

DUAL DHCP/DNS SERVER



Installation and Configuration

Edison 2

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2 Preface

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

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 local 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.

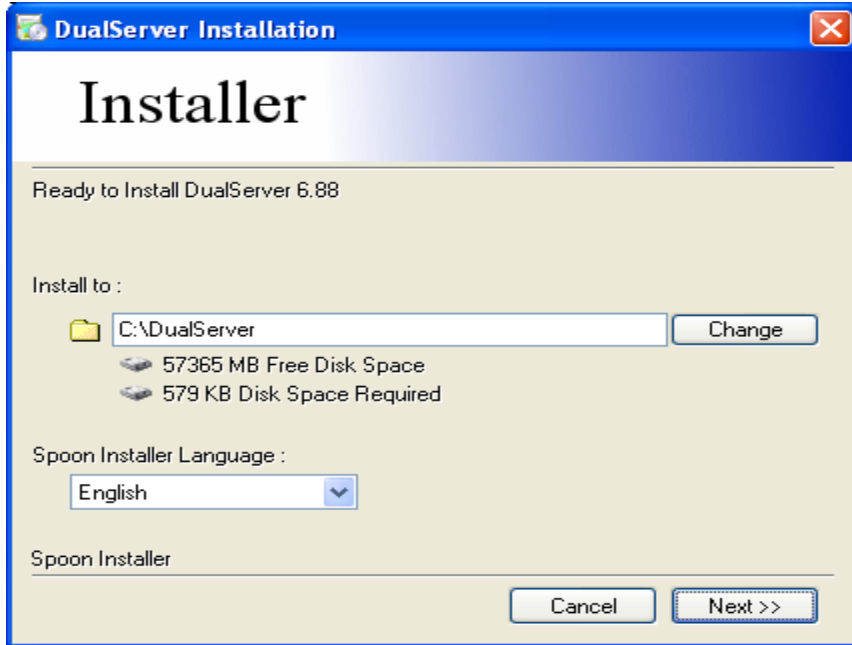
The salient features are:

- 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
- DHCP Support infinite number of Static DHCP Host with host 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 viewing 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 **Dual Server** on Windows is straightforward. Just run the Installer and it installs.



You should permit it to Install as Windows Service by keeping the checkbox.



If you did not install as service, still want to do that, go to installation directory (default c:\DualServer) and run InstallService.exe, which will install it as Windows Service. If you want to remove the Windows

Service but just want to keep the install, you can call utility RemoveService.exe. You need to run these utilities as Administrator. You can right click on these files and choose "Run as Administrator".

To fully uninstall Windows version, just go to control panel and use the Programs->Uninstall. It will uninstall both Windows Service and program itself.

3.2 Windows Compiling

It is not needed to recompile Dual DHCP DNS Server on windows version. 64 bit versions can also run this 32 bit executable. However the command for compiling is:-

```
g++ -o DualServer.exe DualServer.cpp -lwsock32 -liphlpapi -lws2_32
```

3.3 Linux Installation

Expand the GZ archive to any directory (preferably /opt/dualserver) and change the permission of file dualserverd with chmod 755 dualserverd, if needed. Linux Installation is easy too but in Linux, we need to create script files for daemonization. Also compiling 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.

3.4 Linux Compiling

The enclosed dualserver executable file may only run on Intel Linux 32 bit version. For 64 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.

3.5 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 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
```

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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/ubuntu support rconf command, which is very similar to chkconfig command (You may need some changes in the comments section of rc.dualserver file). If your flavor doesn't support chkconfig or rconf you can manually do:-

```
#ln -s /opt/dualserver/rc.dualserver /etc/rc.d/dualserver
#chmod 755 /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 DHCP DNS Server daemon:
if [ -x /etc/rc.d/rc.dualserver ]; then
/etc/rc.d/rc.dualserver 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 4.2 to 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.

You need not specify all your entries in this ini file; you can create additional files (only one for each section). Then just specify single entry under the section like:-

```
[DNS_HOSTS]
@my_hosts_file.xxx
```

```
#This is file my_hosts_file.xxx
OracleServer.yahoo.com=192.168.0.43
DNS=192.168.0.1
cpltcaxd02b=192.168.0.2
homehost.external.com=187.178.187.178
strange=192.168.6.11
soho=192.168.0.111
www=12.67.4.3
```

Now section will be loaded from specified file my_hosts_file.xxx. You can give full path or just file name. If just filename is given, it should be put in directory where this ini file is. Do not give section name again in included file, but comments can still be given. You cannot make SECTION's some entries here and some in included file. Once include file is used, SECTION's all entries will be read only from included file.

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 need to 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 DOMAIN_NAME

All the DNS queries are fqdn or in other words it has components [hostname.zone.domain.com](#). Domain Name is specific to each site and DNS Server figures out by checking the domain name part of query if it local query or external query. DNS Server will resolve the local queries from its own set of records and forward the external query to forwarding server. Entry 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
```

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
```

Once a server is authorized, all the entries under [DNS_HOSTS] should fall in one of the authorized zones.

This 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 never be forwarded to forwarding servers. Authorized server will also return SOA, NS and AXFR queries.

4.5 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. **There is no limit to number of entries here.**

```
[DNS_HOSTS]
OracleServer.example.com=192.168.55.45
DNS=192.168.55.1
DNS=192.168.55.2
cpltcaxd02b=192.168.55.2
homehost.ext.com=187.178.187.178
strange=192.168.6.11
soho=192.168.0.111
```

When the Dual Server is in replication mode (two instances are used one Primary and other Secondary) , the entries are only read from Primary Server's configuration file and Secondary Server gets these entries only through zone transfer replication process. Authorized Dual DHCP DNS Server has one forward zone and one reverse zone.

Dual Server allows you to make entries in this section which may not belong to it's zones. However when under replicated operation; Dual Server will ignore entries which are not part of its zones. The reason for this is that these entries cannot be replicated to secondary server.

It may happen that entry may match with forward zone but not in reverse zone. In this case entry will be added to forward zone but will not be added in reverse zone. Also if an entry do not match forward but matches reverse zone, it will be added to reverse zone but not to forward zone. For example if you specify your zones as mydomain.com=55.168.192.in-addr.arpa under domain name then entry www=192.168.55.23 or [www.mydomain.com=192.168.55.23](#) will be added to both forward and reverse zones. However an entry like [www.otherdomain.com=192.168.55.45](#) only will be added to reverse zone. Similarly entry database.mydomain.com=10.5.67.231 will only be added to forward zone as ip is out of reverse zone. Entry like [www.somedomain.com=192.168.56.23](#) will not be added into any zones.

4.6 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. Left side of = sign is the alias name while right side of = is canonical name or the real name, also called cname. However you can also create another alias for an alias. Alias name should be bare name or need to match the default or authorized zone, but cname can be from any zone. **There is no limit to number of entries here.**

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

4.7 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 128 max wild entries are allowed in version 6.96**

```
[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.

4.8 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 normally 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 max ranges can be specified.** DHCP ranges are automatically added, you don't have to add them again here. 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
```

4.9 CONDITIONAL_FORWARDERS

All the non local queries need to be resolved from Forwarding Servers. Generally all external queries are forwarded to some external DNS Server (usually provided by your ISP). Dual Server forwards non local queries to Default External Servers and caches the results. Dual Server also allows you to forward selected queries to specific DNS Servers, based on matching the last part of query. This is sometimes called as DNS Proxy. **Only 128 entries allowed here.** For example you want to forward all queries with domain name myzone.mydomain.com to your special DNS Server 192.168.55.45. You can make an entry as:-

```
[CONDITIONAL_FORWARDERS]
myzone.mydomain.com=192.168.55.45
```

Now queries like a.myzone.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 like 11.34.158.195.in-addr.arpa can also be forwarded to your special DNS Server 192.168.55.45. This feature helps in creating Child Zones. You can specify up to 2 DNS Servers (separated by comma) for each entry. Please see the related topic for using Dual Server under Multizone Operation.

```
[CONDITIONAL_FORWARDERS]
zone1.workgroup.com=192.168.1.1
1.168.192.in_addr.arpa=192.168.1.1
zone2.workgroup.com=192.168.2.1,192.168.2.2
2.168.192.in_addr.arpa=192.168.2.1,192.168.2.2
google.com=8.8.8.8
```

4.10 FORWARDING_SERVERS

These are default forwarding DNS Servers and usually hosted by your ISP. 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). Remember external queries will be forwarded to these servers only if there are no matching servers under [CONDITIONAL_FORWARDERS]. **Only 125 max entries allowed here.**

```
[FORWARDING_SERVERS]
192.168.0.1
10.10.10.1
```

4.11 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
```

4.12 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 sent, zone is all entries having same zone name extension. Periodically 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) do 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 AXFRClient. These clients/servers (**max 14**) can also be specified in this section as AXFRClient like:-

```
[ZONE_REPLICATION]
Primary=192.168.55.254
Secondary=192.168.55.23
AXFRClient=192.168.0.1         #This server/client can pull zones too
AXFRClient=192.168.0.3         #This server/client can pull zones too
AXFRClient=192.168.0.4         #This server/client can pull zones too
AXFRClient=192.168.0.6         #This server/client can pull zones too
```

For DHCP Replicated operation too the Primary and Secondary Servers should be specified here too.

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 additionally needs Refresh, Retry, Expire and Minimum time parameters. All these times need to be added under TIMINGS section.

```
[TIMINGS]
AddressTime=360      #This is DNS host expiry time for all local hostnames also Lease Time for DHCP
Refresh=3600        #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
```

For testing of DNS Caching, there are MinCacheTime and MaxCacheTime can be specified here.

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 actual 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 (1-254) and values can be specified many different ways. Please Refer to **DHCP Options**. 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/use 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. **The total ranges together in all [RANGE_SET]s is limited to 125** and there can also be 125 [RANGE_SET]s max.

```
[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. 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 specified 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. This is advance topic and please refer to Range Filters topic for more info. Below is an example of a filtered range.

4.15 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.

4.15.1 Mac Range Filters

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

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

If above filter is specified (as option), the range of this RANGE_SET will 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 Mac Addresses falling in any FilterMacRange.

4.15.2 Vendor Class and User Class Filters

Vendor Class (option 60) and user Class (option 77) are sent by client in DHCPDISCOVER. These values can be used to select the RANGE_SET. These filters require exact case sensitive match to value specified but if multiple values can be added to each RANGE_SET, the client sent values need to match with any one of specified values. You can use string, byte array or hex bytes for specifying values.

Vendor Class is set by manufacturer and has limited use of segregating the DHCP Ranges, for example 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 default range 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 choose other options for RANGE_SET. You can have different DNS Server, Proxy Server, Gateway Server etc. You can deny internet access to some computers based on User Class.

```
[RANGE_SET]
DHCPRange=192.168.12.231-92.168.12.240
FilterVendorClass="MSFT 5.0"
FilterUserClass="home"
DomainServer= #Blank option values ensure this option is never sent
Router= #Blank option values ensure this option is never sent
```

```
[RANGE_SET]
DHCPRange=192.168.12.1-92.168.12.230
DomainServer=192.168.12.1
Router=192.168.12.1
```

Blank option values ensure these options are not complimented even from GLOBAL_OPTIONS.

4.15.3 Subnet Selection Filters

When the DHCPDISCOVER arrives from local subnet, the listening interface's IP address is used to find matching DHCP Range. If DHCPDISCOVER comes from another subnet, Relay Agent's IP address is put in the DHCPDISCOVER by Relay Agent. Now this IP is used to find matching DHCP Range. If subnet selection 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. 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. But what IP is matched against 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. If relay agent IP is also not available, listening interface's IP is matched to FilterSubnetSelection value. In one RANGE_SET, 32 FilterSubnetSelection values can be specified and any of these values can match for the RANGE_SET to qualify.

```
[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 to be routed to 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.

4.16 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. However if value is different for specific client or RANGE_SET, you can override values for specific host or RANGE_SET. 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 please refer DHCP Options topic.

```
[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
```

4.17 Static Host Sections

You can create Static Host Sections for hosts having fixed IP addresses. A new section against its 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 Dual Server. (This feature can be used to prevent some clients from getting any IP from this Server). All options are optional. For BOOTP requests, only these options (specified against Host) 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
```

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```
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
```

Dual Server will never allot any address to 00:41:42:41:42:76 as no 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
```

4.18 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. This page is only available if DHCP Service is enabled.

```
[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=192.168.23.113
```

5 Running of Dual Server

5.1 Windows

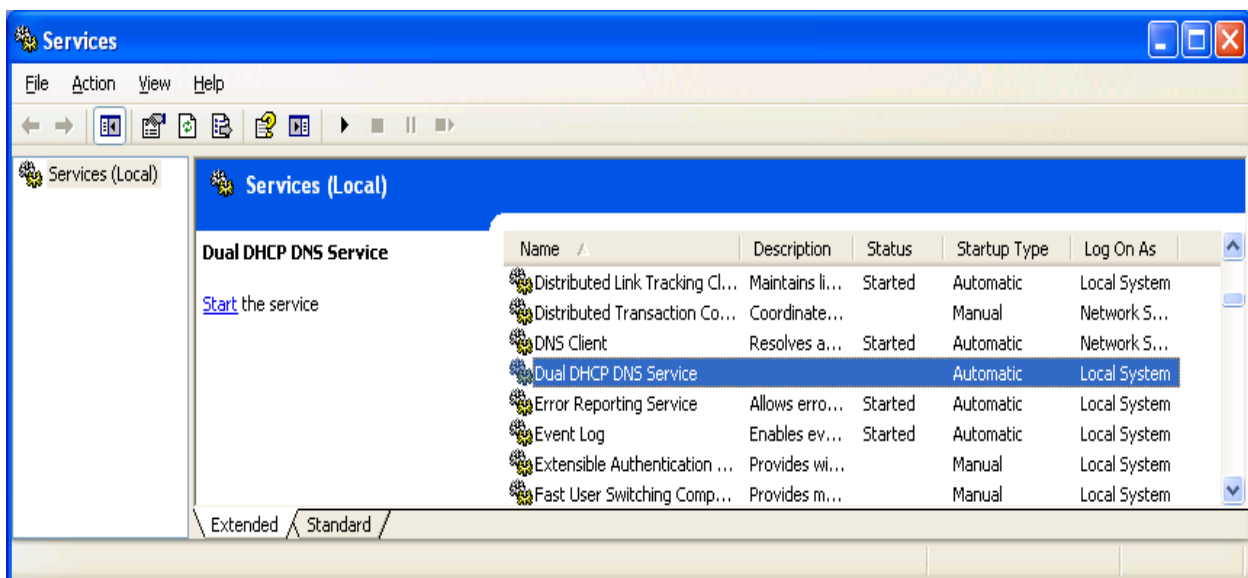
In Windows, you can run Dual Server in two different modes a) As Windows Service b) as StandAlone from Start Menu. For running it as Service you should go to windows Services Control Applet and start the Service called Dual DHCP DNS Sever. When the service is started, it will put the log in the log directory. Running StandAlone will show all the activity in the Command Window only.

```

C:\WINDOWS\system32\cmd.exe
Dual DHCP DNS Server Version 6.88 Windows Build 7006
Starting DNS...
Starting DHCP...
DHCP Range: 192.168.55.247-192.168.55.254/255.255.255.0
DHCP Range: 192.168.33.250-192.168.33.254/255.255.255.0
0 RRs imported from Secondary Server
Max Lease: 360 (sec)
Server Name: VirtualXP-18775 (Primary)
Authority for Zone: workgroup.com (168.192.in-addr.arpa)
Refresh: 360 (sec)
Retry: 10 (sec)
Expire: 36000 (sec)
Min: 20 (sec)
Default Host Expiry: 360 (sec)
Forwarding DNS Server: 192.168.1.1
Forwarding DNS Server: 192.168.56.1
Detecting Static Interfaces..
Warning: Interface 192.168.131.67 is not Static, not used
Lease Status URL: http://127.0.0.1:6789
Listening On: 192.168.55.55

```

If you have just installed the Dual Server, run it in StandAlone mode from Start Menu to see if it works fine. For normal operation you should just start the Windows Service in 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 create 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. Once you have 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
```

5.3 Starting Sequence for Primary/Secondary Mode

When Dual DHCP Server runs in Primary/Secondary mode, Primary Server has to be started first. If Primary Server is not running, secondary will not be able to start as it needs to pull the full zones before actually starting. Once Secondary Server has started, Primary server can stop or go down temporarily, secondary will continue to run. It will allocate/renew leases and will also serve External and Local DNS Queries.

When Primary server is down, the leases will be allotted/renewed secondary server but DNS Zone in secondary will not be updated with newly allotted hosts. The zone is only updated in Primary Server (with newly allotted DHCP leases and expiring leases of both servers). Secondary only replicates the Primary Zone. All new leases issued even by secondary server will not be replicated to Primary Server and Primary Server being down, its Zone will not be updated. Secondary will not be able to refresh its zone. Hence newly allotted hosts will not be added to the zone of Secondary Server. Once the primary server is restarted, everything will be automatically corrected as leases of new hosts are renewed.

6 Process of Allotting Addresses

DHCP 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.

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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) Checks if [DNS_HOSTS] has an IP associated to Hostname of this host. If this IP falls in suitable DHCPRange, it is free, then it is selected.
- c) 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. The matching range is the one which :-
 - Has the IP of server's interface from which the DISCOVER is received. If request came from a relay agent, then the range in which the IP of relay agent falls.
 - If some ranges have filters specified, then only those ranges, which meet the filter condition, will only be used. More information about these filters is available somewhere in this document.

If the range has a previously allotted address of same host, which is still free, then this IP will be re-selected, if not, then if new free address will be selected or an expired address of another client will be selected.

Once it finds a usable address, it temporarily reserves that address and sends DHCP DISCOVER.

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/Answers. There are multiple types 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 most DNS Servers, these tables are loaded (into memory) from text files called resource records. Some servers do store these records in a backend database or LDAP.

Fully Qualified Domain name means hostname. zone. For example in www.example.com, [www](http://www.example.com) is actual hostname while [example.com](http://www.example.com) is zone or domain. All records which have last part as [example.com](http://www.example.com) are part of zone [example.com](http://www.example.com). Zone [example.com](http://www.example.com) is forward zone and will be appended to all computer names of example company. www.example.com is called Fully Qualified Domain Name or fqdn. For resolving hostname to IP, this fqdn is sent to DNSServer, which returns its IP. Now for resolving IP address back to it's computer name, there will be another zone, 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. One forward entry for resolving hostname to IP and also equivalent reverse entry for resolving IP address to its hostname are created. 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. For an authorized server, although all entries are read and added to DualServer but entries not falling in any zone are not replicated.

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 authorized zone's records from its DualServer.ini file but will rather replicate these from Primary Server by regular zone transfer. Wild host records and records out of zone 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 CONDITIONAL_FORWARDERS or 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 Entries specified in DualServer.ini file or included file or DHCP Allotted entries. If a 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 CONDITIONAL_FORWARDERS. All queries including NS, SOA are forwarded. Dual Server does not forward tcp/ip queries. If resolved, these are cached (A and PTR only) before reply is sent to querying host.

7.4.2 Authorized Forwarding

If Server is an Authority for a zone, the zone specific queries are never forwarded and if host is not found in its database, NXDOMAIN (host not found) response will be sent. Suppose the DualServer is an authority for zone achal.com=55.168.192.in-addr.arpa, then all queries whose last part matches with any of these Zones will not be forwarded. In the given example in previous line, www.achal.com will not be forwarded also reverse lookup query 30. 55.168.192.in-addr.arpa will not be forwarded. Also for Authorized Server for a zone, SOA, NS, AXFR queries will be responded locally.

7.4.3 Conditional Forwarding

This is also called DNS Proxy. This can be configured under section CONDITIONAL_FORWARDERS. Before forwarding to default FORWARDING_SERVERS, DualServer will check if the queried hostname has matching zone (forward or reverse), queries will be forwarded to DNS Servers specified on right of = sign.

7.4.4 Non-Authorized entries and queries.

Dual DHCP DNS Server also allows you to make entries for External Queries (Queries which do not belong to its authorized zones). These are also resolved locally even when the server is not operating in replicated mode. These entries are not read by server when run in replicated mode and hence will not be resolved. The simple reason for this is than these entries will not be replicated to secondary server.

8 Dual Server in Multi Zone Domain.

Dual Server is single zone server that means it only supports one forward zone and one reverse zone only. This may be enough for all most organizations, who normally have just one zone. Sometimes due to management ease, a Domain is divided into multiple zones. Say example.com domain has marketing.example.com and developer.example.com zones. Each of these zones can have computers of their own like www.marketing.example.com and www.developer.example.com. Each zone will have its own set of DNS servers and main domain (example.com) has its own DNS Servers. Now Domain's DNS Server should forward queries *.marketing.example.com to DNS Server of zone marketing.example.com, *. developer.example.com to DNS Server of zone developer.example.com but all other external queries still need to be forwarded to default FORWARDING_SERVER.

If the organization has multiple zones in their domain, Dual Server can still be used both as main Domain Server and Individual zone Server. If you have a domain with multiple child zones, each zone having its own DNS/DHCP or DNS server, You can use a multizone DNS Server like bind as Main Domain Name Server, which would transfer different zones from child servers. Dual Server can be very well used as Child Zone Servers with DHCP/DNS for zone and Domain Name Server would have all the zones transferred from Child Servers.

Dual Server, despite being single zone server, still provides a way to work as main Domain Name Server for whole domain. It works differently but with same results, without even the need to transfer child zones. You can configure 1 or more Dual Servers as Master DNS Server (Domain DNS Server) for whole domain and these can forward queries to specific zone servers based on zone match. Queries not matching to zones specified in [CONDITIONAL_FORWADERS] section will be forwarded to default forwarding DNS Servers. One query will be forwarded only once to Child server and then cache is used to resolve unless it has expired. Please see the [CONDITIONAL_FORWADERS] section of ini file. Entries in [CONDITIONAL_FORWADERS] behave differently than forwarding server entries in [FORWARDING_SERVERS] section. For correct behavior you should specify child zone servers in [CONDITIONAL_FORWADERS] like:-

```
[CONDITIONAL_FORWADERS]
childzone1.workgroup.com=xxx.xxx.xxx.xxx, xxx.xxx.xxx.xxx
1.168.192.in-addr-arpa=xxx.xxx.xxx.xxx, xxx.xxx.xxx.xxx
childzone2.workgroup.com=xxx.xxx.xxx.xxx
2.168.192.in-addr-arpa=xxx.xxx.xxx.xxx
```

The child zone can have just one DNS Server or can have primary and secondary with zone replication between themselves. Domain Server would contact primary or secondary child zone server, whichever is available. You can specify one server also, if child zone has only 1 server. Main Domain Name servers should be specified as forwarding servers in child zone dns servers, so that each zone can also resolve entries in sibling child zones through main Domain Name Server. ISP or Public DNS Servers should only be specified in main Domain Name Servers. If you need full backup, minimum 2 DualServers should be

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used as main Domain Name Server for main domain with identical configuration and each child zone should have 2 DualServers, with zone replication between them only.

9 Replicated Operation.

The Dual Server have been designed and developed to do 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.

9.1 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. All the DHCP allotted hostnames are automatically added to DNS Server's records.

9.2 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 DHCP operation too. 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.

9.3 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. This keeps the DNS Database consistent between both servers.

But how about DHCP allotted hosts. 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.

9.4 Replication Schemes

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

9.4.1 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 its 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.

9.4.2 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 only 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.

9.4.3 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.

9.4.4 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.

9.4.5 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).

9.4.6 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.

9.4.7 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.

9.5 Timings for Replicated Operation

When using the replicated operation, special attention needs to be given about lease time, so that both servers quickly become in synch. It is recommended to keep the lease time to lowest possible. Sometimes a lease time of 600 seconds and refresh time of 1200 seconds may be the best, so that both servers are quickly in synch.

10 DHCP OPTIONS

10.1 Specifying options and values in Dual DHCP DNS Server

DHCP Options are 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 DHCP DNS 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 DHCP DNS Server now uses option names (less spaces/dashes) 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 hosts. List of all option name are listed in next section.

The option values are multiple types. These can be Strings, IP addresses, Integers, Byte Array or Boolean. The option value types are specified in table in next section. The format of value depends on it's type. String option values are just a string. Value strings should be quoted with double quotes. IPs can be specified using dot convention like xxx.xxx.xxx.xxx and multiple IPs can be specified like xxx.xxx.xxx.xxx, xxx.xxx.xxx.xxx where xxx is octets 0-255. Integer values can be stated as plain numbers. Integer values can be BYTE, SHORT (2 bytes) and LONG (4 bytes). Boolean values can be specified using keywords YES/NO, ON/OFF or 0/1 digit. Byte array can only be specified as Byte Array or Hex Array. Dual DHCP DNS Server always converts the all values to Byte Array for sending these to Hosts. Hence all the option values (irrespective of its type) can always be specified as Byte Array or Hex String. Options having sub-options can only be specified as Byte Array or Hex String.

Byte Array is just comma separated octet values and hex String is colon (:) separated hex bytes.

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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
```

or

```
DomainServer=192.168.0.1, 192.168.0.2
```

Now the values of these options can be specified in multiple ways. String values should 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:-

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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

10.2 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. Please note that some option values are vendor specific and should be cross verified from vendor's documents.

Tag	Option Name in Dual DHCP DNS Server	IANA Name	Option Type	Meaning
1	SubnetMask	Subnet Mask	IP	Subnet Mask Value.
2	TimeOffset	Time Offset	Long	Time Offset in Seconds from UTC (note: deprecated by 100 and 101)
3	Router	Router	IPs	N/4 Router addresses
4	TimeServer	Time Server	IPs	N/4 Timeserver addresses
5	NameServer	Name Server	IPs	N/4 IEN-116 Server addresses
6	DomainServer	Domain Server	IPs	N/4 DNS Server addresses
7	LogServer	Log Server	IPs	N/4 Logging Server addresses
8	QuotesServer	Quotes Server	IPs	N/4 Quotes Server addresses
9	LPRServer	LPR Server	IPs	N/4 Printer Server addresses
10	ImpressServer	Impress Server	IPs	N/4 Impress Server addresses
11	RLPServer	RLP Server	IPs	N/4 RLP Server addresses
12	Hostname	Hostname	String	Hostname string
13	BootFileSize	Boot File Size	Short	Size of boot file in 512 byte chunks
14	MeritDumpFile	Merit Dump File	String	Client to dump and name the file to dump it to
15	DomainName	Domain Name	String	The DNS domain name of the client
16	SwapServer	Swap Server	IP	Swap Server address
17	RootPath	Root Path	String	Path name for root disk
18	ExtensionFile	Extension File	String	Path name for more BOOTP info
19	ForwardOn/Off	Forward On/Off	Bool	Enable/Disable IP Forwarding

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20	SrcRteOn/Off	SrcRte On/Off	Bool	Enable/Disable Source Routing
21	PolicyFilter	Policy Filter	IPs	Routing Policy Filters
22	MaxDGAssembly	Max DG Assembly	Short	Max Datagram Reassembly Size
23	DefaultIPTTL	Default IP TTL	Byte	Default IP Time to Live
24	MTUTimeout	MTU Timeout	Long	Path MTU Aging Timeout
25	MTUPlateau	MTU Plateau	Shorts	Path MTU Plateau Table
26	MTUInterface	MTU Interface	Short	Interface MTU Size
27	MTUSubnet	MTU Subnet	Bool	All Subnets are Local
28	BroadcastAddress	Broadcast Address	IPs	Broadcast Address
29	MaskDiscovery	Mask Discovery	Bool	Perform Mask Discovery
30	MaskSupplier	Mask Supplier	Bool	Provide Mask to Others
31	RouterDiscovery	Router Discovery	Bool	Perform Router Discovery
32	RouterRequest	Router Request	IP	Router Solicitation Address
33	StaticRoute	Static Route	IPs	Static Routing Table
34	Trailers	Trailers	Bool	Trailer Encapsulation
35	ARPTimeout	ARP Timeout	Long	ARP Cache Timeout
36	Ethernet	Ethernet	Bool	Ethernet Encapsulation
37	DefaultTCPTTL	Default TCP TTL	Byte	Default TCP Time to Live
38	KeepaliveTime	Keepalive Time	Long	TCP Keepalive Interval
39	KeepaliveData	Keepalive Data	Bool	TCP Keepalive Garbage
40	NISDomain	NIS Domain	String	NIS Domain Name
41	NISServers	NIS Servers	IPs	NIS Server Addresses
42	NTPServers	NTP Servers	IPs	NTP Server Addresses
44	NETBIOSNameSrv	NETBIOS Name Srv	IPs	NETBIOS Name Servers, List of RFC 1001/1002 NBNS name servers in order of preference.
45	NETBIOSDistSrv	NETBIOS Dist Srv	IPs	NETBIOS Datagram Distribution. List of RFC 1001/1002 NBDD servers in order of preference.
46	NETBIOSNodeType	NETBIOS Node Type	Byte	NETBIOS Node Type 1=B-node (broadcast node) 2=P-node (point-to-point node) 4=M-node (mixed node) 8=H-node (hybrid node)
47	NETBIOSScope	NETBIOS Scope	Bool	NETBIOS Scope 1 = Enable NetBIOS over TCP/IP 2 = Disable NetBIOS over TCP/IP
48	XWindowFont	X Window Font	IPs	X Window Font Server
49	XWindowManager	X Window Manager	IPs	X Window Display Manager
51	AddressTime	Address Time	Long	IP Address Lease Time
58	RenewalTime	Renewal Time	Long	DHCP Renewal (T1) Time (should be less than Lease Time above. If not specified, default is half the Lease Time)
59	RebindingTime	Rebinding Time	Long	DHCP Rebinding (T2) Time, should be more than Lease Time above. If not specified, it is equal to Lease Time above.
62	NetWare/IPDomain	NetWare/IP Domain	String	NetWare/IP Domain Name
63	NetWare/IPOption	NetWare/IP Option	Sub Options	NetWare/IP sub Options 05 Perform NSQ Broadcast 06 Preferred DSS 07 Nearest NWIP Server(s) 08 Number of Auto Retries 09 Auto Retry Interval 10 Support NWIP 1.1 11 Primary DDS 12 IPX Network Number 13 IPX Stale Time 14 Migration Agents
64	NISDomain	NIS-Domain-Name	String	NIS+ v3 Client Domain Name
65	NISServers	NIS-Server-Addr	IPs	NIS+ v3 Server Addresses
66	TFTPServerName	Server-Name	String	TFTP Server Name
67	BootFileOption	Bootfile-Name	String	Boot File Name

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68	HomeAgentAddr	Home-Agent-Addr	IP	Home Agent Addresses
69	SMTPServer	SMTP-Server	IP	Simple Mail Server Addresses
70	POP3Server	POP3-Server	IP	Post Office Server Addresses
71	NNTPServer	NNTP-Server	IP	Network News Server Addresses
72	WWWServer	WWW-Server	IP	WWW Server Addresses
73	FingerServer	Finger-Server	IP	Finger Server Addresses
74	IRCServer	IRC-Server	IP	Chat Server Addresses
75	StreetTalkServer	StreetTalk-Server	IP	StreetTalk Server Addresses
76	STDAserver	STDA-Server	IP	ST Directory Assist. Addresses
78	DirectoryAgent	Directory Agent	String	directory agent information
79	ServiceScope	Service Scope	String	service location agent scope
83	iSNS	iSNS	String	Internet Storage Name Service
85	NDSservers	NDS Servers	IPs	Novell Directory Services
86	NDSTreeName	NDS Tree Name	String	Novell Directory Services
87	NDSContext	NDS Context	String	Novell Directory Services
95	LDAP	LDAP	String	Lightweight Directory Access Protocol
100	PCode	PCode	String	IEEE 1003.1 TZ String
101	TCode	TCode	String	Reference to the TZ Database
112	NetinfoAddress	Netinfo Address	IPs	NetInfo Parent Server Address
113	NetinfoTag	Netinfo Tag	String	NetInfo Parent Server Tag
114	URL	URL	String	URL
116	AutoConfig	Auto-Config	Bool	DHCP Auto-Configuration
117	NameServiceSearch	Name Service Search	Sub Options	Name Service Search
118	SubnetSelectionOption	Subnet Selection Option	IPs	Subnet Selection Option
119	DomainSearch	Domain Search	String	DNS domain search list
120	SIPserversDHCPoption	SIP Servers DHCP Option	String	SIP Servers DHCP Option
121	ClasslessStaticRouteOption	Classless Static Route Option	String	Classless Static Route Option
122	CCC	CCC	String	CableLabs Client Configuration
128	TFTPPhoneServer	TFTP Server IP address (for IP Phone software load)	IPs	This is not PXE Boot TFTP Server, please use NextServer for PXE Boot Server.
129	CallServerIPaddress	Call Server IP address	IPs	
130	Discriminationstring	Discrimination string (to identify vendor)	String	
131	RemotestatisticsserverIPaddress	Remote statistics server IP address	IPs	
135	HTTPProxyPhone	HTTP Proxy for phone-specific applications	IPs	
141	SIPUAServiceDomains	SIP UA Service Domains	String	SIP UA Service Domains
150	TFTPserverAddress	TFTP server address	IPs	This is not PXE Boot TFTP Server, please use NextServer for PXE Boot Server.
176	IPTelephone	IP Telephone (Tentatively Assigned - 2005-06-23)	String	
209	ConfigurationFile	Configuration File	String	Configuration file
210	PathPrefix	Path Prefix	String	Path Prefix Option
211	RebootTime	Reboot Time	Long	Reboot Time
255	End	End		None

10.3 Dual DHCP DNS Server specific DHCP Header Field Options

There are some Dual DHCP DNS Server special options, although configured as Options which do not go as vendor options but are used to fill the DHCP Header fields only.

	BootFileName	Boot File Field in DHCP Header	128 Bytes Max
	NextServer	PXE TFTP Server Field in DHCP Header	IP Address
	TargetRelayAgent	This option forces the DHCP OFFER to go to specified relay agent. Can be used to override the default relay agent sent in DHCPDISCOVER	IP Address

11 Configuration Tips

There may special/tricky requirements for Configuration. Some of the tips are:

Requirement	Tip
DHCP Should only allot single address to all hosts (one host at a time)	Specify only one RANGE_SET with range like: DHCP Range=192.168.55.1-192.168.55.1
I want to disable some Mac Addresses from Getting Address from DHCP Server	There are two ways to do this. If there are discreet Mac Addresses, add these as Static Hosts without an IP address. If there is a range of Mac Addresses, Create a new [RANGE_SET] and specify the Mac Range, without specifying any actual DHCPRange.
I am using Relay Agent and want to select DHCP Range based on Subnet of Relay Agent IP	This feature is automatic, no special filter is required. Open DHCP Server will select Matching Range to (in order): a) Subnet IP (option 118) b) Relay Agent IP c) Incoming Interface's IP (if no relay agent or subnet is specified in DHCP Request). You can override this automatic range selection using SubnetSelectionFilter (see Range filters)
I want to disable some subnets getting address from this server	Create a [RANGE_SET] specifying all such relay agent IP or Interface IP as SubnetSelectionFilter and don't specify any actual DHCPRange.
I want to specify different IP range for all my departments or customers or makes	User Class (DHCP Option 77) need to be used for this. Please set User Class for the computers based for a Department and use FilterUserClass in RANGE_SET to be used for a department.
I want to set up PXE Boot and want to specify TFTP Server IP	Specify the option NextServer=x.x.x.x under suitable DHCP Section. Make sure that tftp server (Next Server) is available and also file system (operating system) may be needed.
I want to specify boot file	Boot file can go in Header Field as well as under vendor option. Different DHCP Client behaves differently. There are two option names for this. If a option named BootFileName is specified, boot file name will go to header, but if size of filename is longer than 128, it will automatically switched and will be sent as Vendor Option. On the other hand if BootFileOption option is specified, it will be only sent as vendor option (nothing in header). If both are specified both Header and Vendor Option will be sent.
I want to specify sub-options for an option	Just create a string of bytes you want to send and put these as either byte array or hex array in configuration.

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My DHCP hosts need hostname from DHCP Server	Use Static Entries for DHCP Hosts and state the hostname for each entry there.
I have a corporate DNS Server(s) and I want to use Dual Server for one or more zones.	There are two ways to do this: a) If corporate DNS server supports conditional forwarding, let it send filtered queries for your zone to DualServer. b) If corporate server is multizone server, let the corporate server pull zone from DualServer periodically, after checking serial. Both the cases set the first Default Forwarding Server of your Zone Server (DualServer) to your corporate DNS server.
I have some IP6 queries	Dual Server forwards and resolves external IP6 queries but it do not cache these. You cannot specify IP6 addresses or IPs for local hosts in this version.
My ISP keeps changing its DNS Servers and Default Gateway.	There is no way in Dual Server to detect that.

12 Debugging

12.1 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.
- 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.

12.2 Linux

- Ensure that you run this program as root only.
- 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 netstat command to detect which program is listening on these ports. It is also possible that another copy of dualserver itself is running.

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- 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.
- /tmp/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.