THOMSON

DHCP Route Options

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Abstract: This application note provides theoretical and practical information on the use of DHCP route options in the various Thomson Gateway products.

Applicability: This application note applies to all Thomson Gateway products.

Updates: Thomson continuously develops new solutions, but is also committed to improving its existing products.

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Contents

1 Introduction

DHCP

The Dynamic Host Control Protocol (DHCP) provides a framework for passing configuration information to hosts on an IP network. IP configuration information and other parameters are carried in tagged data items called DHCP options.

DHCP Options

DHCP options are variable length containers with a Tag-Length-Value (TLV) structure:

- The first octet, the ***tag field***, uniquely identifies the option type. The value for the tag can range from 0 till 255. Many of the option types are standardized and can be found on http://www.iana.org/assignments/bootp-dhcp-parameters.
- The ***tag field*** is followed by the ***length field***. This field indicates the length of the ***value field***.
- The last field called ***value field*** contains the configuration information in the format defined by the option type itself.

DHCP Route Options

IP packets rely on routes to find their way to their end destination. For each packet the sending host consults its local routing table to find out whether there is a route for the specified destination. If there is one, the packet is transmitted and as such it gets closer to its end destination. If no applicable route is found, the packet is dropped and an error message is issued.

In order for the sending host to find a route, this route must exist in its routing table. There are two classes for routes. Depending on the route class, the routes are supplied to the routing table in a different way:

- Dynamic routes: These routes are supplied via routing protocols (RIP, BGP, OSPF).
- Static routes: These routes are the result of administrative configuration.

Routes that arrive via from DHCP are static routes. The DHCP Options to convey these routes are:

- Option 3: Default routes only
- Option 33: Classful static routes
- Option 121: Classless static routes including default routes

The reason behind these three route options is historical. Initially there was only option 3 assigning a default route to hosts. For non-default situations another option was needed: option 33. However option 33 is classfull hence a third option was added, option 121, to cope with the current classless IP environment.

The next chapters will explains all possible aspects of these three DHCP route options.

The IP adresses used in the following examples are fictional and do not reflect an actual set-up which can be used in the field.

2 Terminology

Route

Simply stated, a route is a path to a destination.
Although generally applicable, this definition is too broad to be of practical use. Therefore, a more precise definition is needed:
An IP route is an entry in the routing table (actually the forwarding table) of an IP gateway (also called router).

Route entry

Any IP gateway contains a routing table which stores all routing entries that it is aware of.
Each route entry consists of the following parameters:

- Destination Prefix
- [Gateway IP]
- [Interface ID]
- [Route metric]

[..] indicates that the parameter in the route entry is optional.

Example:

Destination	Gateway	Interface	Metric
20.0.0.0/24	10.0.0.254	lan1	0

Destination Prefix

A Destination Prefix or simply Prefix describes a set of IP destinations. A single IP destination is fully specified via its IP address. Multiple related IP destinations are referenced via an IP prefix which is the combination of an IP address and a netmask. In general, a netmask is identical to prefix length.

Example:
10.0.0.1 refers to a single host. 10.0.0.0/24 refers to 253 hosts i.e. 255 hosts – NetID (10.0.0.0) – Directed Broadcast (10.0.0.255).

A Destination Prefix in a route may be equal to an IP prefix but it may also aggregate multiple IP prefixes. e.g.: The following IP-prefixes 10.0.0.0/24, 10.0.1.0/24, 10.0.2.0/24, 10.0.3.0/24 are summarized (or aggregated) into: 10.0.0.0/23.

Gateway IP

Is the IP address of the gateway via which the destinations are assumed to be reachable.
A gateway forwards packets of which the IP destination matches a route's prefix, to the gateway identified with Gateway IP in the route. Via this forwarding action a packet may reach its end destination or at least get closer to it.

Interface ID

The outcome of a route look-up is two-fold: It yields the gateway's IP address of the "next-hop" in the end-to-end path and the interface (actually Interface ID) on which a packet needs to be transmitted.
The Interface ID is often implicitly specified via the relation Gateway IP / Interface IP.

Route metric

In some situations the same set of destinations is reachable via multiple paths. However routes are analyzed in sequential order so an ordering criterion is needed. This is the role of the route metric field: it indicates the relative importance of a route within a set of similar routes. The lower the metric the higher the importance of the route within the set of similar routes.

Link

Any set of network attachment points that will all receive a link-layer broadcast sent on any one of the attachment points. This term is used in DHCP because in some cases more than one IP subnet may be configured on a link. DHCP uses a local- network (all-ones) broadcast, which is not subnet-specific, and will therefore reach all nodes connected to the link, regardless of the IP subnet or subnets on which they are configured. A link is sometimes referred to as a broadcast domain or physical network segment.

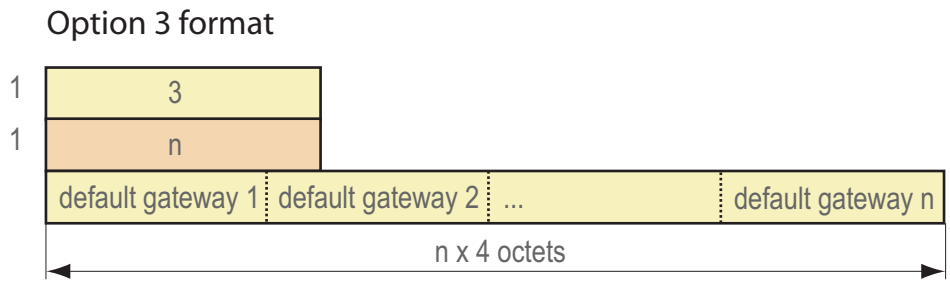
3 Option 3

Definition

Option 3 is the ***default routers*** or ***default gateways*** option which specifies the IP addresses of the default gateways (Gateway IPs). The default routes are created by combining each Gateway IP with the well known Destination Prefix 0.0.0.0/0 (implies all destinations). This Destination Prefix is encoded in the option code and therefor not visible.

After installing a default route the gateway will forward all traffic for which it has no specific route to the gateway(s) indicated in the option.

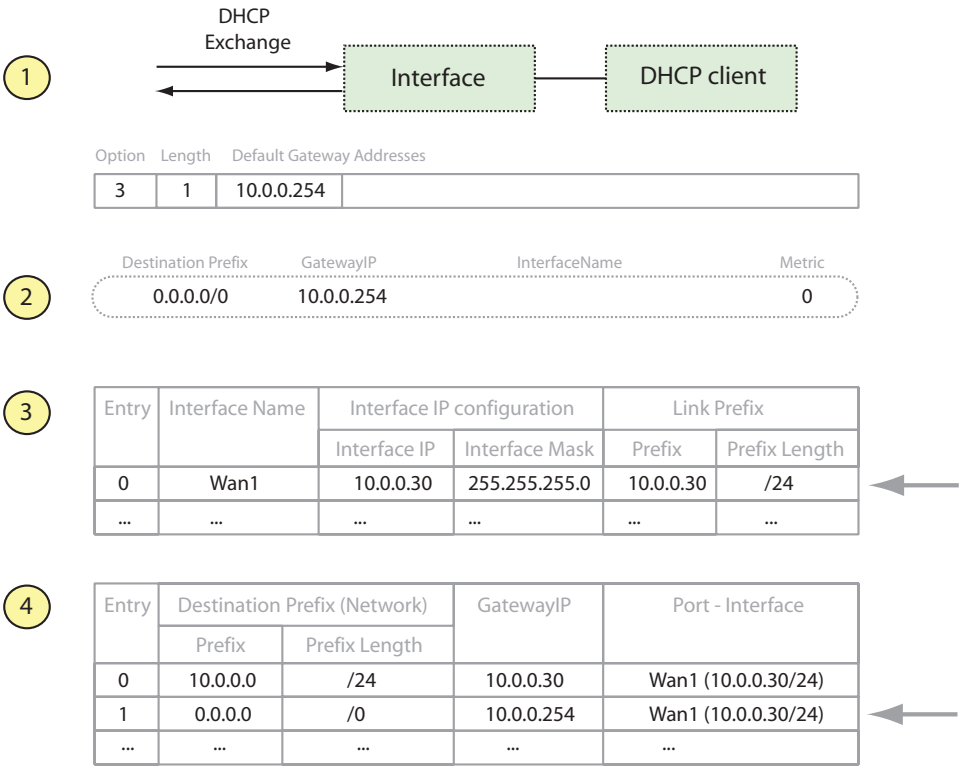
The minimum length for the default gateway option is 4 octets. The length must always be a multiple of 4. The graphic belows shows the format of the default gateway option:



3.1 Example of option 3

Theoretical

The following example shows how a default route is added to the routing table of the DHCP client with option 3:



The IP adresses used in this example are fictionary and do not reflect an actual realization used in the field.

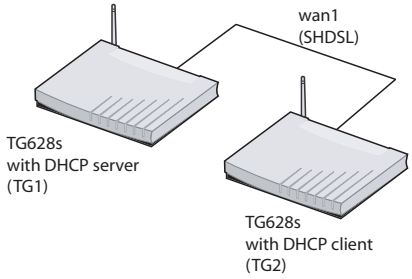
DHCP route metric:
In case Option 3 contains multiple default Gateway IPs, multiple default routes will be injected with their metric set to the relative order of the IP addresses in the option.

e.g. Suppose Option 3 contains: 20.0.0.254, 20.0.0.253, 20.0.0.252. Then three default routes will be added:

- Destination Prefix= 0.0.0.0/0 Gateway IP= 20.0.0.254 Metric= 0
- Destination Prefix= 0.0.0.0/0 Gateway IP= 20.0.0.253 Metric= 1
- Destination Prefix= 0.0.0.0/0 Gateway IP= 20.0.0.252 Metric= 2

With CLI Commands

The graphic below shows the setup used for this example.



To view all routes in the routing table of TG1 in the initial configuration, execute the following command on TG1:

The existing default IP addresses 192.168.1.254 and 10.0.0.138 are removed on both Thomson Gateways.

```
:ip rtlist expand=enabled


Flags Legend:
        [A]uto,   [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,      [G]ateway,  [U]p

Label  Destination              Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       127.0.0.1|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1    A..D.H.U  ADMIN      0
       255.255.255.255|32       127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1    .....H.U  ADMIN      0
```

127.0.0.1/32 is an internal route in the Thomson Gateway (loopback) and 255.255.255.255/ is the route used for broadcast messages.

To add and configure a new DHCP client interface, execute the following commands on TG2:

```
:dhcp client ifadd intf=wan1
:dhcp client ifconfig intf=wan1
```

To view all interfaces, including the new DHCP client interface wan1, execute the following command onTG2:

```
:ip iflist
Interface                          Group  MTU   RX         TX         Admin  Oper
0   loop. . . . . . . . . . . . . .  local  65535 2109       2624       UP     [UP]
1   wan1. . . . . . . . . . . . . .  wan    1500  3794       1949       UP     UP
```

To view all routes in the routing table of TG2 with the DCHP client interface wan1, execute the following command on TG2:

```
:dhcp client ifattach intf=wan1
:ip rtlist expand=enabled


Flags Legend:
        [A]uto,   [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,      [G]ateway,  [U]p

Label  Destination              Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       10.0.0.30|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP       0
       10.0.0.255|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP       0
       127.0.0.1|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  ADMIN     14
       255.255.255.255|32       127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     .....H.U  ADMIN     21
       10.0.0.0|24             10.0.0.30     wan1       0   UP      UP    default       10.0.0.30     A..D...U  DHCP       0
```

The routes with destination 10.0.0.30/32, 10.0.0.255/32 and 10.0.0.0/24 are added with the interface wan1.

To add option 3 in the option request options of this DHCP client interface, execute the following commands on TG2 (for more information about option request options see Option priority in parameter request list option):

```
:dhcp client ifdetach itf=wan1
:dhcp client rqoptions add intf=wan1 option=default-routers index=1
:dhcp client rqoptions list
Interface                              :  wan1

          DHCP Options                        :   3 default-routers
```

Configure option 3 in the DHCP server on TG1 as follows:

Destination	Gateway	Interface	Metric
	10.0.0.254		1

To attach the DHCP client interface wan1 and see the result of this action, execute the following commands on TG2:

```
:dhcp client ifattach intf=wan1
:dhcp client iflist expand=enabled
DHCP Client Info :

     Interface                         :  wan1

          DHCP Client State            :  [BOUND]
          HW address                   :  00:18:f6:6d:c7:65
          Client ID                    :
          User Class ID                :
          Vendor Class ID              :
          Link state                   :  up
          Mode                         :  broadcast
          DHCP server route            :  disabled
          Follow route label           :  disabled

          IP Address                   :  10.0.0.30
          Netmask                      :  255.255.255.0
          Default Gateway              :  10.0.0.254
          DNS Server 1                 :
          DNS Server 2                 :
          DHCP Server                  :  0.0.0.0

          DHCP Options                 :
                Transmitted            :  50 dhcp-requested-address

                Requested              :   3 default-routers

                Received               :   3 default-routers

          Route metric                 :  1
          DNS metric                   :  0

          Lease renews                 :  0 days, 0:00:34
          Lease rebinds                :  0 days, 0:02:26
          Lease expires                :  0 days, 0:04:58
```

The DHCP client has requested and received option 3 from the DHCP server on TG1.

To view the routes in the routing table of TG2, including the newly added through option 3, execute the following command on TG2:

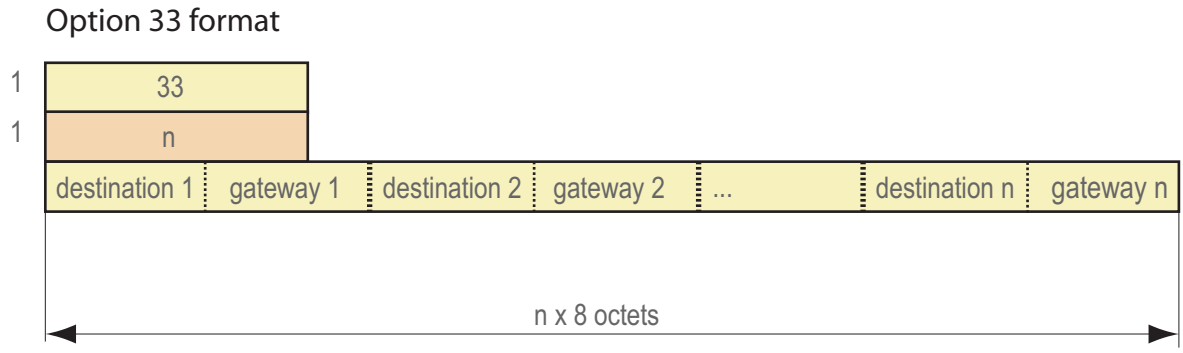
```
:ip rtlist expand=enabled

Flags Legend:
        [A]uto,   [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,      [G]ateway,  [U]p

Label  Destination              Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       10.0.0.30|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       10.0.0.255|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       127.0.0.1|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  ADMIN    14
       255.255.255.255|32       127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     .....H.U  ADMIN    26
       10.0.0.0|24              10.0.0.30    wan1       0   UP     UP     default       10.0.0.30     A..D...U  DHCP      0
       0.0.0.0|0                10.0.0.254   wan1       1   UP      UP    default       10.0.0.30     ...D..GU   DHCP     0
```

4 Option 33

Definition

Option 33, also referred to as ***(classful) static route*** option, specifies a list of static routes. Each static route is specified by a pair of IP addresses. The first address of each pair refers to a classfull Destination Prefix and the second address is the Gateway IP via which this prefix is reachable.

The minimum length of this option is 8. The length must always be a multiple of 8. The graphic below shows the format of the classful static route option:



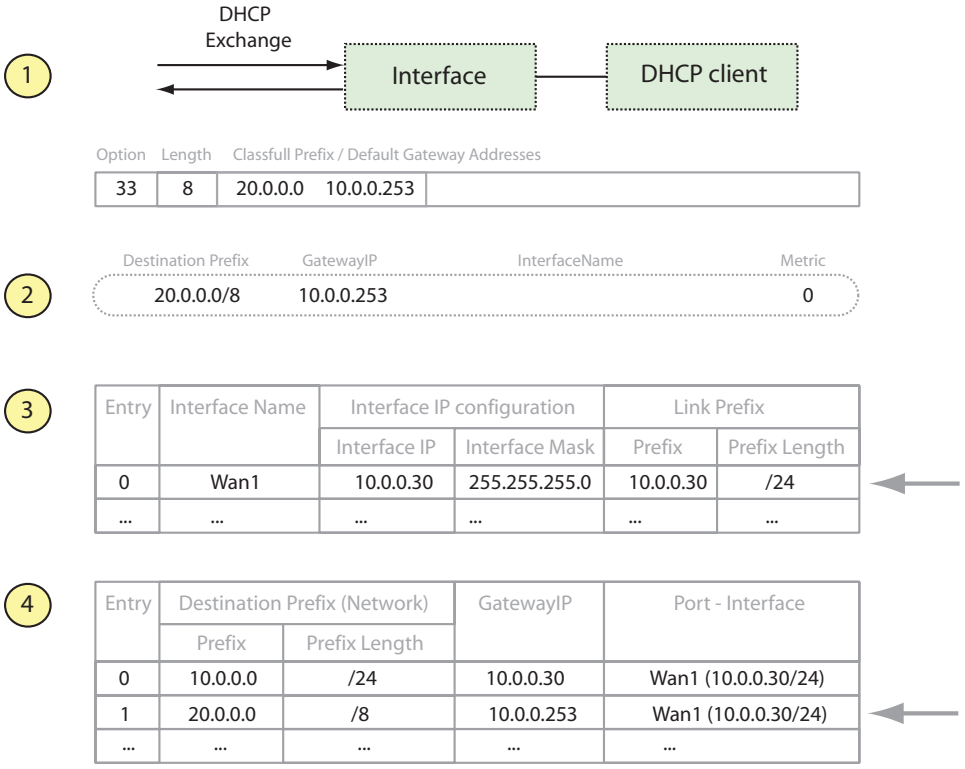
In classful IP, the prefix length is derived from the destination prefix using a class (A,B,C,D) whose value is determined by the first few bits of the prefix.

Class	Leading Bits	Prefix Length
A	0	/8
B	10	/16
C	110	/24

4.1 Example of option 33

Theoretical

The following example shows how a static route is added to the routing table of the DHCP client with option 33:



With CLI Commands

The default route (0.0.0.0) is an illegal destination for a static route as it should be carried in either Option 3 or 121.

DHCP route metric:
In case Option 33 contains multiple IP address pairs, multiple static routes will be injected with their metric set to the relative order of the IP address pairs in the option.

We use the same set-up as in the previous example.

Configure option 3 in the DHCP server on TG1 as follows:

Destination	Gateway	Interface	Metric
20.0.0.0	10.0.0.253		1

To delete option 3 and add option 33 in the option request options of the DHCP client interface , execute the following commands on TG2 (for more information about option request options see Option priority in parameter request list option):

```
:dhcp client ifdetach intf=wan1
:dhcp client rqoptions delete intf=wan1 option=default-routers
:dhcp client rqoptions add intf=wan1 option=classfull-static-routes index=1
:dhcp client ifattach intf=wan1
:dhcp client iflist expand=enabled
DHCP Client Info :

     Interface                          :  wan1

          DHCP Client State             :  [BOUND]
          HW address                    :  00:18:f6:6d:c7:65
          Client ID                     :
          User Class ID                 :
          Vendor Class ID               :
          Link state                    :  up
          Mode                          :  broadcast
          DHCP server route             :  disabled
          Follow route label            :  disabled

          IP Address                    :  10.0.0.30
          Netmask                       :  255.255.255.0
          Default Gateway               :
          DNS Server 1                  :
          DNS Server 2                  :
          DHCP Server                   :  0.0.0.0

          DHCP Options                  :
                 Transmitted            :  50 dhcp-requested-address

                 Requested              :  33 classfull-static-routes

                 Received               :  33 classfull-static-routes

          Route metric                  :  1
          DNS metric                    :  0

          Lease renews                  :  0 days, 0:02:27
          Lease rebinds                 :  0 days, 0:04:19
          Lease expires                 :  0 days, 0:04:57
```

The DHCP client has requested and received option 33 from the DHCP server on TG1.

To view the routes in the routing table of TG2, including the newly added through option 33, execute the following command on TG2:

```
:ip rtlist expand enabled

Flags Legend:
        [A]uto,    [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,       [G]ateway,  [U]p

Label  Destination              Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       10.0.0.30|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       10.0.0.255|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       127.0.0.1|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  ADMIN    14
       255.255.255.255|32       127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1      .....H.U  ADMIN    31
       10.0.0.0|24              10.0.0.30    wan1       0   UP     UP     default       10.0.0.30     A..D...U  DHCP      0
       20.0.0.0|8               10.0.0.253   wan1       1   UP     UP     default       10.0.0.30    ...D..GU   DHCP      0
```

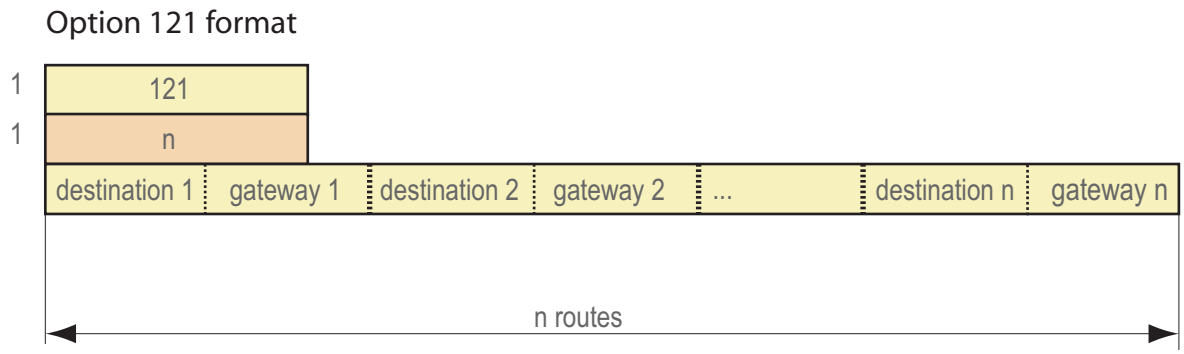
5 Option 121

Definition

Option 121, also referred to as ***classless static route*** option, allows assigning any route via DHCP. The difference with Option 33 is that the prefix length is not restricted to the three wellknown address classes (see "4 Option 33" on page 10 for more information).

Each static route in this option consists of a destination descriptor and a Gateway IP. Destination descriptors describe the Destination Prefix and its prefix length using a compact encoding (see "5.2 Compact Encoding" on page 16).

The minimum length for option 121 is 5 bytes. The graphic below shows the format for the classless static route option:

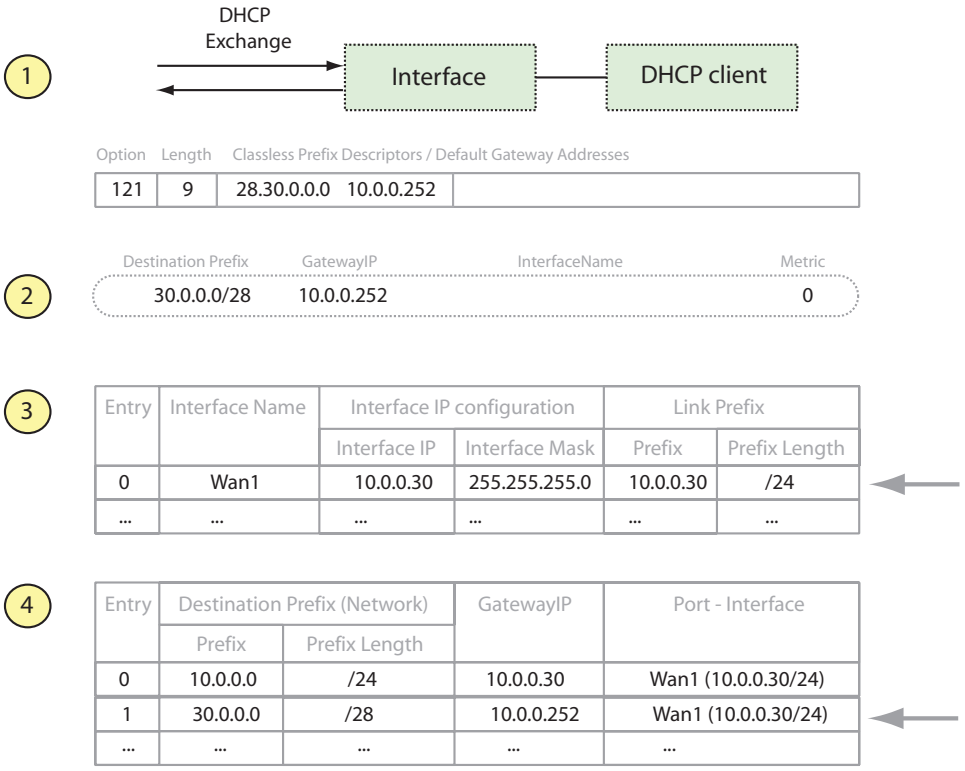


In some cases more than one IP subnet may be configured on a link. In such cases, a host whose IP address is in one IP subnet in the link can communicate directly with a host whose IP address is in a different IP subnet on the same link. In cases where a client is being assigned an IP address on an IP subnet on such a link, for each IP subnet in the link other than the IP subnet on which the client has been assigned the DHCP server can be configured to specify a router IP address of 0.0.0.0.

5.1 Example of option 121

Theoretical

The following example shows how a classless static route is added to the routing table of the DHCP client with option 121:



DHCP clients that support this option must not install the routes specified in option 3 and/or 33 if these options are provided also.

DHCP route metric:
In case Option 121 contains multiple destination descriptor/Gateway IP pairs, multiple static routes will be injected with their metric set to the relative order of the destination descriptor/Gateway IP pairs in the option.

With CLI Commands

We use the same set-up as in the previous example.

Configure option 3 in the DHCP server on TG1 as follows:

Destination	Gateway	Interface	Metric
28.30.0.0.0	10.0.0.252		1

To delete option 33 and add option 121 in the option request options of the DHCP client interface , execute the following commands on TG2 (for more information about option request options see Option priority in parameter request list option):

```
:dhcp client ifdetach intf=wan1
:dhcp client rqoptions delete intf=wan1 option=classfull-static-routes
:dhcp client rqoptions add intf=wan1 option=classless-static-routes index=1
:dhcp client ifattach intf=wan1
:dhcp client iflist expand=enabled
DHCP Client Info :

     Interface                          :  wan1

           DHCP Client State            :  [BOUND]
           HW address                   :  00:18:f6:6d:c7:65
           Client ID                    :
           User Class ID                :
           Vendor Class ID              :
           Link state                   :  up
           Mode                         :  broadcast
           DHCP server route            :  disabled
           Follow route label           :  disabled

           IP Address                   :  10.0.0.30
           Netmask                      :  255.255.255.0
           Default Gateway              :
           DNS Server 1                 :
           DNS Server 2                 :
           DHCP Server                  :  0.0.0.0

           DHCP Options                 :
                  Transmitted           :  50 dhcp-requested-address

                  Requested             : 121 classless-static-routes

                  Received              : 121 classless-static-routes

           Route metric                 :  1
           DNS metric                   :  0

           Lease renews                 :  0 days, 0:02:24
           Lease rebinds                :  0 days, 0:04:16
           Lease expires                :  0 days, 0:04:54
```

The DHCP client has requested and received option 121 from the DHCP server on TG1.

To view the routes in the routing table of TG2, including the newly added through option 121, execute the following command on TG2:

```
:ip rtlist expand enabled

Flags Legend:
        [A]uto,   [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,      [G]ateway,  [U]p

Label  Destination              Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       10.0.0.30|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       10.0.0.255|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       127.0.0.1|32             127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  ADMIN    14
       255.255.255.255|32       127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     .....H.U  ADMIN    37
       30.0.0.0|28              10.0.0.252   wan1       1   UP      UP    default       10.0.0.30     ...D..GU  DHCP      0
       10.0.0.0|24              10.0.0.30    wan1       0   UP     UP     default       10.0.0.30     A..D...U  DHCP      0
```

5.2 Compact Encoding

Encoding rules

Compact encoding consists of one octet describing the prefix length, followed by all the significant octets of the prefix.

The number of significant octets is the prefix length divided by eight, rounding up, as shown in the following table:

Prefix Length	Number of Significant Octets
0	0
1-8	1
9-16	2
17-24	3
25-32	4

The table below shows some examples of destination descriptors:

Prefix	Prefix Length	Destination Descriptor
0	0	0
10.0.0.0	8	8.10
10.17.0.0	16	16.10.17
10.229.0.128	25	25.10.229.0.128
10.198.122.47	32	32.10.198.122.47

5.3 Option 249

Definition

Option 249, also referred to as ***MicroSoft (MS) classless static route*** is the same as option 121 but for MS servers. This option was used by Microsoft because option 121 was not standardized yet at the time of need.

6 Option priority in parameter request list option

Explanation

Option 55 is the Parameter Request List (PRL) option. The DHCP client includes this PRL option in discover and request messages to notify the DHCP server which parameters it needs. The list of requested parameters is specified as n octets, where each octet is a valid DHCP option code.

The options are listed in order of preference. The DHCP server tries to insert the requested options in the order requested by the client.

When configuring/customizing the Thomson Gateway DHCP client (e.g. instead of PPP for dynamic WAN addressing), please keep in mind to configure a PRL to successfully obtain a lease.

While configuring the PRL make sure the interface of the Thomson Gateway DHCP client is detached.

The minimal PRL contains the following options in order of preference:

Order Number	Option Number	Option Description
1	51	Lease time
2	58	Renewal time
3	59	Rebinding time
4	1	Mask
5	121	Classless static route
6	3	Default gateway
7	33	Static route
8	6	Domain Name Servers (DNS)

The following guidelines concerning the order of preference for router options apply:

- The classless static route option must appear in the parameter request list prior to both the default gateway option and the static route option, if present.
- DHCP clients that support the classless static router option and that send a PRL option must request both this option and the default gateway option in the PRL. The static route option can also be added for compatibility with older servers that don't support classless static routes.

With CLI Commands

We use the same set-up as in the previous example.

Configure the following options in the DHCP server on TG1:

- Option 3:

Destination	Gateway	Interface	Metric
	10.0.0.254		1

- Option 33:

Destination	Gateway	Interface	Metric
20.0.0.0	10.0.0.253		1

- Option 121:

Destination	Gateway	Interface	Metric
28.30.0.0.0	10.0.0.252		1

To configure and view the result of a minimal PRL for the DHCP client, execute the following commands on TG2:

```
:dhcp client ifdetach intf=wan1
:dhcp client rqoptions add intf=wan1 option=51 index=1
:dhcp client rqoptions add intf=wan1 option=58 index=2
:dhcp client rqoptions add intf=wan1 option=59 index=3
:dhcp client rqoptions add intf=wan1 option=1 index=4
:dhcp client rqoptions add intf=wan1 option=121 index=5
:dhcp client rqoptions add intf=wan1 option=3 index=6
:dhcp client rqoptions add intf=wan1 option=33 index=7
:dhcp client rqoptions add intf=wan1 option=6 index=8
:dhcp client rqoptions list
Interface                              :  wan1

          DHCP Options                        :  51 dhcp-lease-time
                                                 58 dhcp-renewal-time
                                                 59 dhcp-rebinding-time
                                                  1 subnet-mask
                                                121 classless-static-routes
                                                  3 default-routers
                                                 33 classfull-static-routes
                                                  6 domain-name-servers
:dhcp client ifattach intf=wan1
```

To view the routing table of TG2 which shows the result of the PRL, execute the following command on TG2:

```
:ip rtlist expand=enabled

Flags Legend:
        [A]uto,   [I]nterface, [M]odified, [D]ynamic,
        [R]eject, [H]ost,      [G]ateway,  [U]p

Label  Destination             Gateway      Interface  Mtc Admin  Oper   Src Select    Src Address   Flags     Origin  Use
       10.0.0.30|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       10.0.0.255|32           127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  DHCP      0
       127.0.0.1|32            127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     A..D.H.U  ADMIN    14
       255.255.255.255|32      127.0.0.1    loop       0   UP     [UP]   default       127.0.0.1     .....H.U  ADMIN    39
       30.0.0.0|28             10.0.0.252   wan1       1   UP     UP     default       10.0.0.30     ...D..GU   DHCP     0
       10.0.0.0|24             10.0.0.30    wan1       0   UP     UP     default       10.0.0.30     A..D...U DHCP       0
```

7 DHCP server route option policy

Explanation

The Thomson Gateway DHCP server behaviour concerning route options can be configured as follows:

- Traditional policy: Use of Option 3 and Option 33 only. The DHCP server is “unaware” of options 121 and 249 hence no response on the latter two.
- Standard policy: Compliant with the behavior described in RFC2132 and RFC 3442. The DHCP server is unaware of option 249 hence no response on this option.
- MSFT policy: The DHCP server knows all route options but responds in a way that is as close as possible to RFC2132 and RFC3442 following the Microsoft logic.

The table below shows how the Thomson Gateway DHCP server will behave in the various policy modes:

DHCP Client Parameter Request List	Traditional Mode	Standard Mode	MSFT Mode
3	3	3	3
3, 33	3, 33	3, 33	3, 33
3, 33, 121	3, 33	121	121
3, 33, 249	3, 33	3, 33	249
3, 33, 121, 249	3, 33	121	121

With CLI Commands

The default settings of the Thomson Gateway DHCP server can be found by executing the following command:

```
:dhcp server policy
Verifyfirst: enabled
Trustclient: enabled
Rtbehaviour: traditional
The other options of the rtbehaviour are: standard and msft.
```

8 Static Route Types

8.1 Introduction

Standard routes

A standard route is always defined by the pair *(Destination Prefix, Gateway IP)*. The Gateway IP must match with an Interface Prefix.

Interface routes

An interface route is defined by *(Destination Prefix, Interface Name)*. The Interface Name must match with any of the available Interface Names defined in the Thomson Gateway. In case of DHCP, Interface Name is derived from the interface to which the DHCP Client is attached.

Extended routes

An extended route is defined by *(Destination Prefix, Gateway IP, Interface Name)*. Regarding Interface Name, the same remarks apply as for interface routes.

Connected routes vs. static routes

Connected routes are routes which are the consequense of putting an Destination Prefix on an interface (a typical example is loop).

8.2 Static route types with option 3

When adding default routes in the Thomson Gateway routing table the following parameters must be readily available:

- Destination Prefix for the default route option: Derived from the option itself and equal to 0.0.0.0/0.
- Gateway IP: Equal to the IP address conveyed in the option.
- Interface Name/Interface IP: Derived directly via Gateway IP lookup or indirectly via the relation DHCP client - Interface Name.

If the Gateway IP is not 0.0.0.0, it is used to look up the Interface IP and Interface Name. This is done by matching the Gateway IP against the various Interface Prefixes in the interface list (the Interface Prefix is derived from Interface IP and Interface Mask):

- In case of a match, the route is interpreted as a ***standard route***.
- In case of no match, the route is interpreted as an ***extended route***. The Interface Name is derived from the IP Interface on which the DHCP client is sending and receiving.

If the Gateway IP is equal to 0.0.0.0 the route is interpreted as an ***interface route***. That is, at the server side the Gateway IP is set to 0.0.0.0 and this is interpreted at the client side as an interface route. The Interface Name is derived from the interface on which the DHCP messages are sent and received.

An interface route can also be obtained when the Interface IP is static by setting the Gateway IP address equal to the Interface IP address in the DHCP server.

8.3 Static routes types with option 33

When adding (classfull) static routes in the Thomson Gateway routing table the following parameters must be readily available:

- Destination Prefix: Derived from the first IP address itself. The prefix length is derived from the leading address bits.
- Gateway IP: Is set to the second IP address of the option.

If the Gateway IP is within an Interface Prefix, routes announced via this option are ***standard routes***. When the Gateway IP has no relation with any Interface Prefix it is enterpreted as an ***extended route***. The Thomson Gateway will use the Interface Name on which the DHCP client is sending and receiving to add the route to the routing table.

Interface routes conveyed via this option can be created by setting the Gateway IP to 0.0.0.0 at the server side. This is interpreted as an interface route at the client side. The Interface Name of the interface on which the DHCP reply was received is used to add the route in the routing table. Another way to create interface routes is by setting the Gateway IP equal to the Interface IP in the DHCP Server (the Interface IP needs to be static for this).

It is possible to announce a mix of standard routes, extended routes and interface routes in one option 33 field.

Default routes announced via option 33 are rejected.The default route (0.0.0.0) is an illegal Destination Prefix for a static route.

8.4 Static route types with option 121

Similar as the default gateway and static route option, the classless static route option can convey ***standard routes***, ***interface routes***, and ***extended routes***:

- Destination Prefix: Derived from the first IP address itself via compact encoding. The prefix length is derived from the first octet.
- Gateway IP: Is set to the second IP address of the option.

If both static routes and classless static routes are present in the same DHCP reply message, the static route option is ignored.

If both an classless static route and an default gateway option are present in the same DHCP reply message, the default gateway option is ignored.

If all three options are present, the default gateway and static route options are ignored.

9 Appendix

Relevant RFCs

The table below shows the relevant RFCs for the topics in this document:

RFC	Description
RFC2131	Dynamic Host Control Protocol
RFC2132	DHCP Options and BOOTP Vendor Extensions
RFC3442	The Classless Static Route Option (121) for DHCP version 4

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