gateway Management

Current VPN server: us-midwest.privateinternetaccess.com

United States (Chicago IL)

Choose new VPN server:

When I click on the Canadian flag, the VPN Client Gateway stops the VPN service and forwards traffic via my normal ISP internet connection:



VPN Client Gateway Management

Current VPN server: none. All traffic originates from your ISP.

Canada (no VPN)

Choose new VPN server:

When a different VPN server is selected, the VPN service will be restarted and traffic will be forwarded through it.