<https://www.linux.com/community/blogs/133-general-linux/283637>

## [Troubleshooting connection problems with TCPDUMP: DHCP](https://www.linux.com/community/blogs/133-general-linux/283637)

Here is a list of common options I use with TCPdump almost every time I listen in.

**-v** shows more information about the packet. You can use *-vv* or *-vvv* for even more.  
**-n** disables name resolution so you are not waiting on DNS responses to show the packet.  
**-e** shows link layer information (MAC Address)  
**-s** sets how much of the packet to see. 0 shows full packet.  
**-i** sets the interface to use

DHCP traffic operates on port 67 (Server) and 68 (Client). So we can capture the appropriate traffic with the following expression: ***port 67 or port 68***  
The tcpdump statement would look like: ***tcpdump -vnes0 -i eth0 port 67 or port 68***

A successful DHCP should contain 4 packets.

**The DISCOVER packet**

The first packet should be the client trying to discover its DHCP information.

**16:42:18.799064** **00:1f:3c:9d:68:f2** > **ff:ff:ff:ff:ff:ff**, ethertype **IPv4** (0x0800), length 342: (tos 0x0, ttl 128, id 44982, offset 0, flags [none], **proto UDP (17)**, length 328) **0.0.0.0.68** > **255.255.255.255.67**: BOOTP/DHCP, Request from 00:1f:3c:9d:68:f2, length 300, xid 0xbbe4078f, Flags [none]  
          Client-Ethernet-Address 00:1f:3c:9d:68:f2  
          Vendor-rfc1048 Extensions  
            Magic Cookie 0x63825363  
            DHCP-Message **Option 53**, length 1: **Discover**  
            NOAUTO Option 116, length 1: Y  
            Client-ID Option 61, length 7: ether 00:1f:3c:9d:68:f2  
            Hostname **Option 12**, length 11: "FA-MCKENZIE"  
            Vendor-Class Option 60, length 8: "MSFT 5.0"  
            Parameter-Request **Option 55**, length 11:  
              Subnet-Mask, Domain-Name, Default-Gateway, Domain-Name-Server  
              Netbios-Name-Server, Netbios-Node, Netbios-Scope, Router-Discovery  
              Static-Route, Option 249, Vendor-Option  
            Vendor-Option Option 43, length 2: 220.0

The packet begins with a timestamp. Since we are displaying link layer information, the next bit is the sender and destination MAC addresses. You can see that the destination MAC address is all F's. This means it's a broadcast packet. Because the sender doesn't know specifically who to ask for its DHCP information, it yells to everyone that can hear.  
The next bit of information is about the protocol that was used in this packet. it’s an IPv4 packet and UDP (protocol 17). The next part contains the senders IP address. They don't have one so it’s all 0's. And since the sender is broadcasting the packet, the destination ip is 255.255.255.255. The sender is using port 67 trying to reach a server on port 68 as expected. Below the packets header information we have all the options they are using. It’s a DISCOVER from Option 53. We can see all the standard DHCP information that may be required (Option 55), the Hostname (option 12).

**The OFFER packet**

The second packet is expected to see the server offering the DHCP information to the client.  
**16:42:18.800018 00:30:18:a8:c6:13** > **00:1f:3c:9d:68:f2**, ethertype **IPv4** (0x0800), length 342: (tos 0x10, ttl 16, id 0, offset 0, flags [none], **proto UDP (17)**, length 328) 10.5.0.1.67 > 10.5.0.198.68: BOOTP/DHCP, Reply, length 300, xid 0xbbe4078f, Flags [none]  
          **Your-IP** 10.5.0.198  
          Client-Ethernet-Address 00:1f:3c:9d:68:f2  
          Vendor-rfc1048 Extensions  
            Magic Cookie 0x63825363  
            DHCP-Message **Option 53**, length 1: **Offer**  
            Server-ID Option 54, length 4: 10.5.0.1  
            Lease-Time **Option 51**, length 4: 60  
            Subnet-Mask **Option 1**, length 4: 255.255.0.0  
            Domain-Name Option 15, length 10: "sandara.ca"  
            Default-Gateway **Option 3**, length 4: 10.5.0.1  
            Domain-Name-Server **Option 6**, length 4: 10.5.0.1  
Starts off with a timestamp then the senders MAC address, this time it’s the server's MAC address. Since the server knows who to send this packet to, it makes it unicast and sets the destination to the client. Still it’s an IPv4 UDP packet. The packet originated from the server and it uses the IP address that it's offering as its destination. Option 53 indicates that this is the OFFER packet. The options offered in the packet contain some very useful information like lease time in seconds (Option 51) DNS Server (Option 6), Subnet Mask (Option 1), Default Gateway (Option 3) and the IP address the client can use, labeled Your-IP.

**The REQUEST packet.**  
The next two packets are for confirmation. The client will start off by requesting confirmation from the server that the DHCP information it was offered is correct.  
**16:42:18.802420 00:1f:3c:9d:68:f2** > **ff:ff:ff:ff:ff:ff**, ethertype **IPv4** (0x0800), length 377: (tos 0x0, ttl 128, id 44983, offset 0, flags [none], **proto UDP (17)**, length 363) **0.0.0.0.68** > **255.255.255.255.67**: BOOTP/DHCP, Request from 00:1f:3c:9d:68:f2, length 335, xid 0xbbe4078f, Flags [none]  
          Client-Ethernet-Address 00:1f:3c:9d:68:f2  
          Vendor-rfc1048 Extensions  
            Magic Cookie 0x63825363  
            DHCP-Message **Option 53**, length 1: **Request**  
            Client-ID Option 61, length 7: ether 00:1f:3c:9d:68:f2  
            Requested-IP Option 50, length 4: 10.5.0.198  
            Server-ID **Option 54**, length 4: 10.5.0.1  
            Hostname Option 12, length 11: "FA-MCKENZIE"  
            FQDN Option 81, length 27: "FA-MCKENZIE.sfaftusa.lan"  
            Vendor-Class Option 60, length 8: "MSFT 5.0"  
            Parameter-Request Option 55, length 11:  
              Subnet-Mask, Domain-Name, Default-Gateway, Domain-Name-Server  
              Netbios-Name-Server, Netbios-Node, Netbios-Scope, Router-Discovery  
              Static-Route, Option 249, Vendor-Option  
            Vendor-Option Option 43, length 3: 220.1.0  
Option 53 indicates this to be the REQUEST packet. This packet is still a broadcast. The client still doesn't have an IP address without confirmation first. And all the options to confirm show up like verifying the DHCP server (Option 54), verifying the IP address to use (Option 50) and so on,

**The ACK packet**

The fourth and final packet should be a confirmation by the DHCP server.  
**16:42:18.803152 00:30:18:a8:c6:13** > **00:1f:3c:9d:68:f2**, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 16, id 0, offset 0, flags [none], **proto UDP (17)**, length 328) **10.5.0.1.67** > **10.5.0.198.68**: BOOTP/DHCP, Reply, length 300, xid 0xbbe4078f, Flags [none]  
          Your-IP 10.5.0.198  
          Client-Ethernet-Address 00:1f:3c:9d:68:f2  
          Vendor-rfc1048 Extensions  
            Magic Cookie 0x63825363  
            DHCP-Message **Option 53**, length 1: **ACK**  
            Server-ID Option 54, length 4: 10.5.0.1  
            Lease-Time Option 51, length 4: 60  
            Subnet-Mask Option 1, length 4: 255.255.0.0  
            Domain-Name Option 15, length 10: "sandara.ca"  
            Default-Gateway Option 3, length 4: 10.5.0.1  
            Domain-Name-Server Option 6, length 4: 10.5.0.1  
This final packet has everything filled out as you would expect in the header. And in the options section contains the acknowledgement (Option 53)  
**Recap**

The 4 packets to a successful DHCP

***DISCOVER***: Client connects to the network and sends out a broadcast discovery looking for its DHCP information.  
***OFFER***: The server offers the DHCP information to the client  
***REQUEST***: The client requests verification of the DHCP information  
***ACK***: The server acknowledges the DHCP request  
**Additional Notes.**

Sometimes you will not see the *DISCOVER*/*OFFER* and just see the *REQUEST*/*ACK*. This happens when the client has already obtained a valid DHCP lease earlier and is just requesting to have it again before its lease time expires. Typically this is performed when half the lease has lapsed. If the *REQUEST* is not valid anymore the server will send a *NACK* indicating to the client that it can no longer use this DHCP information. This should cause the client to start over with a *DISCOVER*.  
Sometimes you will see repeated *DISCOVER*/*OFFER* but never a *REQUEST* from the client. This happens when the client either doesn't receive the *OFFER* or doesn't like it for some reason. Perhaps a firewall is blocking it, they have a poor connection, or simply they're using a Windows computer.

<http://15103895.blog.hexun.com.tw/64572072_d.html>

Option82應用場景

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **網絡使用者** | **內網** | **外網** | **舉例說明** |
| **場景** | 訪問者 | 不能訪問 | 能訪問 | 高校學術交流，與會者在會務期間，需要訪問Internet，但出於安全考慮，這些臨時來訪者應當不允許訪問學校內網。 |
| 內部員工 | 能訪問 | 能訪問 |

　　在該場景下，臨時接入者可以在不安裝認證客戶端的情況下，直接訪問Internet資源，但不能訪問內網，正式員工可在會議區通過認證接入到內網。為了實現該場景，我們要對DHCP Option82功能進行描述。

# Option82相關技術

## Option82 功能介紹

　　DHCP option 82是為了增強DHCP服務器的安全性，改善IP地址配置策略而提出的一種DHCP選項。通過在網絡接入設備上配置DHCP中繼代理功能，中繼代理把從客戶端接收到的DHCP請求報文添加進option 82選項(其中包含了客戶端的接入物理端口和接入設備標識等信息），然後再轉發給DHCP服務器，支持option 82功能的DHCP服務器收到報文後，根據預先配置策略和報文中option 82信息分配IP地址和其它配置信息給客戶端，同時DHCP服務器也可依據option 82中的信息識別可能的DHCP攻擊報文作出防範。DHCP中繼代理收到服務器應答報文後，剝離其中的option 82選項並根據選項中的物理端口信息，把應答報文轉交到網絡接入設備的指定端口。

## Option 82報文結構

　　DHCP option 82又稱為DHCP中繼代理信息選項(Relay Agent Information Option)，是DHCP報文中的一個選項，其編號為82。

　　Code：表示中繼代理信息選項的序號，rfc3046定義為82，option 82即由此得名。

　　Len：為代理信息域（Agent Information Field）的字節個數，不包括Code和Len字段的兩個字節。

　　Option 82可由多個sub-option組成，每個option 82選項至少有一個子選項，rfc3046定義了以下兩個子選項：

　　SubOpt：子選項編號， Circuit ID子選項編號為1，Remote ID子選項編號為2。

　　Len：為Sub-option Value的字節個數，不包括SubOpt和Len字段的兩個字節。

　　option82子選項1：定義Circuit ID，它表示接收到的DHCP請求報文來自的鏈路標識，這個標識只在中繼代理節點內部有意義，在服務器端不解析其含義，只作為一個不具含義的標識使用。在本文Circuit ID默認指接收到DHCP請求報文的接入交換機Vlan名加接入二層端口名稱，如Vlan2+Ethernet0/0/10，用戶也可自己定義。

　　option82子選項2：定義Remote ID，在我司交換機實現中，Remote ID指接DHCP中繼設備本身的MAC地址。

　　DHCP請求報文：由DHCP客戶端發起的報文，希望DHCP服務器響應後分配IP地址和其它配置信息。DHCP請求報文一般有四種，分別為DHCP\_DISCOVER、DHCP\_REQUEST、DHCP\_RELEASE和 DHCP\_INFORM報文。中繼代理只針對DHCP請求報文添加option 82選項並轉發給服務器。本文的DHCP中繼對這四種請求報文都添加option 82選項。

　　DHCP應答報文：指由DHCP服務器響應客戶端發起的請求報文，包含配置信息或指示回應結果的DHCP響應報文，DHCP應答報文一般有DHCP\_OFFER報文，DHCP\_DECLINE報文，DHCP\_ACK報文和DHCP\_NAK報文。

## Option 82工作原理

　　在DHCP中繼代理(交換機)支持option 82的情況下，DHCP客戶端通過DHCP中繼從DHCP服務器獲取IP地址同樣要經歷Discover、Offer、Request和Ack四個階段。這時DHCP協議按如下過程進行：

　　1）DHCP客戶端在初始化時廣播發送請求報文，這時的請求報文並不包含option 82選項。

　　2）DHCP中繼代理將option 82選項添加到接收到的請求報文尾部後中繼轉發給DHCP服務器。option 82選項的SubOpt為Circuit ID，option 82選項的SubOpt為Remote IP。

　　3）DHCP服務器收到DHCP中繼設備轉發的DHCP請求報文後，根據報文中option選項所攜帶的信息和預定策略分配IP地址和其它信息給客戶端，然後將帶著DHCP配置信息以及option 82信息的應答報文發給DHCP中繼代理。

　　4）DHCP中繼代理收到DHCP服務器的應答報文後將剝離報文中的option 82信息，將帶有DHCP配置信息的報文轉發給DHCP客戶端。