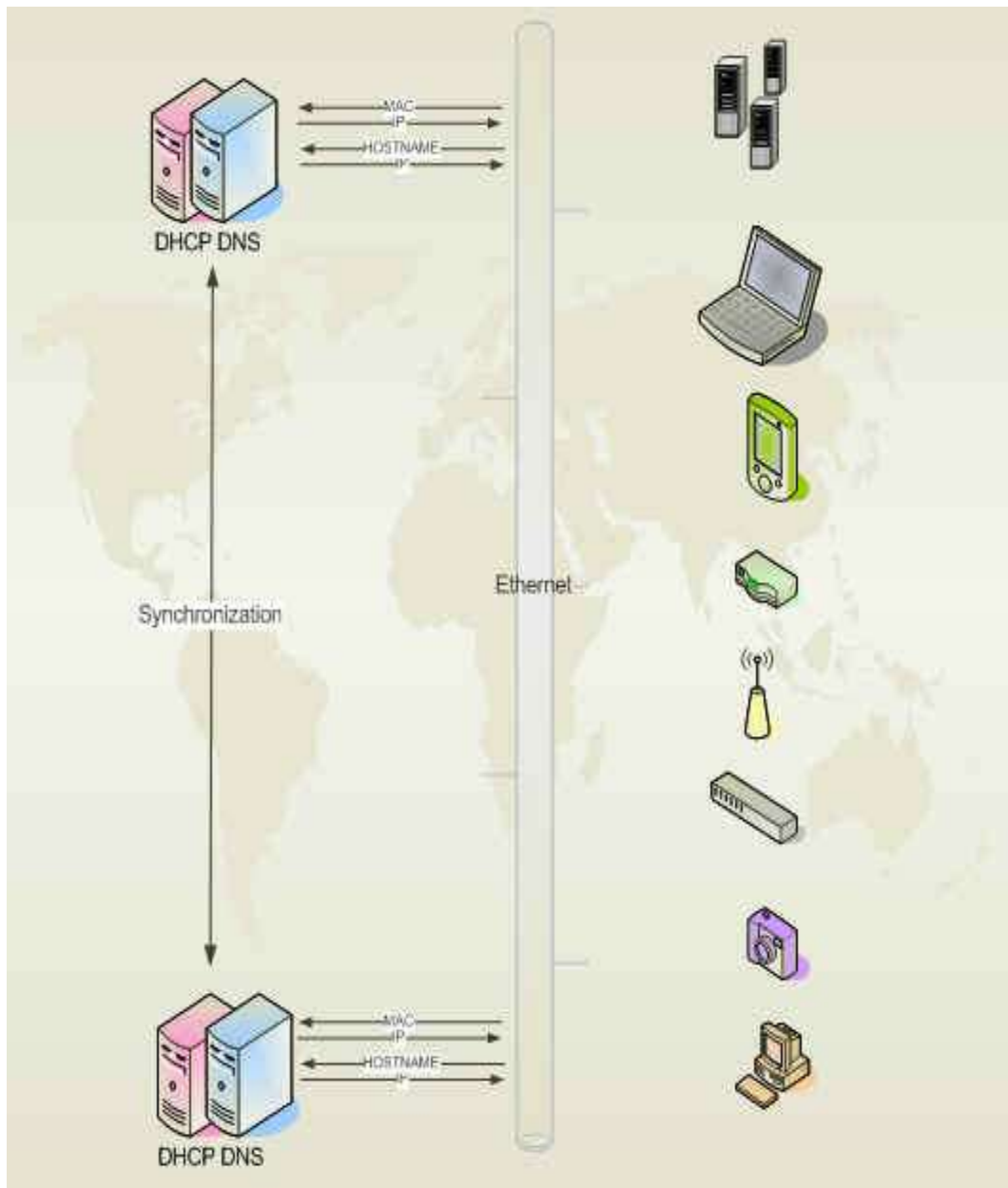


Dual DHCP DNS Server



Installation and Configuration Manual

1 Contents

1	Contents.....	2
2	Preface	5
3	Installation.....	6
3.1	Windows Installation.....	6
3.2	Windows Uninstallation	6
3.3	Windows Compiling	6
3.4	Linux Installation.....	7
3.5	Linux Compiling.....	7
3.6	Linux Daemonizing.....	7
4	Configuration.....	9
4.1	SERVICES.....	9
4.2	LISTEN_ON.....	9
4.3	LOGGING.....	9
4.4	DNS_HOSTS.....	10
4.5	ALIASES.....	10
4.6	WILD_HOSTS.....	11
4.7	DNS_ALLOWED_HOSTS	11
4.8	DOMAIN_NAME.....	11
4.9	MAIL_SERVERS.....	12
4.10	FORWARDING_SERVERS.....	12
4.11	CONDITIONAL_FORWARDERS	12
4.12	ZONE_REPLICATION	13
4.13	TIMINGS.....	14
4.14	RANGE_SET.....	14
4.15	GLOBAL_OPTIONS.....	15
4.16	Static Host Sections.....	16
4.17	HTTP Interface	16
5	Running of Dual Server	18
5.1	Windows.....	18

5.2	Linux	19
6	Process of Allotting Addresses	20
7	Process of Resolving Addresses.....	22
7.1	General	22
7.2	Dual Server Resource Records	22
7.2.1	Records loaded from DualServer.ini files.....	22
7.2.2	Records added by DHCP Service	23
7.2.3	Records replicated from Primary Server	23
7.2.4	Cached Records.....	23
7.3	Dual Server Queries Supported	23
7.4	Forwarding.....	23
7.4.1	Non-Authorized Forwarding	24
7.4.2	Authorized Forwarding.....	24
7.5	Replicated Operation.	24
7.6	Co-Ordination between DHCP and DNS components.....	24
7.7	DHCP Co-Ordination between two instances of Dual Server	24
7.8	DNS Co-Ordination between two instances of Dual Server.	25
7.9	Replication Schemes	25
7.9.1	Dual Server with only DNS Service as Primary and Secondary Server.	25
7.9.2	Dual Server with DNS and DHCP as Primary Server and Dual Server with only DNS as Secondary Server	25
7.9.3	Dual Server with DNS and DHCP as Primary Server and third party DNS server as Secondary Server.	26
7.9.4	Dual Server as secondary server and third party server as primary server.....	26
7.9.5	Dual Server with only DHCP Service as Primary and Secondary Server.	26
7.9.6	Dual Server with DNS and DHCP as Primary Server and Dual Server with DNS and DHCP as Secondary Server	26
7.9.7	Dual Server with only DNS (or third party DNS) as Primary and Dual Server with DHCP as Secondary.....	27
7.9.8	Conditional Forwarding	27
7.9.9	Domain with child Zones	27
8	DHCP OPTIONS	29
8.1	Specifying options and values in Dual DHCP DNS Server	29

8.2	Filtering DHCP Ranges	31
8.2.1	Mac Range Filters	31
8.2.2	Vendor Class and User Class Filters	31
8.2.3	Subnet Selection Filters	32
8.3	List of DHCP Options Names (in Dual DHCP DNS Server)	33
8.4	Dual Server specific DHCP Header Field Options	35
9	Debugging	36
9.1	Windows	36
9.2	Linux	36
10	Other Recommended Software	38
10.1	Open DHCP Server	38
10.2	Open TFTP Server	38

2 Preface

DHCP Server allots the IP addresses to computers, while DNS server resolves them.

You need DHCP Server if you do not want to manually maintain IP Addresses or you have less IP Addresses than number of machines you have, as dynamic DHCP Server will recycle IP Addresses on machines.

DNS Server is needed for resolving hostnames to their IP addresses. Normally your ISP will provide you with DNS Service, which will resolve external names.

Now if you have home/small office network with internal machines, your ISP's DNS Server will not have this list and these machines won't be resolved from each other. You may use your own DNS Server but maintaining IP addresses against the hostnames will be tedious task. Windows do provide slow NBNS protocol to overcome this issue but Linux/Unix machines don't use this. Other solution is to configure Dynamic Updates but configuring it is too complex.

Dual DHCP Server is straight answer to above issues. It is combined DHCP DNS Servers. DNS Server will resolve external names and it would also resolve DHCP Server allotted hosts to their IPs automatically. You can also use this server as DHCP Server only or caching DNS Server only.

The salient features are:

- Either DHCP or DNS or Both Services can be used.
- DHCP hosts automatically added to DNS, If both services used
- DHCP Supports 125 ranges, all options, range specific options
- DNS Supports Zone Transfer and Zone Replication.
- DHCP Supports BOOTP Relay Agents, PXE Boot, BOOTP.
- Dynamically Detects Listening Interfaces, can listen on 125 interfaces
- HTTP Interface for Lease Status.
- Filtering of Ranges by Mac Range, Vendor Class and User Class
- Very easy configuration, no Zone files required.
- Allows Fully Replicated operations for both DHCP and DNS
- Very Low Memory and CPU use
- Can be installed and used by person not having DNS/DHCP Concepts

3 Installation

3.1 Windows Installation

Installation of **DualServer** on Windows is straightforward. Just run the Installer and it installs. Windows Service is automatically created. You can start/stop the Service from Windows Service Control Applet, also setup as **Auto Start** or **Manual Start**.



3.2 Windows Uninstallation

The uninstaller, in Control Panel (Programs), cleanly installs the program and also removes the Windows Service. If you want to remove the windows service but keep the installation run the utility (in Admin Mode) RemoveService.exe from installation directory. You can add it back using utility InstallService.exe from same place.

3.3 Windows Compiling

It is not needed to recompile **Dual Server** on windows version. 64 bit versions can also run this 32 bit executable. If you have 64 bit GCC Compiler, you can do so. The command for compiling is:-

```
g++ -o DualServer.exe DualServer.cpp -lws2_32 -liphlpapi -lws2_32
```

3.4 Linux Installation

Expand the GZ archive to any directory (preferably /opt/dualserver) and change the permission of file dualserverd with `chmod 744 dualserverd`, if needed. Linux Installation is easy too but in Linux, we need to create script files for daemonization. Also recompiling may be needed.

Warning: dualserver (Linux version) has been designed to run only on Linux Operating System and may not run on other operating systems like BDS, Mac and Solaris.

3.5 Linux Compiling

The enclosed dualserver executable file may only run on Linux 64 bit version. For 32 bit Linux system, you can try:-

```
#g++ dualserverd.cpp -odualserverd -lpthread
#g++ dualserverd.cpp -odualserverd -lpthread -lgcc_s
```

You need C++ compiler for Versions 3 onwards, as these versions use STL. If you have only C Compiler, you need to download and use Version 2.1 only.

3.6 Linux Daemonizing

If your Linux flavor supports `chkconfig` command, you can use the enclosed `rc.dualserver` file to add the service. Just create a symbolic link `/etc/init.d/dualserver` to `/opt/dualserver/rc.dualserver` in `init.d` directory and make it executable. Also change the file paths (depending on where you have installed the executive and log file directory) in this file. Then you can use `chkconfig` command to add the daemon:-

```
#ln -s /opt/dualserver/rc.dualserver /etc/init.d/dualserver
#chmod 755 /etc/init.d/dualserver
#chkconfig --add dualserver
#chkconfig dualserver on
```

Last command is for automatic start/stop only. That's all you may need on such Linux flavors.

Some of the Linux flavors like debian support `rcconf` command, which is very similar to `chkconfig` command. Nothing more is required to be done for flavors supporting `chkconfig` or `rcconf` command.

If your flavor doesn't support `chkconfig` or `rcconf` you can manually do following 2 steps:-

```
#ln -s /opt/opendhcp/rc.dualserver /etc/rc.d/dualserver
#chmod 744 /etc/rc.d/dualserver
```

For automatic start Add the following line to `/etc/rc.d/rc.local` file or `/etc/inittab` file or `/etc/rc.d/rc.inet2` file (preferred).

```
# Start the Dual Server daemon:  
if [ -x /etc/rc.d/rc.opendhcp ]; then  
/etc/rc.d/rc.opendhcp start  
fi
```


4 Configuration

The entire configuration for Dual Server is done in file DualServer.ini (or dualserver.in in Linux). You should find and keep this file in your installation directory in Windows. In Linux you can keep this file at any location. Configuration file has many sections. DNS configuration is covered in first few sections and DHCP configuration is covered in last few sections. These sections are described further. **Comments in red are for guiding purpose only and should not be copied in actual DualServer.ini file.** Each section have many entries in the form Name=Value. Any entry starting with punctuation mark is a comment and such entry will be ignored.

4.1 SERVICES

You can use Dual Server as DHCP Server only or DNS Server only or both. **Using both services only brings the star feature alive, means DHCP allotted hosts are automatically added to DNS Service.** If you use both services you don't have to configure the Dynamic Updates.

```
[SERVICES]
DNS #This entry enables DNS Service of Dual Server
DHCP #This entry enables DHCP Service of Dual Server
```

4.2 LISTEN_ON

This section is common to both DHCP Service and DNS Service. This section restricts the server to listen for DHCP and DNS requests on selected interfaces. There may be many interfaces on multi-homed servers. Out of these interfaces, you can still restrict which interface(s) should listen for requests. DualServer only listens on Static Interfaces which means the IP address is fixed and not obtained from another DHCP Server. Any dynamic interfaces specified here will be ignored. If no interface is specified here, Dual Server listens on all Static Interfaces.

```
[LISTEN_ON]
192.168.0.1
192.168.55.23
```

4.3 LOGGING

Logging level should be specified under section [LOGGING]. Logging will be done only if run as Service. LogLevels can be set as **None, Normal** or **All**. It is advisable to keep logging to **Normal**. Normal means errors and DHCP renewal messages. None and All are self-explanatory. Log levels can be separately specified for DNS and DHCP Services.

```
[LOGGING]
DNSLogLevel=Normal #Can be None, Normal or All
DHCPLogLevel=Normal #Can be None, Normal or All
```

4.4 DNS_HOSTS

Section [DNS_HOSTS] is list of all the hostnames, which will be resolved by Dual Server. Each host should be specified with it's IP address. Dual Server loads hosts from here to it's memory and resolves to give IP against the hostname. Also Dual Server will resolve the IP address to it's hostname, which is called reverse lookup. You don't have to make reverse lookup entries, these are automatic. There is no limit to number of entries here. Host here can be bare names (without domain extension) or with domain extension. Bare names assume default domain name specified under [DOMAIN_NAME]. Some names are repeated with different IP, which is Okay, as hosts can have multiple IPs.

```
[DNS_HOSTS]
OracleServer.yahoo.com=192.168.55.43
DNS=192.168.55.1
DNS=192.168.55.2
cpltcaxd02b=192.168.55.2
homehost.external.com=187.178.187.178
strange=192.168.6.11
soho=192.168.0.111
```

You need not specify your hosts in DualServer.ini file, you can also specify in a separate file. You can just make all the above entries in filename of your own choice and specify the just the filename here. Comments are not allowed in this section, when you do this but allowed in file myhostfile.txt. Only one file is allowed here.

```
[DNS_HOSTS]
@myhostfile.txt
```

4.5 ALIASES

You can use alias names to hostnames specified above. For example if you have previously specified the hostname=192.168.4.6 in [DNS_HOSTS] section, you can add alias here as newhost=hostname. Now your DNS query for both hostname and newhost will be resolved to IP 192.168.4.6

```
[ALIASES]
MyHost=HomeHost
DBServer=DB2Server.com
gmail=gmail.google.com
workgroup=www
dns1 = dns
```

4.6 WILD_HOSTS

Wild host resolve names based on wild card match. Wild card char are * and ?. Axfz/Zone queries do not include wild hosts and these are not replicated from Primary to Secondary Server. You need to create WILD_HOSTS entries on both Primary and Secondary Servers. Only 256 wild host entries are allowed in current version 7.40. To increase this number you need to change the line MAX_WILD_HOSTS 256 in DualServer.h and recompile.

```
[WILD_HOSTS]
*.google.com=64.136.20.120
www.*.com=127.0.0.1
*xyz.com*=4.2.2.3
*.hostnotfound.com=0.0.0.0
```

You can give the target IP as 0.0.0.0 if “host not found” response is required. This last example plays a very useful role in blocking some of the external web sites. For example you want to block all google sites, you can make an entry like:

```
[WILD_HOSTS]
*.google.com=0.0.0.0
```

4.7 DNS_ALLOWED_HOSTS

These entries restrict the access to DNS Server. There are two different protocols are used for accessing DNS records, UDP and TCP/IP. UDP is used for hostname and reverse lookup while TCP/IP is used for zone transfer. SOA and NS queries can be done using any protocols. This section allows/restricts UDP queries. Please specify the range of hosts which will be able to query this server. Hosts "queried for" has nothing to do with these ranges. 32 ranges can be specified. You can simply allow **all hosts** by specifying single range 1.0.0.1-255.255.255.254 as second example below:-

```
[DNS_ALLOWED_HOSTS]
192.168.0.1-192.168.255.254
1.0.0.1-255.255.255.254
```

4.8 DOMAIN_NAME

Domain Name specified in this section is the default domain for all the bare hosts and aliases specified under previous sections. Suppose you specify the domain name as mydomain.com then an entry in [DNS_HOSTS] section like www=192.168.55.3 will be treated as www.mydomain.com=192.168.55.3. Just specifying a domain name do not make this server authorized for the domain. To make this server authority for domain, you need to specify both forward zone and reverse zone with = sign.

```
[DOMAIN_NAME]
```

```
workgroup.com
```

```
#Not an Authority
```

Above entry will make the workgroup.com as the default domain for this server but still unfound queries may be forwarded to forwarding servers, if not resolved locally.

```
[DOMAIN_NAME]
```

```
workgroup.com=55.168.192.in-addr.arpa
```

```
#Server is an authority for zones
```

Above entry will make the server an authority for both zones workgroup.com and 55.168.192.in-addr.arpa and any query with above domain names will only be locally resolved and not be forwarded to forwarding servers. Authorized server will also return SOA, NS and AXFR queries.

4.9 MAIL_SERVERS

These are default mail servers for domain. Entries should be in form HOST=Priority. Hosts can be local or external. Up to 5 servers can be specified. Mail Servers will be added as attributes mXRecord in forward zone only. The hostnames below need not be internal.

```
[MAIL_SERVERS]
```

```
MailServer1.com=10
```

```
MailServer2.net=20
```

4.10 FORWARDING_SERVERS

To resolve external hosts, DNS Server needs to forward the query to external DNS Servers and get the answer back. Dual Server do caches the external hosts for a duration which is equal to expiry, as returned in the response from forwarding servers. Up to 125 servers can be specified here. However only the last successful server will be repeatedly used unless it fails (then next and so on). However query will be forwarded to these servers if it do not match with conditional forwarders.

```
[FORWARDING_SERVERS]
```

```
192.168.0.1
```

```
10.10.10.1
```

4.11 CONDITIONAL_FORWARDERS

Dual Server resolves queries either locally if query's domain name extension is local else by forwarding to forwarding DNS Servers above. But Dual Service allows you to forward selected queries to specific DNS Servers, based on matching the last part of DNS Query. Something this is also referred as DNS Proxy. For example you want to forward all queries with domain name mydomain.com to your special DNS Server 192.168.55.45. You can make an entry as:-

```
[CONDITIONAL_FORWARDERS]
mydomain.com=192.168.55.45
55.168.192.in_addr.arpa=192.168.55.45
```

Now queries like a.mydomain.com will be forwarded to 192.168.55.45 but all other external queries still will be forwarded to servers under [FORWARDING_SERVERS]. You can also make entries here for reverse lookup like 34.158.195.in-addr.arpa=192.168.55.45 so that reverse queries can also be forwarded to your special DNS Servers.

4.12 ZONE_REPLICATION

Normally for redundancy, there are two DNS Servers are used one is primary and other secondary. To make sure both DNS Servers have identically information, zone replication scheme is used. All the entries are done on primary server and secondary server automatically replicates entries from primary server. This is done by DNS Protocol's zone transfer functionality. On sending axfr type query, full zone is returned, zone is all entries having same zone extension. Secondary server send axfr query for zone and copies all entries returned by primary server, discarding it's all previous entries. Zone replication is done periodically after lapse of a time called Refresh Time. Make sure the Dual Server(s) actually listen on these interfaces.

```
[ZONE_REPLICATION]
Primary=192.168.55.254 #Primary or Master zone DNS Server
Secondary=192.168.55.23 #Secondary or Replicated zone DNS Server
```

Other than secondary server, some clients may also need to pull full zone or there may be some more servers who replicate or pull full zone. DNS Servers of other vendors can also be specified as AXFRClients. These clients/servers can be specified in this section as AXFRClient like:-

```
[ZONE_REPLICATION]
Primary=192.168.55.254
Secondary=192.168.55.23
;AXFRClient=192.15.0.1 #This server/client can pull zones too
;AXFRClient=192.16.0.3 #This server/client can pull zones too
;AXFRClient=192.16.0.4 #This server/client can pull zones too
;AXFRClient=192.17.0.6 #This server/client can pull zones too
```

If only DHCP or DNS Service is used then also Replication can be used and for Replicated operation the Primary and Secondary Servers should be specified here.

4.13 TIMINGS

Default host expiry is one kind of time DNS Servers need. DHCP Server needs maximum lease time. Both of these have single entry called **AddressTime**. Zone replication needs Refresh, Retry, Expire and Minimum time parameters. All these times need to be added under TIMINGS section.

```
[TIMINGS]
AddressTime=3600          #This is DNS host expiry time for all local hostnames also Lease Time for DHCP
Refresh=360               #Secondary DNS Server's refresh time
Retry=10                 #If zone replication fails, retry after this time
Expire=36000            #Zone expires after this time, if not refreshed
Minimum=20              #Minimum host time in zone
#MinCacheTime=1000     #Only for testing
#MaxCacheTime=50000    #Only for testing
```

For testing of DNS Caching, there are MinCacheTime and MaxCacheTime can be specified here. But in actual use, please comment or remove these entries.

The proceeding Sections are DHCP configuration Sections. Clients can be allotted addresses in two ways, dynamically from DHCP Range or statically. For static addresses, client section needs to be created for each static client against its MAC Address. BOOTP clients are always static.

4.14 RANGE_SET

DHCP Ranges are required for Dynamic Address allocation. The DHCP Ranges are grouped into [RANGE_SET]s, so that range specific options can be specified for a group of ranges at one place. Each [RANGE_SET] can contain actual DHCP Ranges, Range specific options and Range Filters. Options have option tags (0-254) and values can be specified many different ways. Please Refer to [DHCP Options](#) and [Range Filters](#) topics for more info on these. The total ranges together in all [RANGE_SET]s is limited to 125 and there can also be 125 [RANGE_SET]s max. You can specify one or more ranges in each [RANGE_SET] section, in format specified. DHCP Server will allot addresses from these ranges. Static Hosts and BootP clients do not need ranges. You need not specify any [RANGE_SET] if all clients are Static. Next is example of simple DHCP Range and may be sufficient for home/SOHO use.

```
[RANGE_SET]
DHCPRange=192.168.0.1-192.168.254 #Actual DHCP Range
SubnetMask=255.255.255.0          #Subnet Mask for range
Router=192.168.0.1                #Default Gateway
AddressTime=500                   #Lease Expiry Time after which client will renew.
```

The SubnetMask and Router are range specific options and will be added to all DHCP responses falling in this range. Even you need not specify these options in [RANGE_SET] if you have already specified in

[GLOBAL_OPTIONS] section. Keywords SubnetMask and Router are option names (specific to Dual Server) but clients are sent with option tags. You can also use option tags directly as below.

```
[RANGE_SET]
DHCPRange=192.168.0.1-192.168..254           #Actual DHCP Range
1=255.255.255.0                             #Subnet Mask for range
3=192.168.0.1                               #Default Gateway
51=500                                       #Lease Expiry Time after which client will renew.
```

You can specify as many options in a [RANGE_SET]. Option values can also be multiple ways please refer to DHCP Options topic. You can also filter [RANGE_SET]s based on client sent values Mac Address, Vendor Class and User Class. These is advance topic and please refer to [Range Filters](#) topic for more info. Below is an example of a filtered range.

```
[RANGE_SET]
FilterMacRange=00:0d:60:c5:4e:00-00:0d:60:c5:4e:ff           #Mac Filter, can be hex only
FilterMacRange=00:0e:12:c5:4e:00-00:0e:12:c5:4e:ff           #Another Mac Filter can be 30 more
FilterVendorClass="MSFT 5.0"                                  #Vendor Class Filter
FilterVendorClass="MSFT 5.1"                                  #Another Vendor Class Filter
FilterUserClass="My User Class 4.0"                            #User Class Filter using text
FilterUserClass=123,56,87,123,109,0,23,56,156,209,234,56       #Another User Class Filter using bytes
FilterUserClass=00:0d:60:c5:4e:0d:60:c5:4e                     #Another User Class Filter using hex
DHCPRange=10.0.0.5-10.0.0.10                                   #Actual DHCP Range
DHCPRange=10.0.10.1-10.0.10.254                               #One more DHCP Range
SubnetMask=255.255.255.0                                       #DHCP option for range set
DomainServer=10.5.6.90, 11.4.5.6                               #another option for range set
Router=11.5.6.7, 10.0.99.1                                     #Default Gateway option
```

4.15 GLOBAL_OPTIONS

If some of DHCP Options are common to all the DHCP Ranges and Static Clients, you can specify these under [GLOBAL_OPTIONS] and you need not specify these options in [RANGE_SET] or under static clients. DHCP Options under these sections would supplement (but not replace) client specific options and [RANGE_SET] options. Here only some examples are given, for complete list of mnemonic option names please refer [DHCP Options](#) topic. However all 254 DHCP options can be specified using Tag Names directly.

```
[GLOBAL_OPTIONS]
SubNetMask=255.255.255.0
DomainServer=192.168.1.1, 192.168.1.2
Router=192.168.1.1
RenewalTime=0
```

```
RebindingTime=0
```

4.16 Static Host Sections

You can create Static Host Sections for hosts having fixed IP addresses. A new section against it's MAC Address need to be created for each client. You can specify client specific options under the client section. You need to specify IP Address only. If IP is not specified for a Static Host, this host would not be able to get an IP from Open DHCP Server. (This feature can be used to prevent some clients from getting any IP from this Server, even dynamic address won't be available for such client). All options are optional. For BOOTP requests, only these options (specified in client section) would be sent. However for DHCP requests, missing Options will be supplemented first from matching [RANGE_SET] options (if IP falls in any range) then from [GLOBAL_OPTIONS].

Following example below is simple most section where only IP is specified. Other options will be supplemented from [DHCP_RANGE] and [GLOBAL_OPTIONS].

```
[00:41:42:41:42:00] #This is a client with MAC addr 00:41:42:41:42:00
IP=192.168.0.200 #Only IP is specified for this client
```

This is another example with some client specific options

```
[00:41:42:41:42:05] #This is a client with MAC addr 00:41:42:41:42:05
IP=192.168.0.211 #IP Address for this client
HostName=TestHost #DHCP will offer this host name to client
DomainServer=10.5.6.90, 11.4.5.6 #Domain Name Server for client
Router=11.5.6.7, 4.6.7.34 #Default Gateway for client
```

Open DHCP Server will never allot any address to 00:41:42:41:42:76 as 0.0.0.0 IP has been specified

```
[00:41:42:41:42:76] #This is a client with MAC addr 00:41:42:41:42:00
IP=0.0.0.0 #No IP is specified for this client
```

#Following hosts will also never get an IP from this server as no IP is specified

```
[ff:00:27:78:7b:01] #Easy way to specify no IP
[ff:00:27:78:7b:02]
[ff:00:27:78:7b:03]HTTP_INTERFACE
```

4.17 HTTP Interface

Dual Server publishes a page showing the Lease Status. The default IP for this is 127.0.0.1 (windows) or first interface on Linux and default port is 6789. You can change both IP and port here.

```
[HTTP_INTERFACE]
HTTPServer=192.168.0.3:6789
```

If no port is specified, it is 6789

In addition to HTTPServer, you can specify upto 8 http clients, which can access this http page. If no client is specified, all clients can access this page.

```
[HTTP_INTERFACE]
HTTPServer=192.168.55.254
HTTPClient=192.168.0.11
HTTPClient=192.168.23.123
```

Dual DHCP DNS Server Version 7.40 Windows Build 7050
Server: Lenovo (Primary) <http://dhcp-dns-server.sourceforge.net>

Active Leases

Mac Address	IP	Lease Expiry	Hostname (first 20 chars)	Server
dc:44:b6:ed:eb:35	192.168.1.80	22-Jun-19 19:22:40	Galaxy-J7	Primary
e0:9d:31:e4:21:a9	192.168.1.131	26-Jun-19 18:37:55	S298193	Secondary

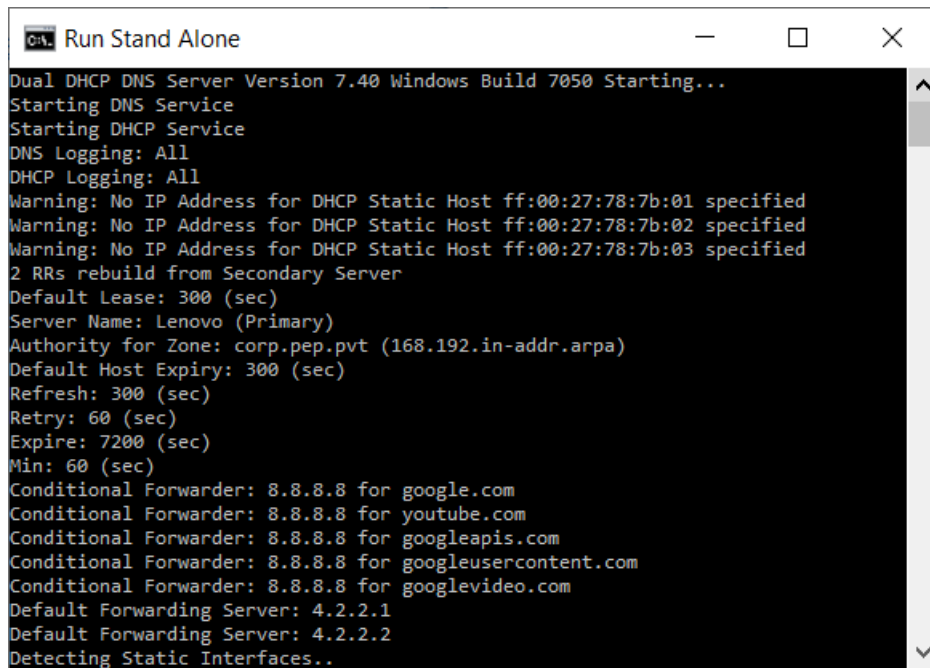
Free Dynamic Leases

DHCP Range	Mask	Available Leases	Free Leases
192.168.1.71 - 192.168.1.80	255.255.255.0	10	9
192.168.1.81 - 192.168.1.90	255.255.255.0	10	10
192.168.1.101 - 192.168.1.110	255.255.255.0	10	10
192.168.55.151 - 192.168.55.160	255.255.255.0	9	9
192.168.1.91 - 192.168.1.100	255.255.255.0	10	10

5 Running of Dual Server

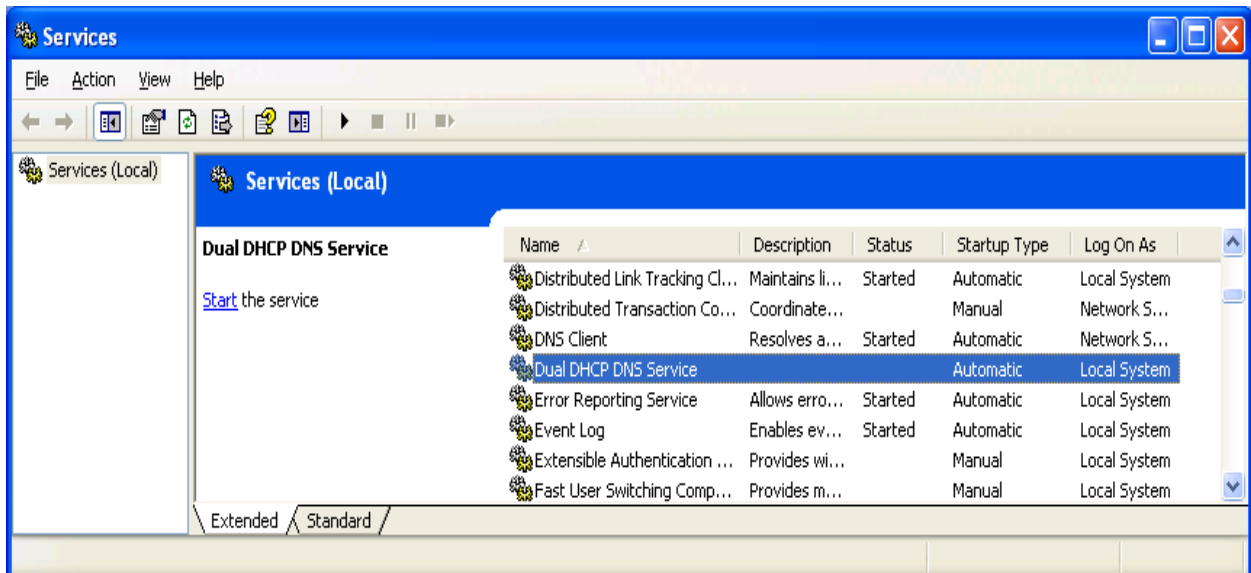
5.1 Windows

In Windows, you can run Dual Server in two different modes a) As Windows Service b) as StandAlone from Start Menu/Command Line. For running it as Service you should go to windows Services Control Applet and start the Service called Dual DHCP DNS Sever. For running from Command Window, you



```
Run Stand Alone
Dual DHCP DNS Server Version 7.40 Windows Build 7050 Starting...
Starting DNS Service
Starting DHCP Service
DNS Logging: All
DHCP Logging: All
Warning: No IP Address for DHCP Static Host ff:00:27:78:7b:01 specified
Warning: No IP Address for DHCP Static Host ff:00:27:78:7b:02 specified
Warning: No IP Address for DHCP Static Host ff:00:27:78:7b:03 specified
2 RRs rebuild from Secondary Server
Default Lease: 300 (sec)
Server Name: Lenovo (Primary)
Authority for Zone: corp.pcp.pvt (168.192.in-addr.arpa)
Default Host Expiry: 300 (sec)
Refresh: 300 (sec)
Retry: 60 (sec)
Expire: 7200 (sec)
Min: 60 (sec)
Conditional Forwarder: 8.8.8.8 for google.com
Conditional Forwarder: 8.8.8.8 for youtube.com
Conditional Forwarder: 8.8.8.8 for googleapis.com
Conditional Forwarder: 8.8.8.8 for googleusercontent.com
Conditional Forwarder: 8.8.8.8 for googlevideo.com
Default Forwarding Server: 4.2.2.1
Default Forwarding Server: 4.2.2.2
Detecting Static Interfaces..
```

need to first Stop the Service and then run either from Command Line or Start menu. For normal operation you should run as Window Service from Service Control Panel.



5.2 Linux

In Linux too you can run the dualserver in modes:-

- a) Verbatim Mode (using -v argument)
- b) Daemon (NOT using -v argument)

This program uses 2 or 3 helper files, which should be passed as arguments.

- a) -i[inifile], where configuration settings can be specified, default is ./etc/dualserver.ini
- b) -l[logfile] dumps log to this file in daemon mode, default is syslog
- c) -s[statefile] saves current leases, default is /tmp/dualserver.state

You can start/run as:-

```
/opt/dualserver/dualserverd # (daemon with default files)
/opt/dualserver/dualserverd -v # (verbatim with default files)
/opt/dualserver/dualserverd -i inifile -l logfile # (as daemon)
/opt/dualserver/dualserverd -i inifile # (as daemon)
/opt/dualserver/dualserverd -v -i inifile # (as verbatim)
```

The logfile should include %Y for full year or %y for 2 digit year, %m for month, %d for day of month. These will be replaced with actual values and this will cause different file every day.

```
/opt/dualserver/dualserverd -l /opt/dualserver/log/dualserver%Y%m%d.log -i /opt/dualserver/dualserverd.ini
```

You can also include just %m and %Y if you want monthly log file like:-

```
/opt/dualserver/dualserver -l <logDirecory>/dualserver%Y%m.log -i <someDirecory>/dualserver.ini
```

Make sure the directory for logfiles should exist before running the program. If you have already done the daemonization under section Installation, you can start/stop the dualserver with commands:-

```
service dualserver start
service dualserver stop
```

Otherwise you can try:

```
/opt/dualserver/rc.dualserver start
/etc/rc.d/dualserver start
/opt/dualserver/rc.dualserver stop
/etc/rc.d/dualserver stop
```

6 Process of Allotting Addresses

DHCP part of Dual Server is **Dynamic Host Configuration Protocol** server, which allots IP addresses to computers automatically. You may manually setup IP addresses on computers but managing them is always troublesome process. On networks, where there are many computers, it is nightmare and error prone. DHCP Server allots address to computers as and when an IP address is requested. DHCP Server maintains a pool of addresses and keeps on allocating and renewing IP addresses from this pool (or statically pre-assigned addresses for some computers).

When an address is allotted to a computer, many more parameters of computer are also set like Domain Name, DNS Server, router/gateway etc. These are called DHCP Options. DHCP Server can use different IP address pools and options depends on how the request came (which interface, or relay agent), what parameters are send with request.

As the newly booted computer don't have IP address, it uses broadcast for discover a DHCP Server on network, send the request as broadcast and received the allotted address via broadcast till booted computer gets a IP address of its own.

The actual process is:-

A user turns on a computer with a DHCP client.

The client computer sends a broadcast request (called a DISCOVER or DHCPDISCOVER), looking for a DHCP server to answer.

The server receives the DISCOVER packet. Based on availability and usage policies set on the server, the server determines an appropriate address (if any) to give to the client. The server then temporarily reserves that address for the client and sends back to the client an OFFER (or DHCP OFFER) packet, with that address information. The server also configures the client's DNS servers, WINS servers, NTP servers, and sometimes other services as well.

The client sends a REQUEST (or DHCPREQUEST) packet, letting the server know that it intends to use the address.

The server sends an ACK (or DHCPACK) packet, confirming that the client has a been given a lease on the address for a server-specified period of time.

When a computer uses a static IP address, it means that the computer is manually configured to use a specific IP address. One problem with static assignment, which can result from user error or inattention to detail, occurs when two computers are configured with the same IP address. This creates a conflict that results in loss of service. Using DHCP to dynamically assign IP addresses minimizes these conflicts.

When DHCP-DISCOVER is received by Dual Server, it does the following:-

- a) Look into static hosts, if there is a Static Host entry for that Mac-Address. If one is found, it temporarily allocated that IP to the client and sends the DHCP-OFFER.
- b) If no static host is defined against the Mac-Address of client, it now looks into all the DHCP ranges under all RANGE_SETs one by one. Once it finds a usable address in any matching range, it temporarily reserves that address and sends DHCP DISCOVER. The matching range is the one which :-
 - If it has Subnet Selection IP (option 118) or Relay Agent IP falls in same subnet as that of Subnet Selection IP or Relay Agent IP.
 - If there is no Relay Agent involved, the range falls in same subnet that of IP of interface from which the DISCOVER is received.
 - The range has a previously allotted address of same client, which is free or a new free address is available or an expired address of another client is available.
 - If any of the RANGE_SET has MacRange specified and client Mac Address falls in the MacRange, ranges of only such RANGE_SET are considered. If no RANGE_SET has matching Mac Range, all [RANGE_SET]s, not having MacRange filter are considered.
 - If any of the RANGE_SET has Vender Class specified and client has matching Vendor Class, Ranges of only such RANGE_SET are considered.
 - If any of the RANGE_SET has User Class specified and client has match User Class, Ranges of only such RANGE_SET are considered.

If you do not have MacRange, VendorClass and UserClass specified for any range (which are advance filters, used by experts), please ignore last 3 conditions above.

7 Process of Resolving Addresses

7.1 General

The primary purpose of DNS Service is to translate the Host Name (normally fqdn meaning hostname including the domain name) to its IP address(s). DNS Service runs at Query/Reply. There are multiple type of queries but most common is asking the IP address of host. DNS Service queries its tables and if found sends the reply. These tables are called Resource Records or RRs.

In standard DNS Servers, these tables are loaded (into memory) from text files called resource records. Some servers, these records are stored in a backend database.

The complete DNS System is divided into zones (one domain name can have multiple zones). Usually there is one or more DNS Server for a zone but some DNS server can handle multiple zones. DNS Server can be an Authorized DNS Server for a zone or just a replicated DNS Server, usually a copy of records from an authorized DNS Server. Normally a zone will have 2 DNS Server, Primary and Secondary. The Secondary server replicates records from Primary Server periodically, keeping both Primary and Secondary Server in Sych. Both of these Servers are Authorized DNS Servers for the Zone.

Fully Qualified Domain name means hostname. zone. For example in www.microsoft.com, www is actual hostname while microsoft.com is zone. All records which have last part as microsoft.com are part of zone microsoft.com. These are called forward zone. There are reverse zone too, which is based on IP address only. An IP address 192.168.55.1 will be considered part of reverse zone 55.168.192.in-addr.arpa. All the IPs whose first three octates are 192.168.55, will be part of this zone 55.168.192.in-addr.arpa. 55.168.192.in-addr.arpa is 256 IP zone with subnetmask of 255.255.255.0. We can also define large zone for example 168.192.in-addr.arpa with subnetmask 255.255.0.0. As you can see all IP addresses from 192.168.0.1 to 192.168.254.254 will be part of this zone.

A DNS Server resolves the address using Resource Records from:-

- a) Its list of authorized entries or non authorized entries.
- b) It can forward the queries to its forwarding servers and get the response back.
- c) It can cache the previous queries resolved and use this cache to resolve queries.

Forwarding Server too is a DNS Server but this too may not have record for host being queried. Then forwarding server too can forward the query to it's own forwarding servers and so on till the query is resolved or it is no more resolvable.

7.2 Dual Server Resource Records

Dual Server has following type of Records

7.2.1 Records loaded from DualServer.ini files.

These records all loaded from DualServer.ini file from [DNS_HOSTS], [ALIASES] and [WILD_HOSTS] sections. There is one forward entry for resolving hostname to IP and also there is a reverse entry for

resolving IP address to its hostname. The DualServer makes automatic reverse entry. In other words two records are created from each entry in DNS_HOSTS section. Only one record is created from entries under ALIASES section and one from MAIL_SERVERS section. WILD_HOST are individually loaded but will not be replicated in a zone transfer.

7.2.2 Records added by DHCP Service

If DHCP Service is used, it will add its own records. For example, if a new IP has been allotted by DHCP Server, this record will be added to DNS Records. All hosts allotted by DHCP Service, will be added and will be removed automatically, when the lease expires. In case of Replicated operation, records will not be added to Secondary Server directly but to Primary Server and will be replicated to Secondary Server.

7.2.3 Records replicated from Primary Server

In case of Primary/Secondary operation, Secondary Server will not load these records from its DualServer.ini file but will replicate these from Primary Server by regular zone transfer. Wild host records are still read from local DualServer.ini file.

7.2.4 Cached Records

When a query is external (means it is out of zone of authorized DNS Server), it forwards the query to its parent external DNS Server and gets the answer. It finally send the answer to querying host but also store this record in its memory for a period of time so that it don't have to forward this query. These are called Cached Records.

7.3 Dual Server Queries Supported

Dual Server supports following Queries:-

	Query Type	Protocol	Source of RRs
1	A (Host to IP)	udp	Loaded from DualServer.ini, Allotted by DHCP, From Forwarded queries and Cache or Replicated
2	PTR (IP to Host)	udp	
3	MX (Domain's Mail Servers)	udp	MAIL_SERVERS section of DualServer.ini or replicated from Primary
4	NS (Name Server)	udp	Information from DOMAIN_NAME, authorized operation only.
5	SOA (Start of Authority)	udp/tcp	
6	AXFR (Complete forward and reverse zone)	tcp	Information from DOMAIN_NAME and all other matching records to DOMAIN_NAME, authorized operation only.
7	ANY (All records for a host)	udp	Matching from all SECTIONS

7.4 Forwarding

Dual Server does forward records to forwarding servers stated under FORWARDING_SERVERS. What queries are forwarded depends on Authorized and Non-Authorized operation.

7.4.1 Non-Authorized Forwarding

When Server is not an authority for the zone, all the queries are attempted from Resource Records specified in DualServer.ini file. If the query could not be resolved, it is attempted from cache (A and PTR records only) and if no matching record is found in cache, it is simply forwarded to FORWARDING_SERVERS or CHILD_ZONES. All queries including NS, SOA and AXFR too will be forwarded. If resolved, these are cached (A and PTR only) before reply is sent to querying host.

7.4.2 Authorized Forwarding

If Server is on Authorized operation for a zone, the only difference is zone specific queries are never forwarded. Suppose the DualServer is an authority for zone xxx.com=55.168.192.in-addr.arpa, then all queries whose last part matches with any Zone name specified above will not be forwarded. In the given example in previous line, www.xxx.com will not be forwarded also reverse lookup query 30. 55.168.192.in-addr.arpa will not be forwarded. In case of Authorized Server for a zone, SOA, NS, AXFR queries will be responded locally.

7.5 Replicated Operation.

The Dual Server have been designed and developed to for replicated operation. Dual Server has both DHCP and DNS Capabilities. Replication means multiple things to Dual Server:-

- a. Co-Ordination between DHCP and DNS components of Single Server Instance.
- b. DHCP Co-Ordination between two instances of Dual Server.
- c. DNS Co-Ordination between two instances of Dual Server.

7.6 Co-Ordination between DHCP and DNS components

DHCP server allots the IP address to network hosts and DNS Server resolves them. How DNS server figures out what IP address has been allotted to what host by DHCP server. If you have different DHCP and DNS Servers, one way is to manually do it, which is error prone and tedious task. Another approach is to configure Direct Dynamic Update which too needs complex configuration. Dual Server does this automatically as it is in-build feature of Dual DHCP DNS Server.

7.7 DHCP Co-Ordination between two instances of Dual Server

If you want to have more than one DHCP Servers (from any other vendor) in your network for redundancy, it is not easy as different DHCP Server may assign different IP address to same host. Also already allotted addresses by one server can be re allotted by different Server. Furthermore, if one instance goes down, other would force DHCP DISCOVER and DHCP OFFER etc. causing break of Service. This too would change the allotted address of host.

Dual Server has been designed for well-coordinated replicated operation. Following features make it unique among other DHCP Servers available.

- a. All the allotted addresses are immediately replicated to other instance by sending special DHCP INFORM messages keeping the internal database of both servers identical. This prevents issuing of same address to multiple hosts or issuing different address to same host.
- b. When once instance goes down, other can simply renew the same lease, moment lease request goes to broadcast mode. This process does not need a DHCP DISCOVER and offer. This feature prevents the break of Service for clients.
- c. All the DHCP ranges and option between different instances can be make consistent by simply copying single DualServer.ini file

7.8 DNS Co-Ordination between two instances of Dual Server.

DNS Co-ordination is done in Dual Server using conventional zone transfer scheme. The zone from Primary server is replicated periodically using axfr queries.

But how about DHCP allotted host. These too are replicated from Primary Server, which automatically adds the DHCP allotted hostnames and IPs to Primary Server's zones and increments the serial on primary server. Now the question comes how about addresses allotted by secondary DHCP Server instance. Dual Server do not modify zone in secondary server directly. Even if address is allotted by secondary server, the host is added in the zone of Primary Server only and replicated in secondary server using axfr.

7.9 Replication Schemes

As Dual Server provides both DHCP service and DNS service, there are multiple ways replication operation can be setup.

7.9.1 Dual Server with only DNS Service as Primary and Secondary Server.

This is the simple most arrangement. When primary server is started it reads ALIASes, MX and STATIC-HOST records from it's ini file. When Secondary Server starts, it does not read these entries from its' ini file, but pulls the full zone from Primary Server. Secondary Server keeps checking the Serial from Primary Server, using UDP SOA query, if Serial advances, full zone is transferred from Primary. If any changes are made in ini file of Primary Server, it needs to be restarted and thereafter Secondary Server would pull automatically all RRs from Primary, after refresh time. Dual Servers do not support NOTIFY.

7.9.2 Dual Server with DNS and DHCP as Primary Server and Dual Server with only DNS as Secondary Server

This is the conventional arrangement. When Primary Server starts, it reads Hosts, MX, CNAMEs from ini file. When Secondary server starts/restarts, it pulls Static-Host, MX, Aliases and DHCP added RRs from Primary Server. Secondary Server keeps updating its database through conventional refresh after refresh time. When any DHCP lease is added or released at Primary Server, its serial number advances and secondary DNS Server gets this entry/deletes expired entry ony when refresh takes place. Secondary server keeps checking the serial of primary and if it advances, full zone is refreshed at

secondary server. Similarly changing the Static Entries at Primary Server (followed by restart) also advances its serial and secondary is refreshes automatically.

7.9.3 Dual Server with DNS and DHCP as Primary Server and third party DNS server as Secondary Server.

This arrangement too works similar to 2. Dual Server supports only full zone transfer. Dual Server do not send NOTIFY message and do not send increment zone transfer. The secondary server needs to pull the full zone after refresh time. When using third party server, please do not specify it as Secondary Server but add as AXFRClient. The advantage of using Dual Server as Primary is that all DHCP allotted RRs too are also transferred with zone transfer to third party secondary server. If third party secondary server supports multiple zones you can use this arrangement and pull zones form multiple Dual Server instances operating in different zones.

7.9.4 Dual Server as secondary server and third party server as primary server.

This arrangement too works similar to 2. However third party primary DNS Server need to update its database through DHCP Dynamic update or some other mechanism. Secondary Dual Server would get updated full zone after refresh time.

7.9.5 Dual Server with only DHCP Service as Primary and Secondary Server.

This arrangement provides backup DHCP Server operation. As both the DHCP Servers are in operation, new lease may be allotted by any server on a Client Request. However special DHCP INFORM message keep the database of both servers in synch. When any DHCP lease is added or renewed or released by Primary Server or Secondary Server, the DHCP Entry is automatically duplicated in other server. Under this arrangement, if any DHCP server goes down, other is available and will renew the lease straightaway (without a DISCOVER or OFFER).

7.9.6 Dual Server with DNS and DHCP as Primary Server and Dual Server with DNS and DHCP as Secondary Server

This is the recommended arrangement. When Primary Server starts, it reads MX, Hosts and CNAMEs from ini file. Secondary server pulls Static-Host, MX, Aliases and DHCP added RRs from Primary Server when it starts and also periodically by zone transfer. When any DHCP lease is added or released at Primary Server or Secondary Server, the DHCP Entry is duplicated in other server, through unicast DHCP inform messages. Also the corresponding RR is added to the zone of Primary Server, which is replicated in Secondary Server. Dual Server do not modify zone in secondary server directly. Even if address is allotted by secondary server, the host is added in the zone of Primary Server only and replicated in secondary server using axfr.

This arrangement provides fully synchronized, load shared, fail safe duplicated DNS and DHCP Server, with replication and hence highly recommended over any other arrangement.

7.9.7 Dual Server with only DNS (or third party DNS) as Primary and Dual Server with DHCP as Secondary.

This arrangement is not recommended, as Primary will not be updated of changes to Secondary due to DHCP changes.

7.9.8 Conditional Forwarding

This can be configured under section [CONDITIONAL_FORWARDERS]. Before forwarding to default FORWARDING_SERVERS, DualServer will first check if the query's last part matches with any of the entries under [CONDITIONAL_FORWARDERS]. If so, the query will be forwarded to DNS Server specified against that entry.

Dual Server is basically single zone server, that means it only supports one forward zone and one reverse zone. This may be enough for all small organizations, who normally have just one zone. If the organization has multiple zones in their domain, Dual Server can still be used as explained under following sections.

7.9.9 Domain with child Zones

Domain name (for example Myzone.com) may be a domain name for the organization as whole. But a DNS domain may be divided into multiple DNS zones. (for example marketing.myzone.com and development.myzone.com are zones of Myzone.com domain).

Dual Server basically supports only one zone but can still be used in multizone domain. If you have a domain with multiple child zones, each child zone can have it's own set of DualServers (1 or 2 replicated DualServers).

Now another DualServer can be put as Domain Server (for main domain). Here Domain Server will forward queries belonging to child zones to child zones and will also catch results. In our example say we have zone 10.10 for main domain and zones 10.10.1 and 10.10.2 are child zones for marketing.myzone.com and development.myzone.com and have respectively, we will configure main Domain Name Server for Domain Myzone.com:-

Entries in Main DNS Servers of zone:-

```
[CONDITIONAL_FORWARDERS]
marketing.myzone.com = 10.10.1.1, 10.10.1.2
1.10.10.in-addr.arpa = 10.10.1.1, 10.10.1.2
development.myzone.com 10.10.2.1, 10.10.2.2
2.10.10.in-addr.arpa = 10.10.2.1, 10.10.2.2
```

Here 10.10.1.1, 10.10.1.2 are DNS Servers of zone marketing.myzone.com/1.10.10.in-addr.arpa while 10.10.2.1, 10.10.2.2 are DNS servers of zone development.myzone.com/2.10.10.in-addr.arpa.

For both Child Servers 10.10.1.1, 10.10.1.2, 10.10.2.1, 10.10.2.2 the forwarding servers will be Main Domain Servers (Say 10.10.3.1 and 10.10.3.2).

Entries in Servers 10.10.1.1 and 10.10.1.2 :-

```
[FORWARDING_SERVERS]
```

```
10.10.3.1
```

```
10.10.3.2
```

```
[DOMAIN_NAME]
```

```
marketing.myzone.com = 10.10.1.in-addr.arpa
```

Entries in Servers 10.10.2.1 and 10.10.2.2 :-

```
[FORWARDING_SERVERS]
```

```
10.10.3.1
```

```
10.10.3.2
```

```
[DOMAIN_NAME]
```

```
development.myzone.com = 10.10.2.in-addr.arpa
```

Now any query to both Child Servers will be forwarded to Main Domain Server which will resolve it from other server is needed or it's own forwarding servers.

8 DHCP OPTIONS

8.1 Specifying options and values in Dual DHCP DNS Server

DHCP Options, also called Vendor Options, are also sent to client along with DHCP Offer and DHCP Ack. These are various other setting of client like DNS Server, Router/Gateway, various other default servers like WINS, HTTP Server, Linux Windows Manager etc. There are about 150+ various standard options are available, some of these are Vendor Specific or Server Specific. Each option has an option tag (1 to 254) and the value of option which can be upto 254 bytes.

Dual Server stores DHCP Options at three different levels. These can be stored under [GLOBAL_OPTIONS], [RANGE_SET] or Static Client sections. Option Tag and Option Value are separated by = sign. Global Options are added to each DHCP Offer and DHCP Acknowledgement going out of server, Range specific options are added to each DHCP OFFER/ACK when offered IP falls in DHCP_RANGE and Client specific option sent with DHCP Offer/Ack specific to Static Client.

Options are only supplemented but never replaced. This means if an option has already been specified under Static Client level, value is taken only from Client Specific option; it will not be replaced by value of such option from either RANGE_SET or GLOBAL_OPTIONS. Similarly if an option has value specified under RANGE_SET, value is not replaced in GLOBAL_OPTIONS. However if option is not specified under Client Specific, it will be augmented from RANGE_SET and if RANGE_SET has no such option and Global Options has it, it will be added from Global Options. Global Options are stored as attributes in Configuration entry, Range Specific Options under DHCP Range Entries and Client Specific options are attributes to Static Client Entries.

DHCP Options are specified in all above sections as **OptionTag=value** syntax. Option tags can be number or standard mnemonic text for that Option tag. Mnemonic text is used as remembering numbers is difficult. Dual Server now uses text names (less spaces) stipulated by IANA in document at <http://www.iana.org/assignments/bootp-dhcp-parameters/bootp-dhcp-parameters.xml>. The server translates these mnemonic text (will be called option names) back to option tags when sending options to clients. List of all option name are listed in next section.

For example Sub Net Mask can be specified as:

```
1=255.255.255.0
```

or

```
SubNetMask=255.255.255.0
```

Similarly DNS Servers can be specified as:-

```
6=192.168.0.1, 192.168.0.2
```

```
DNSServers=192.168.0.1, 192.168.0.2
```

Now the values of these options can be specified in multiple ways. String values can be a quoted string or colon separated hex values or comma separated byte array like:-

```
DomainName="MyDomain.com"
```

or

```
15="MyDomain.com"
```

or

```
DomainName=4d:79:44:6f:6d:61:69:6e:2e:63:6f:6d
```

or

```
15=4d:79:44:6f:6d:61:69:6e:2e:63:6f:6d
```

or

```
DomainName=77,121,68,111,109,97,105,110,44,99,111,109
```

or

```
15=77,121,68,111,109,97,105,110,44,99,111,109
```

All of the above Option Entries work same way for string values. For IP address values, you can use both dot separated values or hex string or byte array like:-

```
Router = 192.168.0.1
```

or

```
3 = 192.168.0.1
```

or

```
Router = 192,168,0,1
```

or

```
3 = 192,168,0,1
```

or

```
Router = c0:a8:00:01
```

or

```
3 = c0:a8:00:01
```

If you have multiple values for an Option you can specify like:-

```
DomainServer=192.168.0.2, 192.168.0.3
```

or as 8 consecutive bytes for 2 addresses

```
DomainServer=192,168,0,2,192,168,0,3
```

or as 8 consecutive hexbytes for 2 addresses

```
DomainServer=c0:a8:00:01:c0:a8:00:02
```

Numerical values can be simply stated as:-

```
LeaseTime=360
```

or

```
51=360
```

Boolean Options should be specified as:-

```
AutoConfig=yes
```

or

```
AutoConfig=no
```

or

```
116=yes
```

or

```
116=1
```

or

```
AutoConfig=off
```

DHCP Range can only be specified as:-

```
DHCPRange=10.0.0.5-10.0.0.10
```

8.2 Filtering DHCP Ranges

You can select RANGE_SETs based on filter conditions. If any entry in a RANGE_SET has matched the filter condition then only that RANGE_SET will be available to client (in fact all RANGE_SETs which has matched the filter condition will be available to client). Remaining RANGE_SETs will no more be available to that client. These filters although looks like options, but are not actual options but filter based on client sent values. Hence these filters never go to client with DHCP OFFER or DHCP ACK messages. Dual Server supports 4 type of filters as described below:-

8.2.1 Mac Range Filters

Mac Range Filters Enable a RANGE_SET (All the ranges within a RANGE_SET) for a given Mac Range. Like:-

```
FilterMacRange=00:0d:60:c5:4e:00-00:0d:60:c5:4e:ff
```

(above entry means Mac Address from 00:0d:60:c5:4e:00 to 00:0d:60:c5:4e:ff). If above filter is specified, the range of this RANGE_SET will be only be selected if Mac Address falls in this range. **You can add upto 32 Mac Range filters in each RANGE_SET.** Multiple entries work like “or” operation. In other words, RANGE_SET will be available to all clients having Addresses falling in **any** of FilterMacRanges specified.

8.2.2 Vendor Class and User Class Filters

Vendor Class and *User Class* Filters require exact match to value specified. However multiple values can be added to each RangeSet. If the client sent values match with any one of specified values, DHCP ranges in this RANGE_SET will be available to this client. The values can be Strings, byte array or hex bytes. For example:-

```
[RANGE_SET]
DHCPRange=192.168.1.171-192.168.1.180
FilterVendorClass="MSFT 4.0"
FilterVendorClass="MSFT 5.0"
FilterVendorClass="MSFT 6.0"
```

Vendor Class is set by manufacturer and has limited use of segregating the DHCP Range for say Windows and Linux computers. **User Class** can be set manually for a computer and can be very effectively used to segregate computers. For example you may segregate your computers and customer computers; you can set the **User Class** for all your computers to some value. Now Filter the DHCP Range with this value. Now a particular range will be available to your computers and remaining ranges will only be available to customer's computers. Using **User Class**, you can even use different range for each of your departments. As you can see different RANGE_SET can be selected for different **User Class**, you can also set other options for filtered RANGE_SET. You can have different DNS Server, Proxy Server, and Gateway Server etc. You can deny internet access to some computers based on **User Class**.

```
[RANGE_SET]
DHCPRange=192.168.12.231-192.168.12.240
FilterVendorClass="MSFT 5.0"
FilterUserClass="HomeComputer"
DomainServer=192.168.12.1
Router=192.168.12.1
```

Above example can be used to differentiate between home office computers and third party computers. Home different computers will use different RANGE_SET and different options.

Blank option values ensure these options never sent to host, not even complimented even from GLOBAL_OPTIONS.

```
[RANGE_SET]
DHCPRange=192.168.12.1-192.168.12.230
DomainServer= #Blank option values ensure this option is never sent
Router= #Blank option values ensure this option is never sent
```

8.2.3 Subnet Selection Filters

When the DHCPDISCOVER arrives from local subnet, the listening interface's IP address/SubnetIP is used to find matching DHCP Range. If DHCPDISCOVER comes from another subnet, Relay Agent's IP address is also put in the DHCPDISCOVER by Relay Agent. Now this IP is used to find matching DHCP Range. If subnetselection IP (option 118) is sent by client, this IP is used to find the matching DHCP Range. The preference goes like:-

1. Subnet Selection IP (option 118)
2. Relay Agent IP
3. Listening Interface's IP

This is built in logic and no special filter is required for DHCP Range Selection when using Relay Agent. However you can override this feature and force a particular range set using the filter FilterSubnetSelection. Using this filter will force a RANGE_SET based on matching of IP against FilterSubnetSelection. Now the RANGE_SET is matched against IP (Subnet Selection/Relay Agent IP) specified against this filter. It is done in same sequence as above. If option 118 is sent by client this IP value is matched to filter value. If option 118 is not sent and relay agent IP is available, then relay agent IP is matched against FilterSubnetSelection value.

```
[RANGE_SET]
DHCPRange=192.168.12.1-92.168.12.230
DomainServer=192.168.12.1
Router=192.168.12.1
FilterSubnetSelection=192.168.12.125
FilterSubnetSelection=192.168.13.125
TargetRelayAgent=192.168.11.2
```

The last item TargetRelayAgent above, forces the DHCP OFFER/DHCP ACCEPT to be routed to another Relay Agent 192.168.11.2. Normally the DHCP OFFER will be routed to Relay Agent, from where it came, but can be overridden with this. However **TargetRelayAgent** will be used only when the DHCP DISCOVER and DHCP REQUEST has Subnet Selection IP or Relay Agent IP. If the DHCP DISCOVER and DHCP REQUEST come without these values, TargetRelayAgent will be ignored. This will permit unicast messages to renew DHCP Address.

8.3 List of DHCP Options Names (in Dual DHCP DNS Server)

These are option names used in Dual DHCP DNS Server. These are based on IANA names less spaces and dashes. Please refer to <http://www.iana.org/assignments/bootp-dhcp-parameters/bootp-dhcp-parameters.xml> for more info. You can also use options not listed here using tag names directly.

These are mnemonic option names used in Dual Server. These are based on IANA names less spaces and dashes. Please refer to <http://www.iana.org/assignments/bootp-dhcp-parameters/bootp-dhcp-parameters.xml> for more info. You can also use options not listed here using tag numbers directly.

Tag	Option Name in Dual Server	IANA Name	Meaning
1	SubnetMask	Subnet Mask	Subnet Mask Value
2	TimeOffset	Time Offset	Time Offset in Seconds from UTC (note: deprecated by 100 and 101)
3	Router	Router	Default Gateway is called Router by IANA
4	TimeServer	Time Server	N/4 Timeserver addresses
5	NameServer	Name Server	N/4 IEN-116 Server addresses
6	DomainServer	Domain Server	N/4 DNS Server addresses
7	LogServer	Log Server	N/4 Logging Server addresses
8	QuotesServer	Quotes Server	N/4 Quotes Server addresses
9	LPRServer	LPR Server	N/4 Printer Server addresses
10	ImpressServer	Impress Server	N/4 Impress Server addresses
11	RLPServer	RLP Server	N/4 RLP Server addresses
12	Hostname	Hostname	Hostname string
13	BootFileSize	Boot File Size	Size of boot file in 512 byte chunks
14	MeritDumpFile	Merit Dump File	Client to dump and name the file to dump it to
15	DomainName	Domain Name	The DNS domain name of the client

16	SwapServer	Swap Server	Swap Server address
17	RootPath	Root Path	Path name for root disk
18	ExtensionFile	Extension File	Path name for more BOOTP info
19	ForwardOn/Off	Forward On/Off	Enable/Disable IP Forwarding
20	SrcRteOn/Off	SrcRte On/Off	Enable/Disable Source Routing
21	PolicyFilter	Policy Filter	Routing Policy Filters
22	MaxDGAssembly	Max DG Assembly	Max Datagram Reassembly Size
23	DefaultIPTTL	Default IP TTL	Default IP Time to Live
24	MTUTimeout	MTU Timeout	Path MTU Aging Timeout
25	MTUPlateau	MTU Plateau	Path MTU Plateau Table
26	MTUInterface	MTU Interface	Interface MTU Size
27	MTUSubnet	MTU Subnet	All Subnets are Local
28	BroadcastAddress	Broadcast Address	Broadcast Address
29	MaskDiscovery	Mask Discovery	Perform Mask Discovery
30	MaskSupplier	Mask Supplier	Provide Mask to Others
31	RouterDiscovery	Router Discovery	Perform Router Discovery
32	RouterRequest	Router Request	Router Solicitation Address
33	StaticRoute	Static Route	Static Routing Table
34	Trailers	Trailers	Trailer Encapsulation
35	ARPTimeout	ARP Timeout	ARP Cache Timeout
36	Ethernet	Ethernet	Ethernet Encapsulation
37	DefaultTCPTTL	Default TCP TTL	Default TCP Time to Live
38	KeepaliveTime	Keepalive Time	TCP Keepalive Interval
39	KeepaliveData	Keepalive Data	TCP Keepalive Garbage
40	NISDomain	NIS Domain	NIS Domain Name
41	NISServers	NIS Servers	NIS Server Addresses
42	NTPServers	NTP Servers	NTP Server Addresses
44	NETBIOSNameSrv	NETBIOS Name Srv	NETBIOS Name Servers
45	NETBIOSDistSrv	NETBIOS Dist Srv	NETBIOS Datagram Distribution
46	NETBIOSNodeType	NETBIOS Node Type	NETBIOS Node Type
47	NETBIOSScope	NETBIOS Scope	NETBIOS Scope
48	XWindowFont	X Window Font	X Window Font Server
49	XWindowManager	X Window Manager	X Window Display Manager
51	AddressTime	Address Time	IP Address Lease Time
58	RenewalTime	Renewal Time	DHCP Renewal (T1) Time
59	RebindingTime	Rebinding Time	DHCP Rebinding (T2) Time
62	NetWare/IPDomain	NetWare/IP Domain	NetWare/IP Domain Name
63	NetWare/IPOption	NetWare/IP Option	NetWare/IP sub Options
64	NIS-Domain-Name	NIS-Domain-Name	NIS+ v3 Client Domain Name
65	NIS-Server-Addr	NIS-Server-Addr	NIS+ v3 Server Addresses
66	TFTPServerName	Server-Name	TFTP Server Name
67	BootFileOption	*Bootfile-Name see note	Boot File Name
68	HomeAgentAdrs	Home-Agent-Adrs	Home Agent Addresses
69	SMTPServer	SMTP-Server	Simple Mail Server Addresses
70	POP3Server	POP3-Server	Post Office Server Addresses
71	NNTPServer	NNTP-Server	Network News Server Addresses
72	WWWServer	WWW-Server	WWW Server Addresses
73	FingerServer	Finger-Server	Finger Server Addresses
74	IRCServer	IRC-Server	Chat Server Addresses
75	StreetTalkServer	StreetTalk-Server	StreetTalk Server Addresses
76	STDAServer	STDA-Server	ST Directory Assist. Addresses
78	DirectoryAgent	Directory Agent	directory agent information
79	ServiceScope	Service Scope	service location agent scope
83	iSNS	iSNS	Internet Storage Name Service
85	NDServers	NDS Servers	Novell Directory Services
86	NDSTreeName	NDS Tree Name	Novell Directory Services
87	NDSContext	NDS Context	Novell Directory Services
95	LDAP	LDAP	Lightweight Directory Access Protocol
100	PCode	PCode	IEEE 1003.1 TZ String
101	TCode	TCode	Reference to the TZ Database
112	NetinfoAddress	Netinfo Address	NetInfo Parent Server Address
113	NetinfoTag	Netinfo Tag	NetInfo Parent Server Tag
114	URL	URL	URL

116	AutoConfig	Auto-Config	DHCP Auto-Configuration
117	NameServiceSearch	Name Service Search	Name Service Search
118	SubnetSelectionOption	Subnet Selection Option	Subnet Selection Option
119	DomainSearch	Domain Search	DNS domain search list
120	SIPServersDHCPOption	SIP Servers DHCP Option	SIP Servers DHCP Option
121	ClasslessStaticRouteOption	Classless Static Route Option	Classless Static Route Option
122	CCC	CCC	CableLabs Client Configuration
128	TFTPPhoneServer	TFTP Server IP address (for IP Phone software load)	
129	CallServerIPAddress	Call Server IP address	
130	Discriminationstring	Discrimination string (to identify vendor)	
131	RemotestatisticsserverIPAddress	Remote statistics server IP address	
135	HTTPProxyPhone	HTTP Proxy for phone-specific applications	
141	SIPUAServiceDomains	SIP UA Service Domains	SIP UA Service Domains
150	TFTPserverAddress	TFTP server address	
176	IPTelephone	IP Telephone (Tentatively Assigned - 2005-06-23)	
209	ConfigurationFile	Configuration File	Configuration file
210	PathPrefix	Path Prefix	Path Prefix Option
211	RebootTime	Reboot Time	Reboot Time
255	End	End	None

8.4 Dual Server specific DHCP Header Field Options

There are some Dual Server special options, although specified like Options in ini file, which do not go as vendor options but are used to fill the DHCP Header fields only.

BootFileName	*Boot File Field in DHCP Header	126 Bytes Max
NextServer	PXE TFTP Server Field in DHCP Header	N/4 IP
TargetRelayAgent	**Can be used to send broadcast messages to alternative relay agent.	N/4 IP

*Option BootFileName only fills DHCP Request header field the bp_file while BootFileOption adds the boot file name as DHCP option.

** When DHCPDISCOVER and DHCPREQUEST come from Relay Agent (or has subnetselection option) the DHCPDISCOVER and DHCPACK are sent back to Relay Agent or subnetselection IP. This is normal operation and work correctly. However you can override where these messages go, you can specify as TargetRelayAgent.

9 Debugging

9.1 Windows

- Check network hardware and ensure that client machines have different host names from server and each other.
- No other service should be running on Server on ports 53 and 67. If you get error like port 67 already in use means some other DHCP program or proxy server with DHCP service is running. If you get error port 53 already in use means some other DNS Server or proxy server with DNS Service is already running. Use any port scanner program like Active Ports to detect which program is listening on these ports. It is also possible that another copy of dualserver itself is running or Microsoft connection sharing (ICS) is running, which uses these ports. How to disable ICS DNS/DHCP Service on your target networks, see INTERNET CONNECTION SHARING in ReadMe.txt file.
- If you still get error Static Interfaces/Listening Ports not available, it may be because of 1) Another DHCP/DNS Server is running or Interfaces specified on [LISTEN_ON] section are not available. If your interface may not be ready when your computer/Service starts and due to this service fails to start, use Window's recovery option in Services applet to try starting service at later time.
- Look at DualServer.log (if running as service) or Run in standalone mode, it will provide all debug information as it verbatim the activities.
- If you use Broadband router, which also has DHCP Server, this program may still run, but some hosts configured by other DHCP Server may not use this DNS or DHCP Service.
- Often you will find that other machines can resolve each other and server, but server resolves nothing. This is because server's DNS Server may be different. To resolve machines from server, specify (forwarding) DNS Servers in ini file and set server's DNS Server to itself.
- Zone Transfer and Replication, if used on multihomed servers, make sure the IPs for Primary and Secondary server can be pinged from Each Other.
- Dualserver.state file backs up current leases and is read back when server restarts. If you want to clean previous leases, you may delete this file and restart the server.
- If you are not able to receive DHCP Discover messages from clients, make sure that Dual DHCP DNS Server and client are on same physical network (not separated by routers). If it is separated by routers and it is same subnet, please allow routers to pass broadcast messages to Server on Port 67. If these are different subnets, use the BOOTP relay agents.

9.2 Linux

- Ensure that you run this program as root only.
- Check network hardware and ensure that client machines has different host names from server and each other.
- No other service should be running on Server on ports 53 and 67 If you get error like port 67 already in use means some other DHCP program or proxy server with DHCP service is running. If

you get error port 53 already in use means some other DNS Server or proxy server with DNS Service is already running. Use netstat command to detect which program is listening on these ports. It is also possible that another copy of dualserver itself is running.

- If you get error Static Interfaces/Listening Ports not available, it may be because of 1) Another DHCP/DNS Server is running or Interfaces specified on [LISTEN-ON] section are not available or you have just restated the server and TCP port is not yet closed, then wait for some time.
- Look at log file (if running as service) or Run in standalone mode, it will provide all debug information as it verbatim the activities.
- If you use Broadband router, which also has DHCP Server, this program may still run, but some hosts configured by other DHCP Server may not use this DNS Service.
- Often you will find that other machines can resolve each other and server, but server resolves nothing. This is because server's DNS Server may be different. To resolve machines from server, specify (forwarding) DNS Servers in ini file and set server's DNS Server to itself.
- Zone Transfer and Replication, if used on multihomed servers, make sure the IPs for Primary and Secondary server can be pinged from Each Other.
- dualserver.state file backs up current leases and is read back when server restarts. If you want to clean previous leases, you may delete this file and restart the server.
- Errors like "libstdc++.so.?: cannot open shared object file: No such file or directory" are possible in some Linux flavors. Please recompile the program or create symbolic links:-

```
In -s /usr/local/lib/libstdc++.so.? /usr/lib/libstdc++.so.?  
In -s /usr/local/lib/libgcc_s.so.? /usr/lib/libgcc_s.so.?
```

? is library version as reported in error. Or add the library path (directory where above file is) to env variable LD_LIBRARY_PATH.
- If you are not able to receive DHCP Discover messages from clients, make sure that Dual DHCP DNS Server and client are on same physical network (not separated by routers). If it is separated by routers and it is same subnet, please allow routers to pass broadcast messages to Server on Port 67. If these are different subnets, use the BOOTP relay agents or let routers provide this functionality.

10 Other Recommended Software

10.1 [Open DHCP Server](#)

Open DHCP Server is very similar to Dual DHCP DNS Server, but do not provide the DNS Service. It is pure high performing DHCP Server.

Dual DHCP DNS Server is single zone server but [Open DHCP Server](#) can be used in multi domain mode.

10.2 [Open TFTP Server](#)

It is MultiThreaded TFTP Server, Open Source Freeware for both Windows and Unix for PXEBOOT, firmware load. It support tsize, blksize, timeout Server Port Ranges, Block Number Rollover for Large Files. Runs as Service/daemon.

Single Port version also available. Single Port version communicates through single port 69 to all clients. It can serve multiple client from single port. Very useful for firewalled networks.

The salient feature of this software is that it can be installed as Windows Service or Unix Daemon.