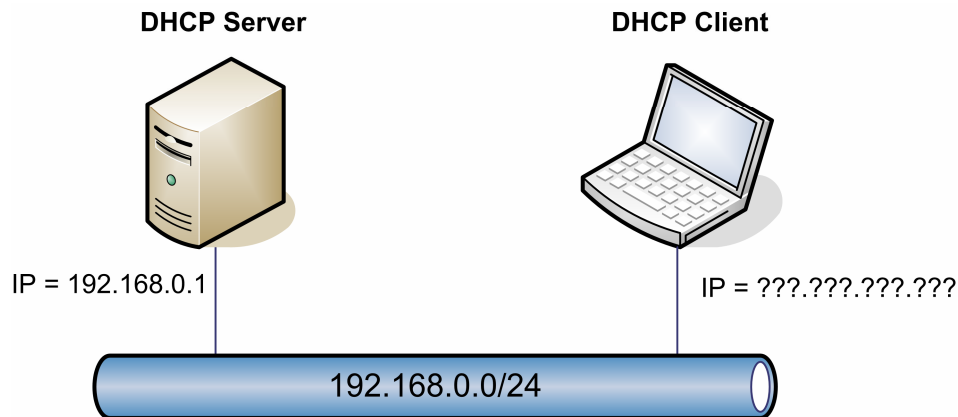


Schema della rete

La rete che ho utilizzato per l'esempio è così strutturato:

1. 1 server DHCP, macchina Windows XP che funge anche da gateway verso Internet
2. 1 client DHCP, pc portatile con Windows XP.

Il client non ha configurato alcun indirizzo IP.



DHCP Discover

Al momento della connessione con la rete locale 192.168.0.0/24, il client portatile effettua un *DHCP Discover* al server DHCP presente sulla rete attraverso il suo processo *client DHCP*.

All'interno del DHCP Discover, segnala una lista di parametri che vorrebbe conoscere.

No.	Time	Source	Destination	Protocol	Info
2	17.474079	0.0.0.0	255.255.255.255	DHCP	DHCP

Discover - Transaction ID 0xec763e04

Frame 2 (342 bytes on wire, 342 bytes captured)

Arrival Time: May 21, 2005 14:42:19.618178000

Time delta from previous packet: 17.474079000 seconds

Time since reference or first frame: 17.474079000 seconds

Frame Number: 2

Packet Length: 342 bytes

Capture Length: 342 bytes

Protocols in frame: eth:ip:udp:bootp

Ethernet II, Src: 00:c0:9f:10:08:25, Dst: ff:ff:ff:ff:ff:ff

Destination: ff:ff:ff:ff:ff:ff (Broadcast)

Source: 00:c0:9f:10:08:25 (192.168.0.2)

Type: IP (0x0800)

Internet Protocol, Src Addr: 0.0.0.0 (0.0.0.0), Dst Addr: 255.255.255.255 (255.255.255.255)

Version: 4

Header length: 20 bytes

Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)

0000 00.. = Differentiated Services Codepoint: Default (0x00)

.... ..0. = ECN-Capable Transport (ECT): 0

.... ...0 = ECN-CE: 0

Total Length: 328

Identification: 0xa193 (41363)

Flags: 0x00

0... = Reserved bit: Not set

.0.. = Don't fragment: Not set

..0. = More fragments: Not set

Fragment offset: 0

```

Time to live: 128
Protocol: UDP (0x11)
Header checksum: 0x9812 (correct)
Source: 0.0.0.0 (0.0.0.0)
Destination: 255.255.255.255 (255.255.255.255)
User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
Source port: bootpc (68)
Destination port: bootps (67)
Length: 308
Checksum: 0x81f6 (correct)
Bootstrap Protocol
  Message type: Boot Request (1)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0xec763e04
  Seconds elapsed: 0
  Bootp flags: 0x0000 (Unicast)
    0... .. = Broadcast flag: Unicast
    .000 0000 0000 0000 = Reserved flags: 0x0000
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 0.0.0.0 (0.0.0.0)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
  Server host name not given
  Boot file name not given
  Magic cookie: (OK)
  Option 53: DHCP Message Type = DHCP Discover
  Option 116: DHCP Auto-Configuration (1 bytes)
  Option 61: Client identifier
    Hardware type: Ethernet
    Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
  Option 50: Requested IP Address = 192.168.0.2
  Option 12: Host Name = "portatile"
  Option 60: Vendor class identifier = "MSFT 5.0"
  Option 55: Parameter Request List
    1 = Subnet Mask
    15 = Domain Name
    3 = Router
    6 = Domain Name Server
    44 = NetBIOS over TCP/IP Name Server
    46 = NetBIOS over TCP/IP Node Type
    47 = NetBIOS over TCP/IP Scope
    31 = Perform Router Discover
    33 = Static Route
    Unknown Option Code: 249
    43 = Vendor-Specific Information
  End Option
  Padding

```

Come si può notare, l'indirizzo MAC di destinazione è *broadcast*, perché il client che si connette alla rete non conosce l'indirizzo fisico dell'interfaccia del DHCP Server e non può nemmeno risolverlo attraverso ARP perché non conosce nemmeno l'indirizzo IP.

L'indirizzo sorgente di livello rete (IP) del pacchetto è 0.0.0.0 e quello di destinazione 255.255.255.255.

Il client è obbligato ad effettuare un *broadcast limitato* e non un *broadcast diretto* perché non conosce ancora l'indirizzo e la netmask della rete a cui appartiene.

DHCP Offer

Il server DHCP risponde, offrendo un indirizzo IP.

Anche se potrebbe essere incapsulato in una trama unicast, il messaggio viene mandato in broadcast a livello 2 perché altri server DHCP potrebbero essere interessati a sapere se qualcuno ha già risposto alla richiesta di DHCP Discover.

L'IP di destinazione è ancora un broadcast limitato per fare in modo che il client faccia passare il messaggio ai livelli superiori.

Oltre all'indirizzo IP, nel messaggio di *DHCP Offer* vengono inviate anche altre informazioni riguardo alla rete, come *subnet mask*, *router di default* e *server DNS*.

No.	Time	Source	Destination	Protocol	Info
3	17.476746	192.168.0.1	255.255.255.255	DHCP	DHCP
Offer	-	Transaction ID 0xec763e04			

Frame 3 (344 bytes on wire, 344 bytes captured)

Arrival Time: May 21, 2005 14:42:19.620845000

Time delta from previous packet: 0.002667000 seconds

Time since reference or first frame: 17.476746000 seconds

Frame Number: 3

Packet Length: 344 bytes

Capture Length: 344 bytes

Protocols in frame: eth:ip:udp:bootp

Ethernet II, Src: 00:50:bf:e6:9e:d1, Dst: ff:ff:ff:ff:ff:ff

Destination: ff:ff:ff:ff:ff:ff (Broadcast)

Source: 00:50:bf:e6:9e:d1 (Mototech_e6:9e:d1)

Type: IP (0x0800)

Internet Protocol, Src Addr: 192.168.0.1 (192.168.0.1), Dst Addr: 255.255.255.255 (255.255.255.255)

Version: 4

Header length: 20 bytes

Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)

0000 00.. = Differentiated Services Codepoint: Default (0x00)

.... ..0. = ECN-Capable Transport (ECT): 0

.... ...0 = ECN-CE: 0

Total Length: 330

Identification: 0xf964 (63844)

Flags: 0x00

0... = Reserved bit: Not set

.0.. = Don't fragment: Not set

..0. = More fragments: Not set

Fragment offset: 0

Time to live: 128

Protocol: UDP (0x11)

Header checksum: 0x7f95 (correct)

Source: 192.168.0.1 (192.168.0.1)

Destination: 255.255.255.255 (255.255.255.255)

User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)

Source port: bootps (67)

Destination port: bootpc (68)

Length: 310

Checksum: 0x1397 (correct)

Bootstrap Protocol

Message type: Boot Reply (2)

Hardware type: Ethernet

Hardware address length: 6

Hops: 0

Transaction ID: 0xec763e04

Seconds elapsed: 0

Bootp flags: 0x0000 (Unicast)
0... .. = Broadcast flag: Unicast
.000 0000 0000 0000 = Reserved flags: 0x0000
Client IP address: 0.0.0.0 (0.0.0.0)
Your (client) IP address: 192.168.0.2 (192.168.0.2)
Next server IP address: 0.0.0.0 (0.0.0.0)
Relay agent IP address: 0.0.0.0 (0.0.0.0)
Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
Server host name not given
Boot file name not given
Magic cookie: (OK)
Option 53: DHCP Message Type = DHCP Offer
Option 54: Server Identifier = 192.168.0.1
Option 1: Subnet Mask = 255.255.255.0
Option 3: Router = 192.168.0.1
Option 6: Domain Name Server = 192.168.0.1
Option 58: Renewal Time Value = 5 minutes
Option 59: Rebinding Time Value = 5 days, 6 hours
Option 51: IP Address Lease Time = 7 days
Option 46: NetBIOS over TCP/IP Node Type = M-node
Option 15: Domain Name = "mshome.net"
End Option

DHCP Request

Nulla vieta che il client riceva più DHCP Offer da valutare; in questo caso ne riceve una sola e risponde con un messaggio di *DHCP Request*, richiedendo formalmente l'indirizzo.

L'indirizzo IP non è ancora stato assegnato, infatti l'IP sorgente è ancora 0.0.0.0.

Il frame viene ancora inviato in broadcast sia a livello rete che a livello IP per notificare tutti gli eventuali server DHCP della scelta fatta.

No.	Time	Source	Destination	Protocol	Info
4	17.509460	0.0.0.0	255.255.255.255	DHCP	DHCP

Request - Transaction ID 0xec763e04

Frame 4 (356 bytes on wire, 356 bytes captured)

Arrival Time: May 21, 2005 14:42:19.653559000

Time delta from previous packet: 0.032714000 seconds

Time since reference or first frame: 17.509460000 seconds

Frame Number: 4

Packet Length: 356 bytes

Capture Length: 356 bytes

Protocols in frame: eth:ip:udp:bootp

Ethernet II, Src: 00:c0:9f:10:08:25, Dst: ff:ff:ff:ff:ff:ff

Destination: ff:ff:ff:ff:ff:ff (Broadcast)

Source: 00:c0:9f:10:08:25 (192.168.0.2)

Type: IP (0x0800)

Internet Protocol, Src Addr: 0.0.0.0 (0.0.0.0), Dst Addr: 255.255.255.255 (255.255.255.255)

Version: 4

Header length: 20 bytes

Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)

0000 00.. = Differentiated Services Codepoint: Default (0x00)

.... ..0. = ECN-Capable Transport (ECT): 0

.... ...0 = ECN-CE: 0

Total Length: 342

Identification: 0xa194 (41364)

Flags: 0x00

0... = Reserved bit: Not set

.0.. = Don't fragment: Not set

..0. = More fragments: Not set

Fragment offset: 0

Time to live: 128

Protocol: UDP (0x11)

Header checksum: 0x9803 (correct)

Source: 0.0.0.0 (0.0.0.0)

Destination: 255.255.255.255 (255.255.255.255)

User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)

Source port: bootpc (68)

Destination port: bootps (67)

Length: 322

Checksum: 0x5a6d (correct)

Bootstrap Protocol

Message type: Boot Request (1)

Hardware type: Ethernet

Hardware address length: 6

Hops: 0

Transaction ID: 0xec763e04

Seconds elapsed: 0

Bootp flags: 0x0000 (Unicast)

0... = Broadcast flag: Unicast

.000 0000 0000 0000 = Reserved flags: 0x0000

Client IP address: 0.0.0.0 (0.0.0.0)

```

Your (client) IP address: 0.0.0.0 (0.0.0.0)
Next server IP address: 0.0.0.0 (0.0.0.0)
Relay agent IP address: 0.0.0.0 (0.0.0.0)
Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
Server host name not given
Boot file name not given
Magic cookie: (OK)
Option 53: DHCP Message Type = DHCP Request
Option 61: Client identifier
    Hardware type: Ethernet
    Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
Option 50: Requested IP Address = 192.168.0.2
Option 54: Server Identifier = 192.168.0.1
Option 12: Host Name = "portatile"
Option 81: FQDN
    Flags: 0x00
        0000 .... = Reserved flags: 0x00
        .... 0... = Server DDNS: Some server updates
        .... .0.. = Encoding: ASCII encoding
        .... ..0. = Server overrides: No override
        .... ...0 = Server: Client
    A-RR result: 0
    PTR-RR result: 0
    Client name: portatile.
Option 60: Vendor class identifier = "MSFT 5.0"
Option 55: Parameter Request List
    1 = Subnet Mask
    15 = Domain Name
    3 = Router
    6 = Domain Name Server
    44 = NetBIOS over TCP/IP Name Server
    46 = NetBIOS over TCP/IP Node Type
    47 = NetBIOS over TCP/IP Scope
    31 = Perform Router Discover
    33 = Static Route
    Unknown Option Code: 249
    43 = Vendor-Specific Information
End Option

```

DHCP Ack

Infine, il server DHCP che riceve la DHCP Request, crea l'associazione IP e manda un messaggio di *DHCP Ack* al client ribadendo i parametri della rete richiesti.

L'indirizzo IP di destinazione del pacchetto IP è ancora un broadcast locale perché solo dopo la ricezione del DHCP Ack il client confermerà il suo indirizzo IP.

No.	Time	Source	Destination	Protocol	Info
5	17.513656	192.168.0.1	255.255.255.255	DHCP	DHCP
ACK	- Transaction ID 0xec763e04				

Frame 5 (349 bytes on wire, 349 bytes captured)

Arrival Time: May 21, 2005 14:42:19.657755000

Time delta from previous packet: 0.004196000 seconds

Time since reference or first frame: 17.513656000 seconds

Frame Number: 5

Packet Length: 349 bytes

Capture Length: 349 bytes

Protocols in frame: eth:ip:udp:bootp

Ethernet II, Src: 00:50:bf:e6:9e:d1, Dst: ff:ff:ff:ff:ff:ff

Destination: ff:ff:ff:ff:ff:ff (Broadcast)

Source: 00:50:bf:e6:9e:d1 (Mototech_e6:9e:d1)

Type: IP (0x0800)

Internet Protocol, Src Addr: 192.168.0.1 (192.168.0.1), Dst Addr: 255.255.255.255 (255.255.255.255)

Version: 4

Header length: 20 bytes

Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)

0000 00.. = Differentiated Services Codepoint: Default (0x00)

.... ..0. = ECN-Capable Transport (ECT): 0

.... ...0 = ECN-CE: 0

Total Length: 335

Identification: 0xf965 (63845)

Flags: 0x00

0... = Reserved bit: Not set

.0.. = Don't fragment: Not set

..0. = More fragments: Not set

Fragment offset: 0

Time to live: 128

Protocol: UDP (0x11)

Header checksum: 0x7f8f (correct)

Source: 192.168.0.1 (192.168.0.1)

Destination: 255.255.255.255 (255.255.255.255)

User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)

Source port: bootps (67)

Destination port: bootpc (68)

Length: 315

Checksum: 0x6ed7 (correct)

Bootstrap Protocol

Message type: Boot Reply (2)

Hardware type: Ethernet

Hardware address length: 6

Hops: 0

Transaction ID: 0xec763e04

Seconds elapsed: 0

Bootp flags: 0x0000 (Unicast)

0... = Broadcast flag: Unicast

.000 0000 0000 0000 = Reserved flags: 0x0000

Client IP address: 0.0.0.0 (0.0.0.0)

Your (client) IP address: 192.168.0.2 (192.168.0.2)

Next server IP address: 0.0.0.0 (0.0.0.0)

Relay agent IP address: 0.0.0.0 (0.0.0.0)
Client MAC address: 00:c0:9f:10:08:25 (192.168.0.2)
Server host name not given
Boot file name not given
Magic cookie: (OK)
Option 53: DHCP Message Type = DHCP ACK
Option 54: Server Identifier = 192.168.0.1
Option 1: Subnet Mask = 255.255.255.0
Option 3: Router = 192.168.0.1
Option 6: Domain Name Server = 192.168.0.1
Option 58: Renewal Time Value = 5 minutes
Option 59: Rebinding Time Value = 5 days, 6 hours
Option 51: IP Address Lease Time = 7 days
Option 46: NetBIOS over TCP/IP Node Type = M-node
Option 81: FQDN
 Flags: 0x03
 0000 = Reserved flags: 0x00
 0... = Server DDNS: Some server updates
 0.. = Encoding: ASCII encoding
 1. = Server overrides: Override
 1 = Server: Server
 A-RR result: 0
 PTR-RR result: 0
Option 15: Domain Name = "mshome.net"
End Option