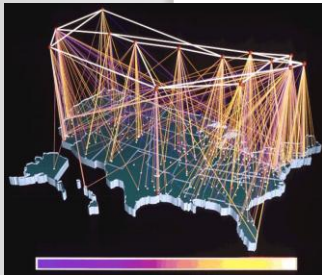


معماری شبکه

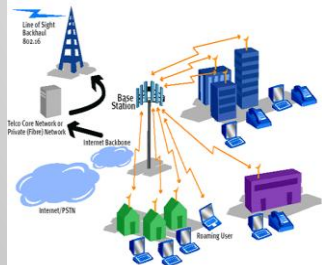
لایه IP در مدل TCP/IP

تهیه و تنظیم:

دکتر سیدرضا کامل

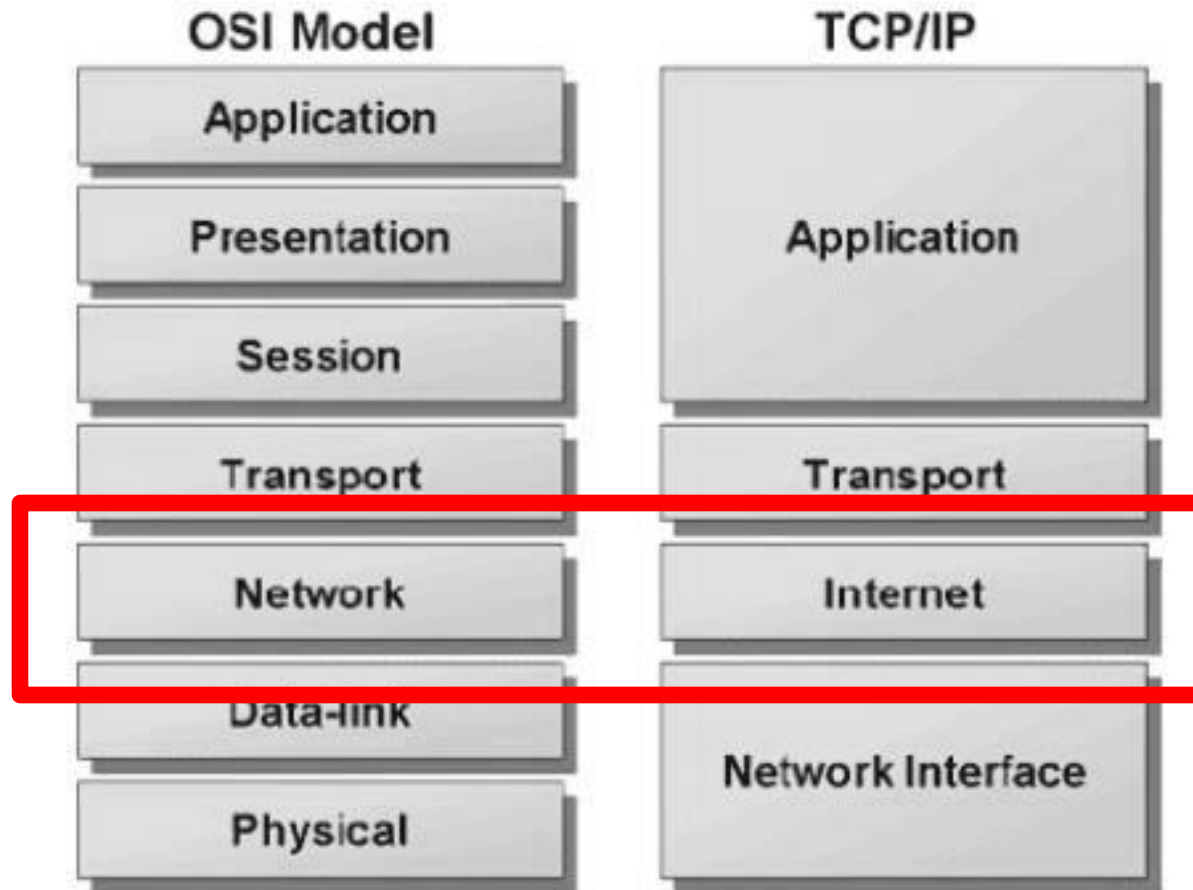


www.shutterstock.com - 24113755



دیدگاه های نرم افزار شبکه

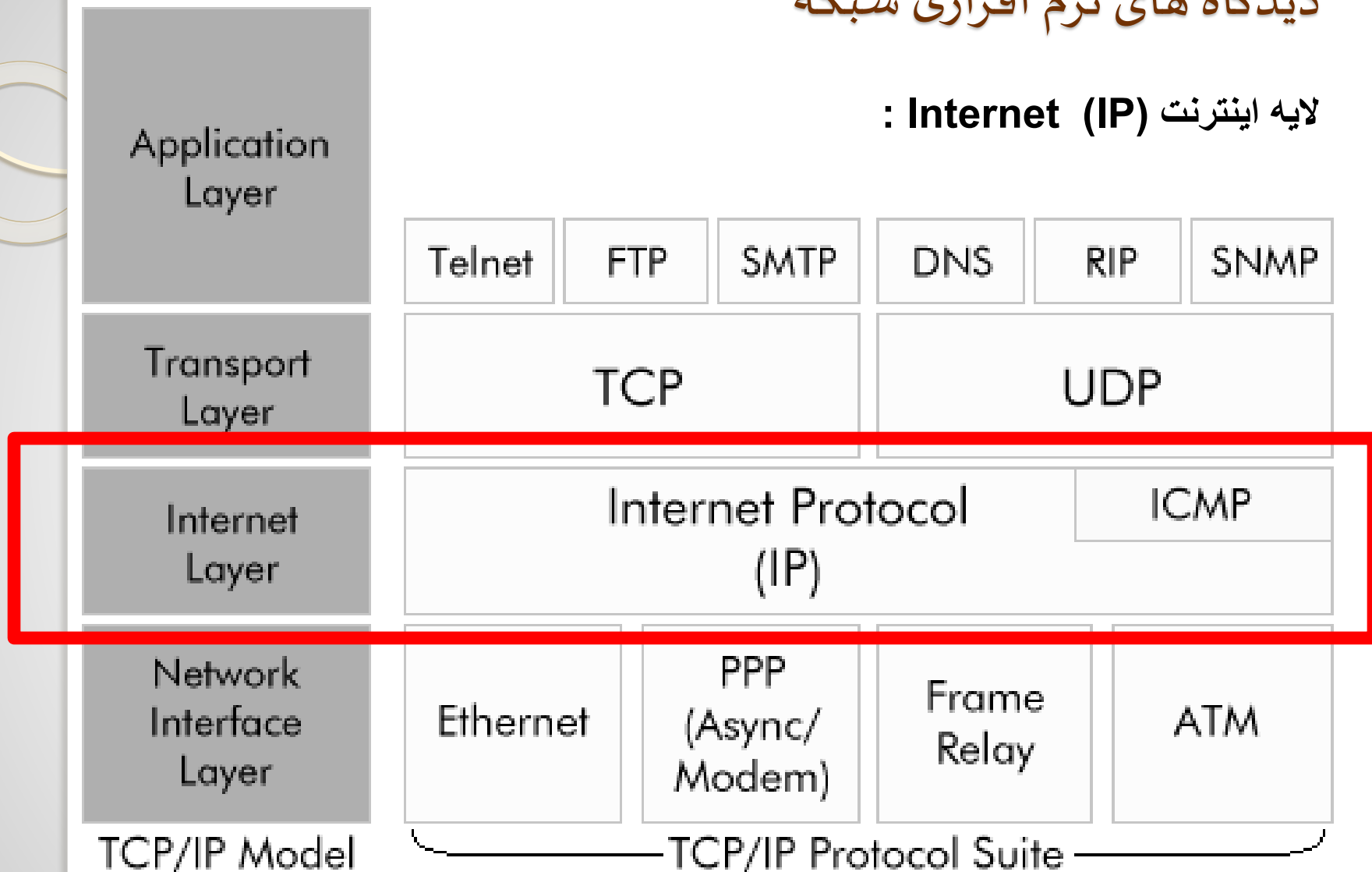
مدل مرجع TCP/IP :



TCP/IP and the OSI model

دیدگاه های نرم افزارى شبکه

لایه اینترنت (IP) : Internet

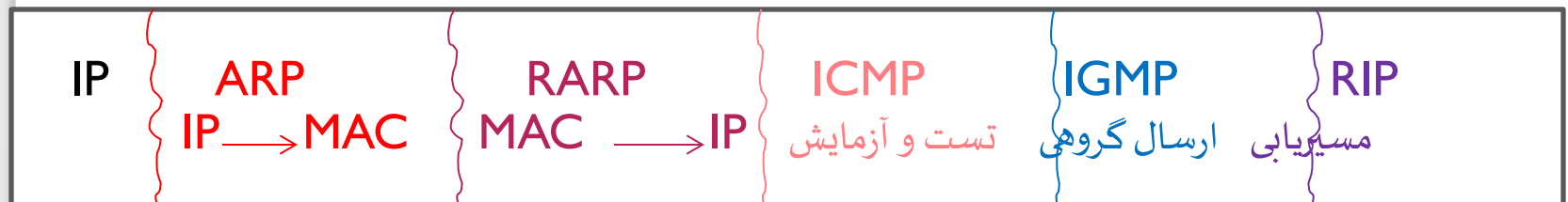


دیدگاه های نرم افزاری شبکه

لایه اینترنت (IP) : Internet

ساختار این لایه در شکل زیر نمایش داده شده که به معرفی پروتکل های مهم این لایه می پردازیم:

ساختار لایه IP در مدل TCP/IP و پروتکل های مهم آن



سایر مفاهیم مرتبط با آدرس های IP:

- آدرس های معتبر و غیر معتبر
- مفاهیم NAT, Proxy و VPN

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To convert invalid IP addresses to valid IP addresses:

- NAT
- Proxy
- Tunneling
- ...

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- ...

**Non-routable
On the Internet**

**Routable
On the Internet**

سایر مفاهیم مرتبط با آدرس های IP:

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- Proxy
- Tunneling
- ...

NAT

دیدگاه های نرم افزاری شبکه

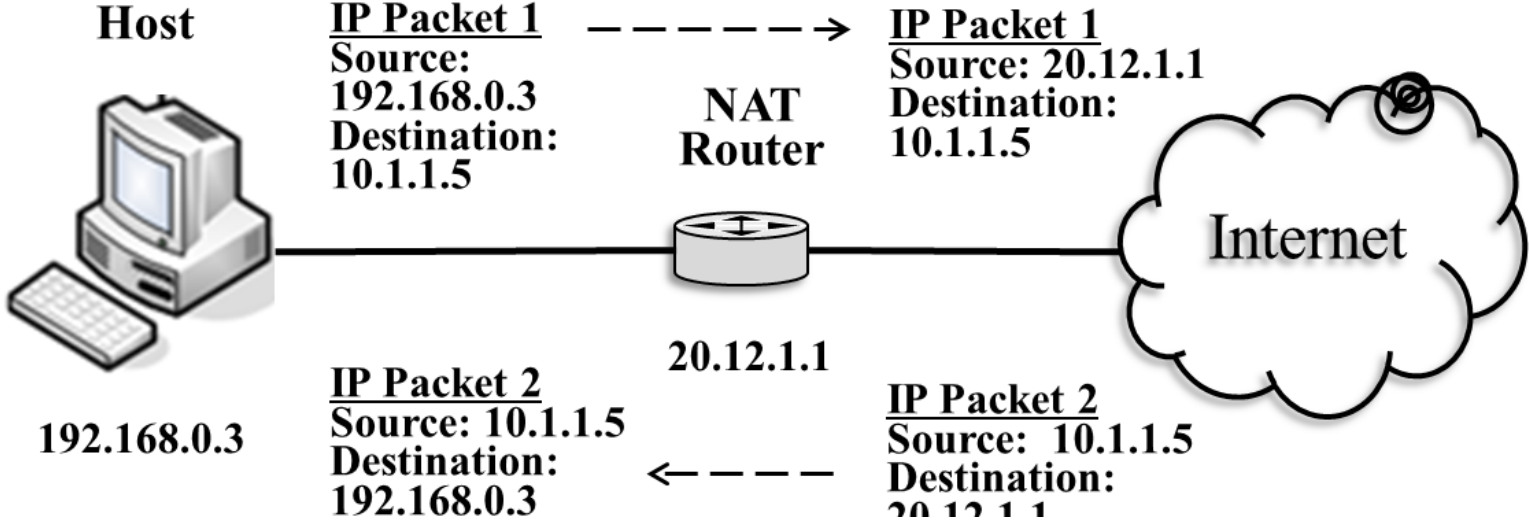
The image shows a screenshot of a Google search page. The search bar contains the text "what is my IP address?". A red box highlights the search query. Below the search bar, the search results are displayed. The first result is "Did you mean: [what is my IP address?](#)". The second result is "What Is My IP Address? Lookup IP, Hide IP, Change IP, Trace IP and ... [whatismyipaddress.com/](#)". A red arrow points from the search bar area to a red box at the bottom right of the image containing the text "So, What is my valid IP Address?".

So, What is my **valid** IP Address?

NAT

دیدگاه های نرم افزاری شبکه

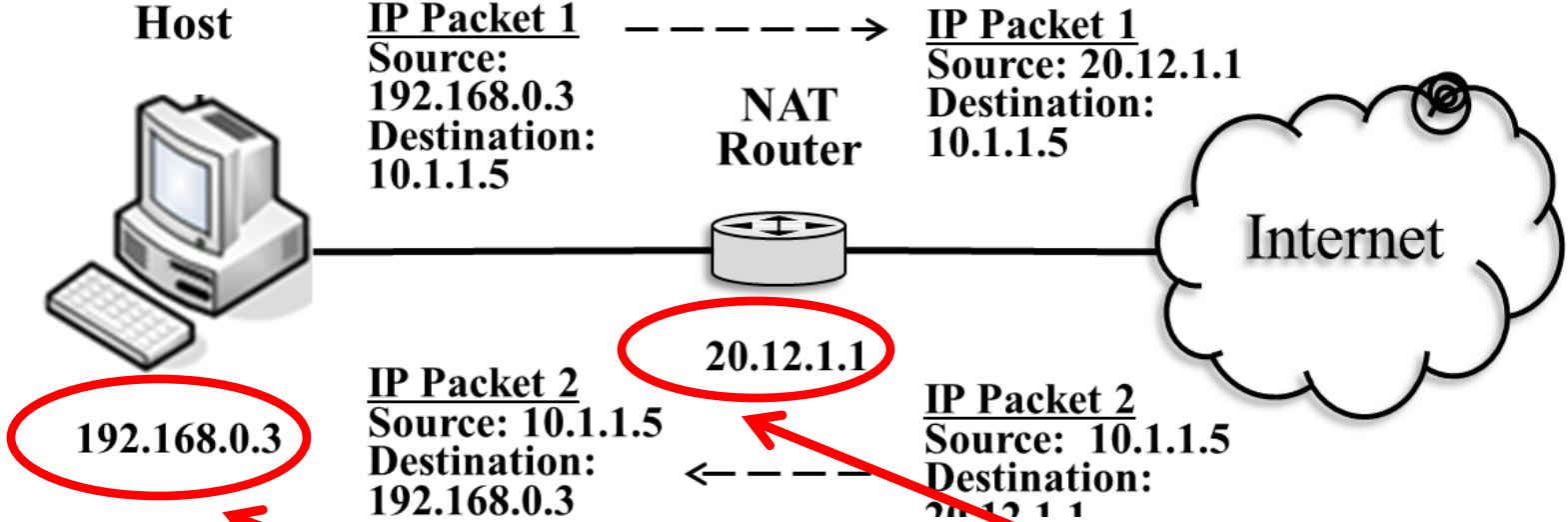
NAT Service



NAT

دیدگاه های نرم افزاری شبکه

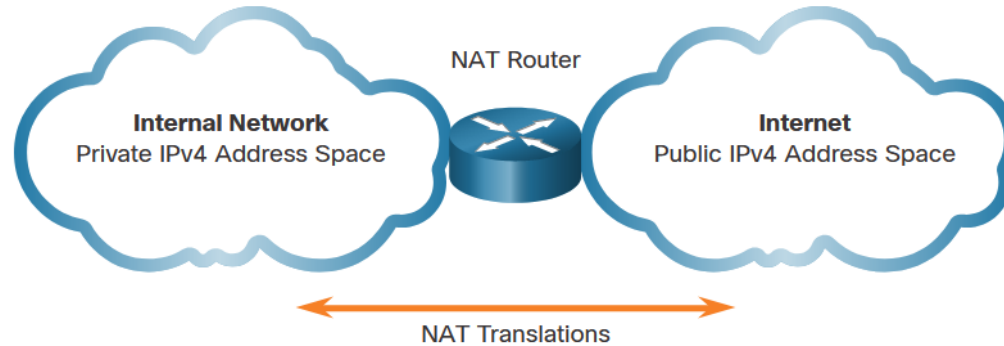
NAT Service



To convert invalid IP addresses to valid IP addresses:

NAT

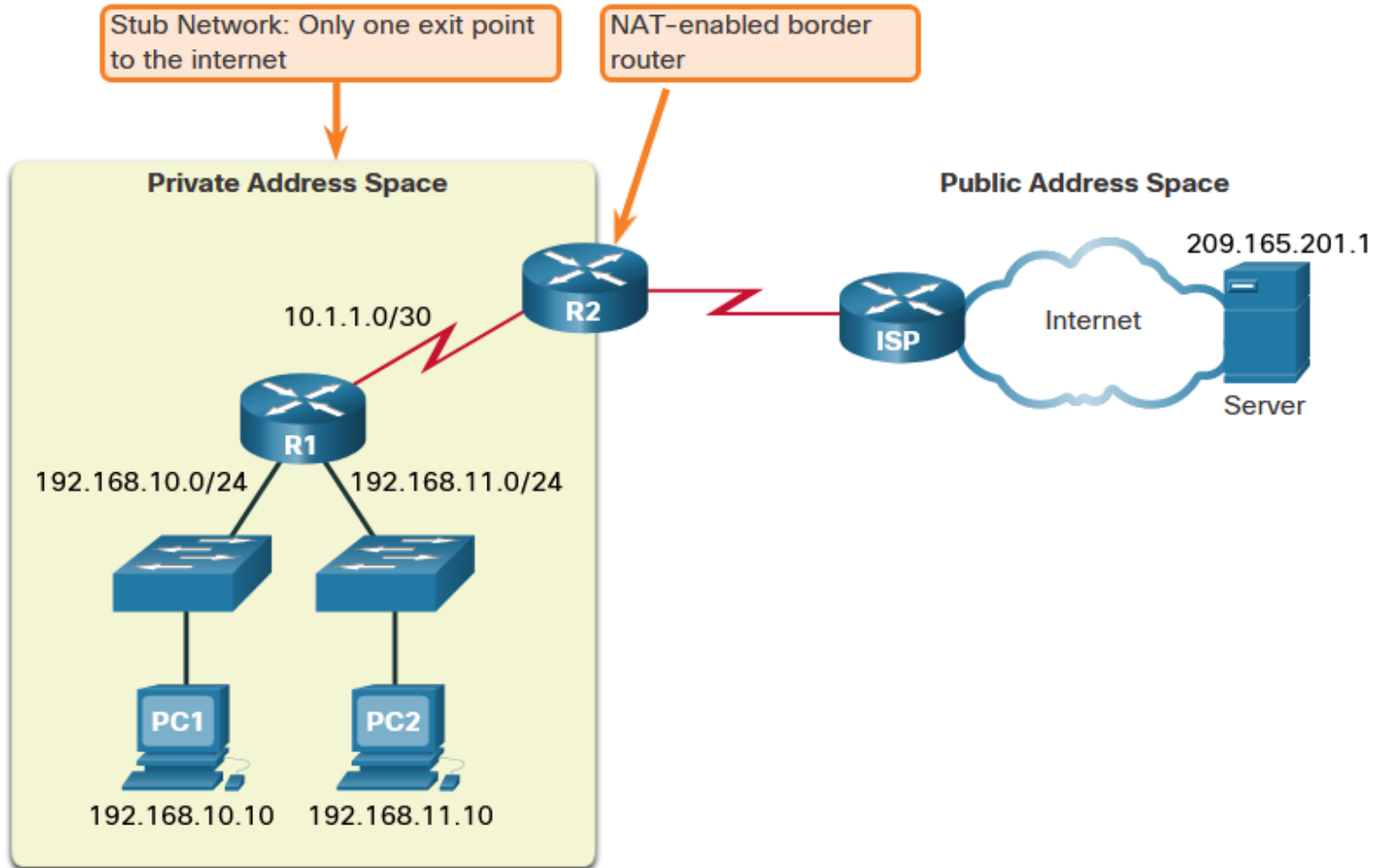
دیدگاه های نرم افزار شبکه



Class	Private Addresses	Classes
A	10.0.0.0 – 10.255.255.255	10.0.0.0/8
B	172.16.0.0 – 172.31.255.255	172.16.0.0/12
C	192.168.0.0 – 192.168.255.255	192.168.0.0/16

NAT

دیدگاه های نرم افزار شبکه



NAT

دیدگاه های نرم افزارى شبکه

NAT includes four types of addresses:

- Inside local address
- Inside global address
- Outside local address
- Outside global address

NAT terminology is always applied from the perspective of the device with the translated address:

- **Inside address** - The address of the device which is being translated by NAT.
- **Outside address** - The address of the destination device.
- **Local address** - A local address is any address that appears on the inside portion of the network.
- **Global address** - A global address is any address that appears on the outside portion of the network.

NAT

دیدگاه های نرم افزارى شبکه

- **Inside local address**

- The address of the source as seen from inside the network. This is typically a private IPv4 address. The inside local address of PC I is 192.168.10.10.

- **Inside global addresses**

- The address of source as seen from the outside network. The inside global address of PC I is 209.165.200.226

- **Outside global address**

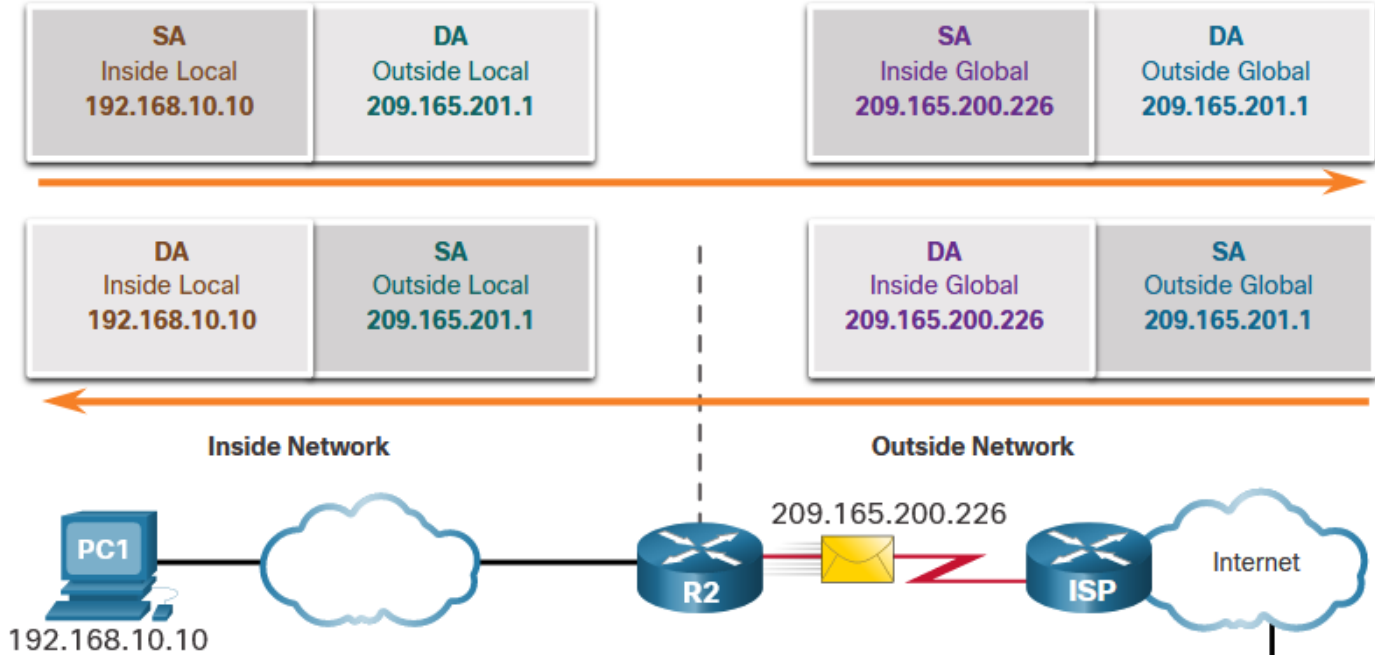
- The address of the destination as seen from the outside network. The outside global address of the web server is 209.165.201.1

- **Outside local address**

- The address of the destination as seen from the inside network. PC I sends traffic to the web server at the IPv4 address 209.165.201.1. While uncommon, this address could be different than the globally routable address of the destination.

NAT

دیدگاه های نرم افزار شبکه



R2 NAT Table			
PC1		Web Server	
Inside Global Address	Inside Local Address	Outside Local Address	Outside Global Address
209.165.200.226	192.168.10.10	209.165.201.1	209.165.201.1

NAT

دیدگاه های نرم افزارى شبکه

انواع روش های NAT

انواع روش های NAT

STATIC NAT

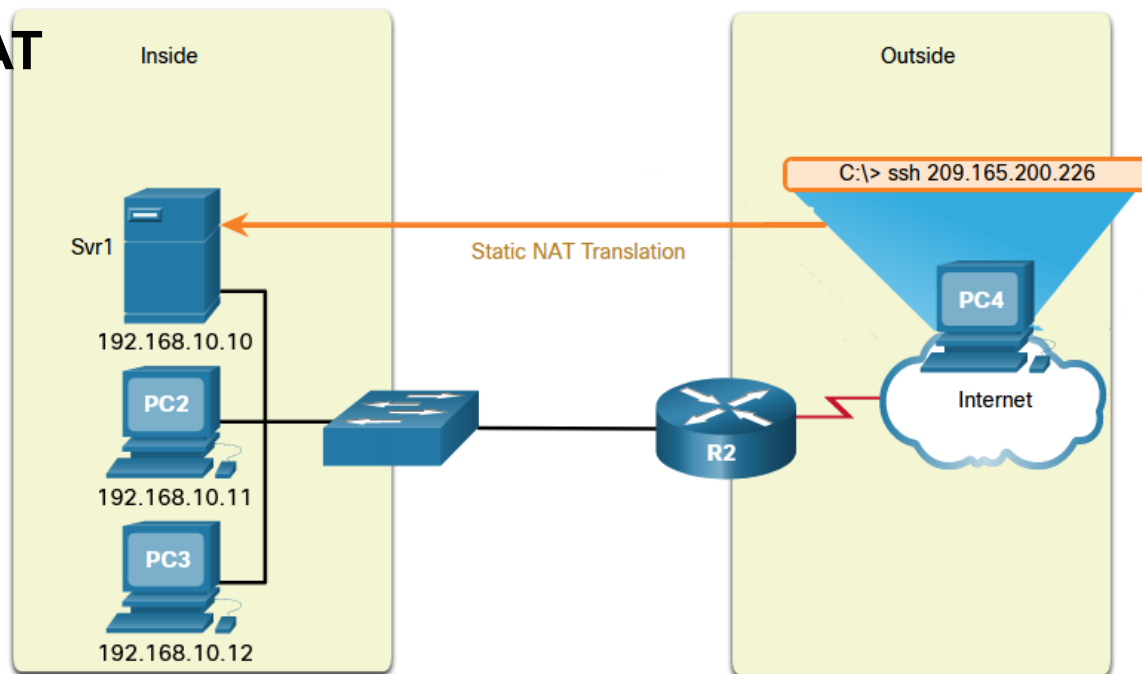
- Static NAT uses a one-to-one mapping of local and global addresses configured by the network administrator that remain constant.
- Static NAT is useful for web servers or devices that must have a consistent address that is accessible from the internet, such as a company web server.
- It is also useful for devices that must be accessible by authorized personnel when offsite, but not by the general public on the internet.

NAT

دیدگاه های نرم افزاری شبکه

انواع روش های NAT

STATIC NAT



Static NAT Table	
Inside Local Address	Inside Global Address - Addresses reachable via R2
192.168.10.10	209.165.200.226
192.168.10.11	209.165.200.227
192.168.10.12	209.165.200.228

انواع روش های NAT

DYNAMIC NAT

- Dynamic NAT uses a pool of public addresses and assigns them on a first-come, first-served basis.
- When an inside device requests access to an outside network, dynamic NAT assigns an available public IPv4 address from the pool.
- The other addresses in the pool are still available for use.

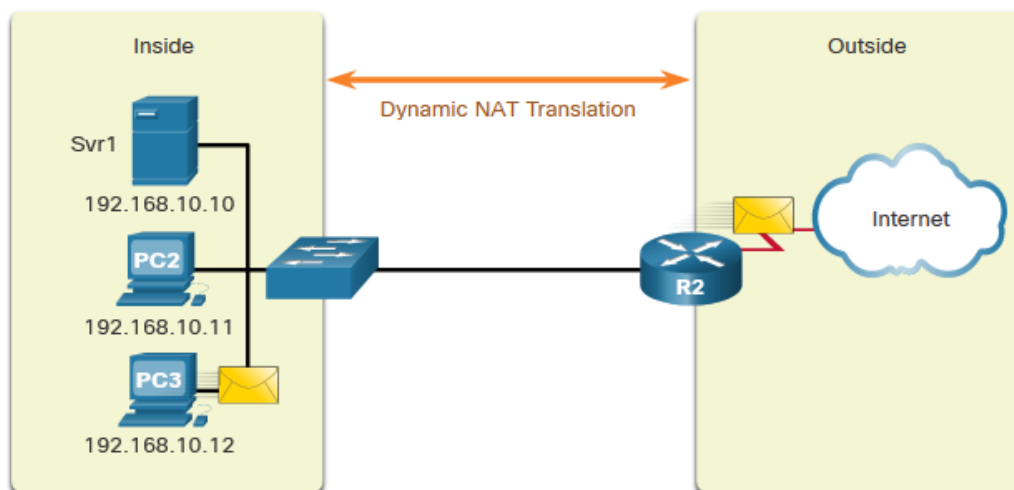
Note: Dynamic NAT requires that enough public addresses are available to satisfy the total number of simultaneous user sessions.

NAT

دیدگاه های نرم افزاری شبکه

انواع روش های NAT

DYNAMIC NAT



IPv4 NAT Pool

Inside Local Address	Inside Global Address Pool - Addresses reachable via R2
192.168.10.12	209.165.200.226
Available	209.165.200.227
Available	209.165.200.228
Available	209.165.200.229
Available	209.165.200.230

انواع روش های NAT

Port Address Translation

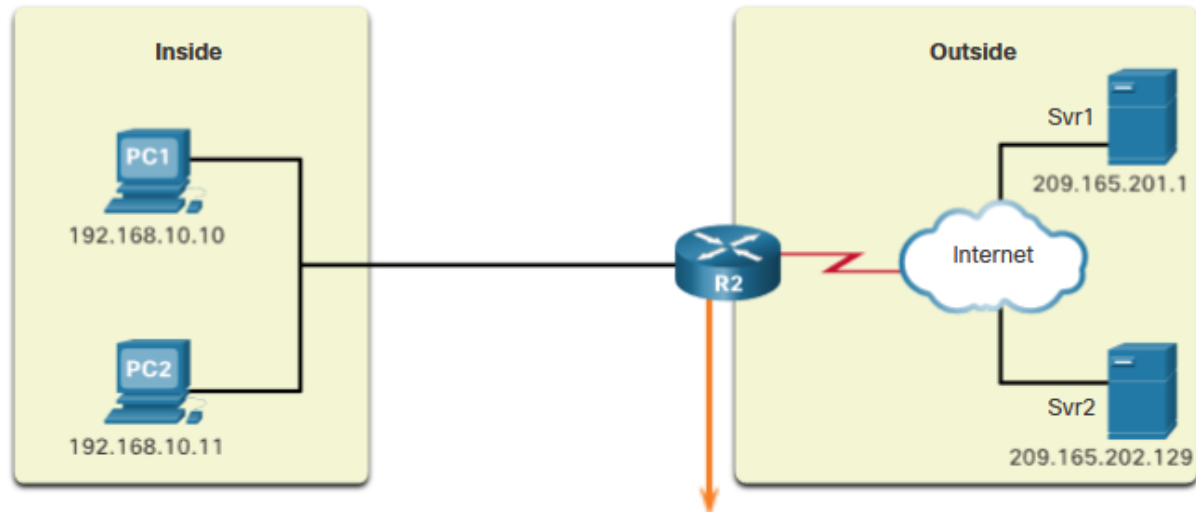
- Port Address Translation (PAT), also known as NAT overload, maps multiple private IPv4 addresses to a single public IPv4 address or a few addresses
- With PAT, when the NAT router receives a packet from the client, it uses the source port number to uniquely identify the specific NAT translation
- PAT ensures that devices use a different TCP port number for each session with a server on the internet.

NAT

دیدگاه های نرم افزار شبکه

انواع روش های NAT

Port Address Translation



NAT Table with Overload

Inside Local IP Address	Inside Global IP Address	Outside Local IP Address	Outside Global IP Address
192.168.10.10:1555	209.165.200.226:1555	209.165.201.1:80	209.165.201.1:80
192.168.10.11:1331	209.165.200.226:1331	209.165.202.129:80	209.165.202.129:80

انواع روش های NAT

Port Address Translation

- Next Available Port
 - PAT attempts to preserve the original source port. If the original source port is already used, PAT assigns the first available port number starting from the beginning of the appropriate port group 0-511, 512-1,023, or 1,024-65,535.
 - When there are no more ports available and there is more than one external address in the address pool, PAT moves to the next address to try to allocate the original source port.
 - The process continues until there are no more available ports or external IPv4 addresses in the address pool.

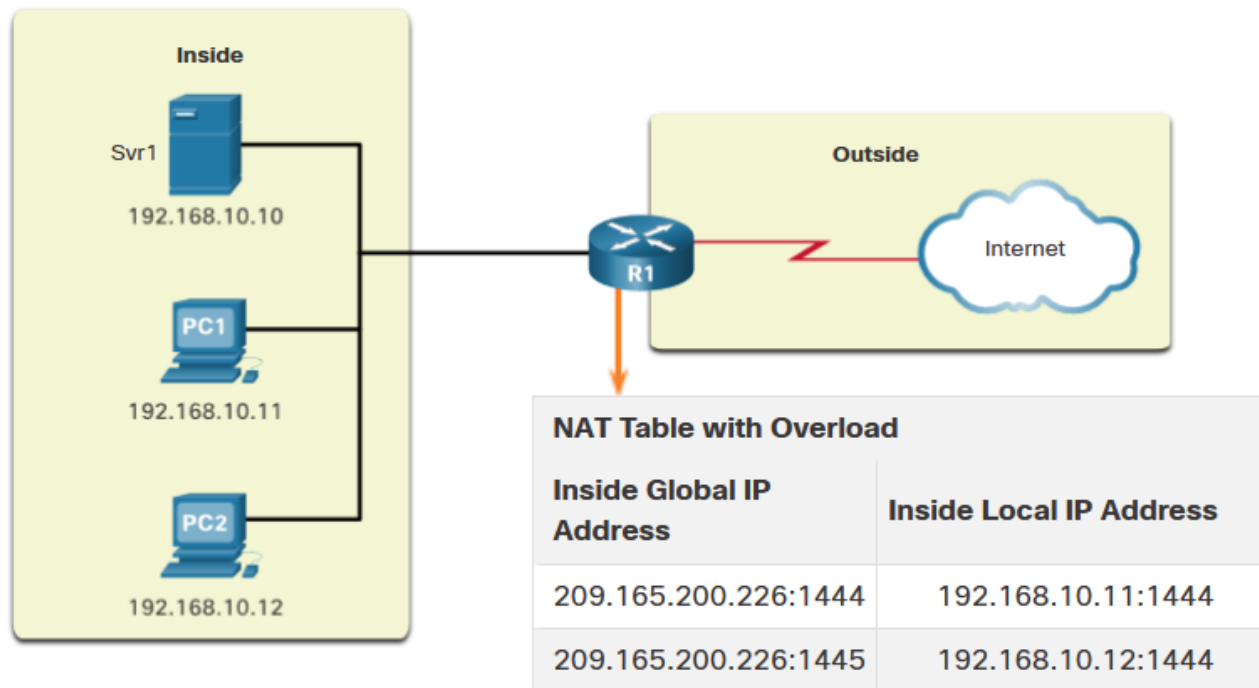
NAT

دیدگاه های نرم افزارى شبکه

انواع روش های NAT

Port Address Translation

- Next Available Port



NAT

دیدگاه های نرم افزاری شبکه

مقایسه روش های NAT و PAT

Summary of the differences between NAT and PAT.

NAT - Only modifies the IPv4 addresses

Inside Global Address	Inside Local Address
209.165.200.226	192.168.10.10

PAT - PAT modifies both the IPv4 address and the port number.

Inside Global Address	Inside Local Address
209.165.200.226:2031	192.168.10.10:2031

NAT	PAT
One-to-one mapping between Inside Local and Inside Global addresses.	One Inside Global address can be mapped to many Inside Local addresses.
Uses only IPv4 addresses in translation process.	Uses IPv4 addresses and TCP or UDP source port numbers in translation process.
A unique Inside Global address is required for each inside host accessing the outside network.	A single unique Inside Global address can be shared by many inside hosts accessing the outside network.

سایر مفاهیم مرتبط با آدرس های IP:

- آدرس های معتبر و غیر معتبر
- مفاهیم NAT, Proxy و VPN

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- Proxy
- Tunneling
- ...

سایر مفاهیم مرتبط با آدرس های IP:

- آدرس های معتبر و غیر معتبر
- مفاهیم NAT, Proxy و VPN

To convert invalid IP addresses to valid IP addresses:

- NAT
- Proxy
- Tunneling (VPN)
- ...

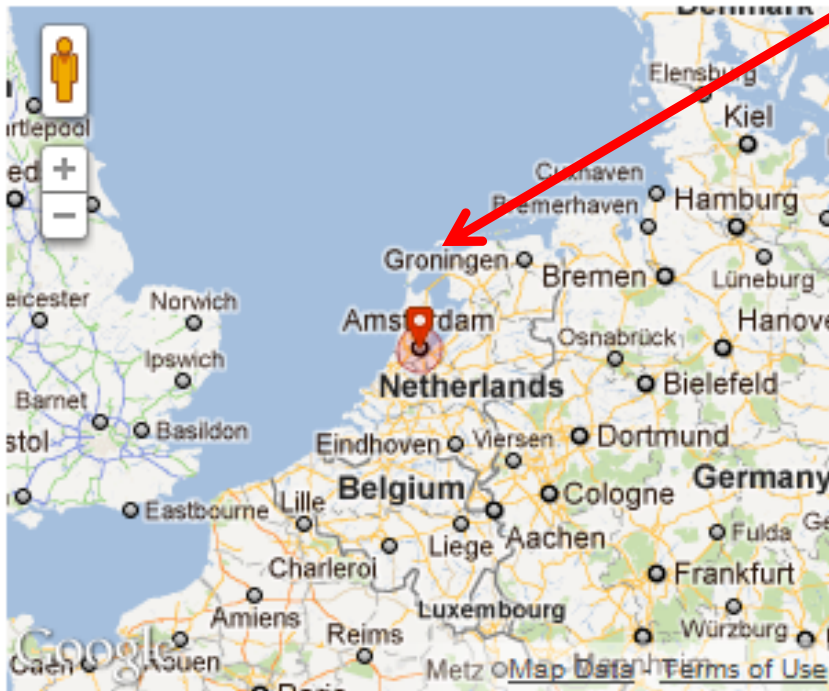
VPN

I am
HERE
In the world

What Is My IP Address? Looku x

address.com

What Is My IP Address? (Now detects many [proxy servers](#))



IP Information: **83.149.126.32**

ISP: LeaseWeb B.V.

Organization: LeaseWeb

Connection:

Services: [Network Sharing Device](#)

City: Amsterdam

Region: Noord-Holland

Country: Netherlands

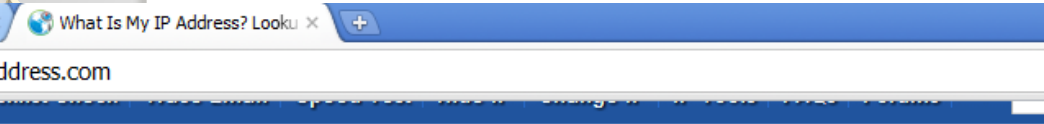
83.149.126.32

Additional IP D

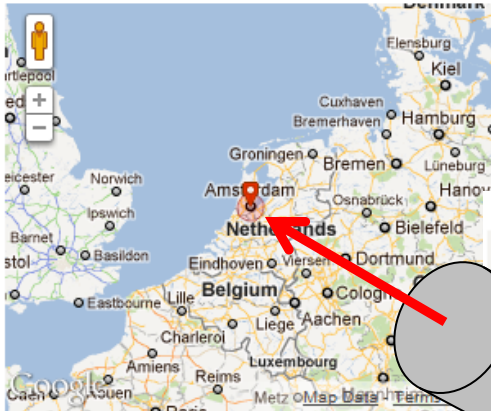
Location not accurate? Try: [Update IP Location](#)

VPN

دیدگاه های نرم افزاری شبکه



What Is My IP Address? (Now detects many [proxy servers](#))



IP Information: 83.149.126.32
ISP: LeaseWeb B.V.
Organization: LeaseWeb
Connection:
Services: [Network Sharinn Device](#)

Location not accurate? Try: [Update IP Location](#)



IP Information: 31.25.88.189
ISP: Toos-Ashena Co. Ltd.
Organization: Toos-Ashena Co. Ltd.
Connection:
Services: [None Detected](#)
City: Mashhad
Region: Khorasan
Country: Iran, Islamic Republic of

Tunneling

31.25.88.189	Additional I
--------------	--------------

دیدگاه های نرم افزارى شبکه

پروتکل شفاف سازی آدرس ها

ARP: Address Resolution Protocol

دیدگاه های نرم افزاری شبکه

پروتکل شفاف سازی آدرس ها

ARP: Address Resolution Protocol

- از این پروتکل برای تحویل بسته های IP به مقصد نهایی استفاده می شود زیرا بسته از مبدأ به مقصد تمام مسیر طولانی را با آدرس IP طی می کند تا به آخرین مسیریاب برسد در این هنگام این مسیریاب باید علاوه بر داشتن آدرس IP ، آدرس سخت افزاری مقصد بسته را نیز بداند. زیرا باید در شبکه نهایی فریمی به آدرس فیزیکی مقصد نهایی ساخته شود و بسته در آن قرار بگیرد تا تحویل تجهیزات لایه دویی شود.
- به کمک این مسیریاب، با داشتن آدرس IP ، آدرس MAC مقصد را از شبکه جستجو می کند.

دیدگاه های نرم افزاری شبکه

پروتکل شفاف سازی آدرس ها

ARP: Address Resolution Protocol

```
Wireless LAN adapter Wireless Network Connection:
```

```
Connection-specific DNS Suffix . :
```

```
Description . . . . . : Intel(R) WiFi Link 1000 BGN
```

```
Physical Address. . . . . : 00-26-C7-E9-69-08
```

```
DHCP Enabled. . . . . : Yes
```

```
Autoconfiguration Enabled . . . . : Yes
```

```
Link-local IPv6 Address . . . . . : fe80::d3d:1949:1d7a:8979%11(If{...})
```

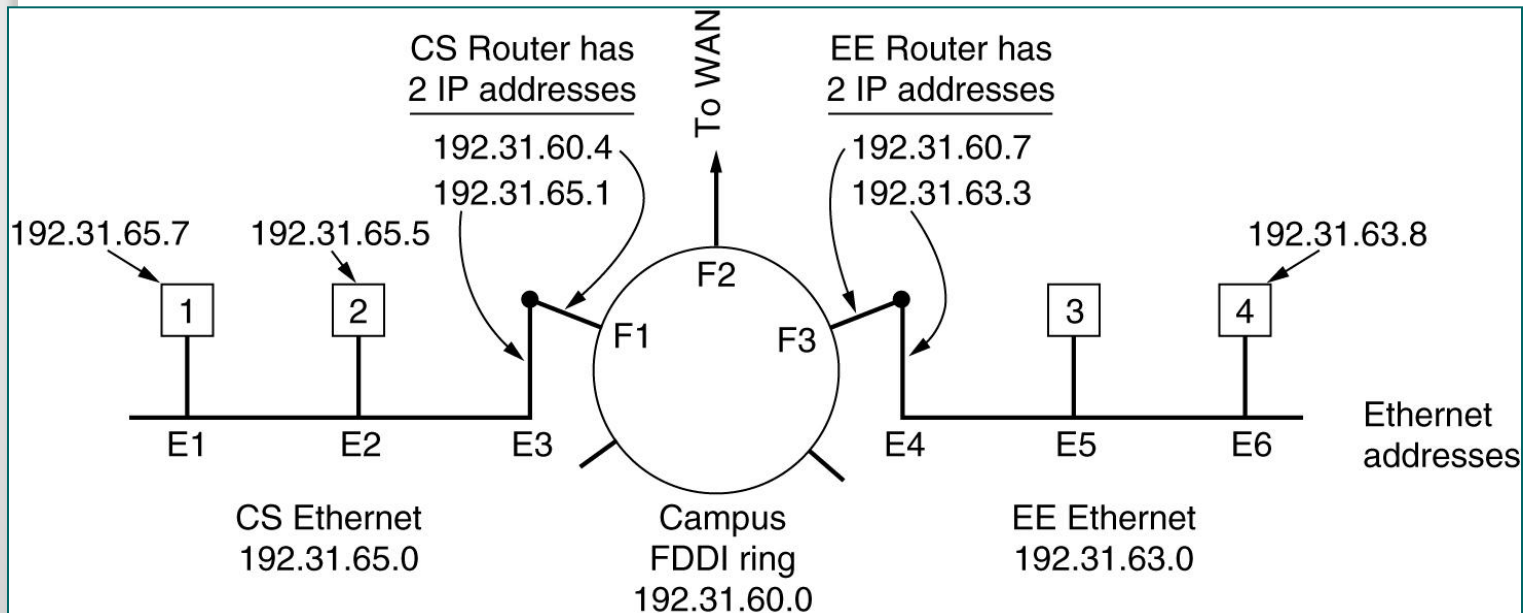
```
IPv4 Address. . . . . : 192.168.1.2(Preferred)
```

```
Subnet Mask . . . . . : 255.255.255.0
```

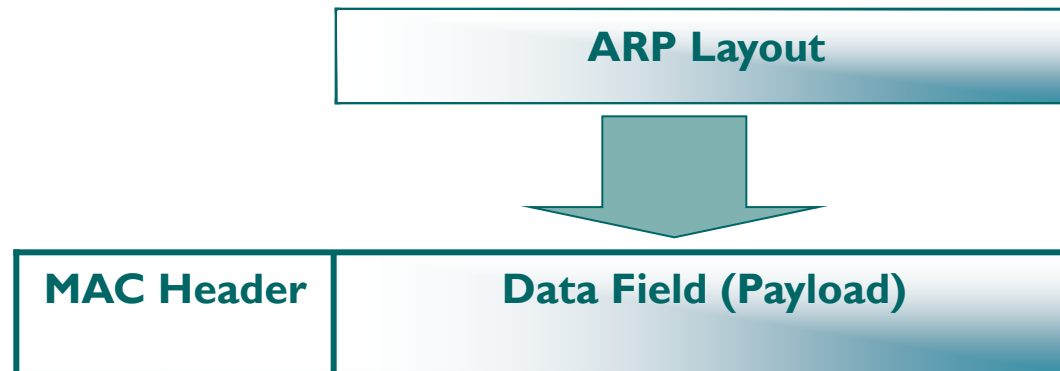
↑ ARP

پروتکل ARP : Address Resolution Protocol

- بی‌معنابودن آدرسهای IP روی کانال انتقال
 - دانستن آدرس IP ماشین مقصد و نیاز به داشتن آدرس فیزیکی آن جهت ارسال بسته
 - وظیفه پروتکل ARP:
 - ارسال بسته فراگیر روی کل شبکه محلی که در آن آدرس IP ماشین مورد نظر قرار دارد. پاسخ ماشین با آدرس IP موجود در بسته ارسالی و ارسال آدرس فیزیکی خود برای ارسال‌کننده بسته
- ARP**



برخلاف پروتکل ICMP که روی پروتکل IP قرار می‌گیرد، پروتکل ARP مستقیماً بر روی پروتکل لایه فیزیکی عمل می‌کند؛ یعنی یک بسته ARP ساخته شده و درون فیلد داده از فریم لایه فیزیکی قرار گرفته و روی کانال ارسال می‌شود.



چگونگی قرار گرفتن یک پیام ARP درون فریم لایه فیزیکی

ساختار پیامهای ARP

Hardware Type	
Protocol Type	
Hardware Address Length	Protocol Address Length
Operation Code	
Source Hardware Address	
Source IP Address	
Destination Hardware Address	
Destination IP Address	

دیدگاه های نرم افزارى شبکه

معكوس پروتكل شفاف سازى آدرس

RARP: Revers Address Resolution Protocol

دیدگاه های نرم افزاری شبکه

معکوس پروتکل شفاف سازی آدرس

RARP: Revers Address Resolution Protocol

- این پروتکل برعکس پروتکل قبلی عمل می کند بدین معنی که اگر آدرس MAC را داشته باشیم ، می توانیم آدرس IP را از شبکه پیرسیم.

دیدگاه های نرم افزاری شبکه

معکوس پروتکل شفاف سازی آدرس

RARP: Revers Address Resolution Protocol

```
Wireless LAN adapter Wireless Network Connection:  
  
Connection-specific DNS Suffix . :  
Description . . . . . : Intel(R) WiFi Link 1000 BGN  
Physical Address. . . . . : 00-26-C7-E9-69-08  
DHCP Enabled. . . . . : Yes  
Autoconfiguration Enabled . . . . : Yes  
Link-local IPv6 Address . . . . . : fe80::d3d:1979:1d7a:8979%11(Ife80::d3d:1979:1d7a:8979%11)  
IPv4 Address. . . . . : 192.168.1.2(Preferred)  
Subnet Mask . . . . . : 255.255.255.0
```

RARP

پروتکل RARP : Reverse Address Resolution Protocol

- ایستگاه آدرس فیزیکی مورد نظرش را می‌داند ولیکن آدرس IP آن را نمی‌داند
- ارسال یک بسته فراگیر روی خط
- تمامی ایستگاههایی که از پروتکل RARP حمایت می‌کنند و بسته‌های مربوطه را تشخیص می‌دهند، در صورتی که آدرس فیزیکی خودشان را درون بسته ببینند در پاسخ به آن، آدرس IP خود را در قالب یک بسته RARP Reply برمی‌گردانند.

توجه: بسته‌های RARP, ARP از نوع فراگیر محلی Local Broadcast هستند و بالطبع توسط مسیریابها منتقل نمی‌شوند و فقط در محدوده شبکه محلی عمل می‌کنند.

دیدگاه های نرم افزارى شبکه

پروتکل پروتکل پیغام کنترلى

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

پروتکل پروتکل پیغام کنترلی

ICMP: Internet Control Message Protocol

- از این پروتکل برای تست ارتباط بین میزبان ها استفاده می شود
- با استفاده از این پروتکل می توان وضعیت کیفیت ارتباط دو میزبان را بررسی کرد، شامل:
 - فاصله زمانی به میلی ثانیه (ms)
 - فاصله دو میزبان به تعداد پرش یا تعداد مسیریاب (Number of Hops)
 - نرخ گم شدگی بسته ها (Packet Loss)
 - و خطاهای احتمالی کانال

```
C:\Windows\system32\cmd.exe
C:\Users\acer>ping 192.9.9.3

Pinging 192.9.9.3 with 32 bytes of data:
Reply from 192.9.9.3: bytes=32 time=365ms TTL=239
Reply from 192.9.9.3: bytes=32 time=367ms TTL=239
Reply from 192.9.9.3: bytes=32 time=356ms TTL=239
Request timed out.

Ping statistics for 192.9.9.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 356ms, Maximum = 367ms, Average = 362ms

C:\Users\acer>ping www.msn.com

Pinging us.co1.cb3.glb dns.microsoft.com [65.55.17.25] with 32 bytes of data:
Reply from 65.55.17.25: bytes=32 time=411ms TTL=237
Reply from 65.55.17.25: bytes=32 time=420ms TTL=237
Request timed out.
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237

Ping statistics for 65.55.17.25:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 411ms, Maximum = 420ms, Average = 415ms

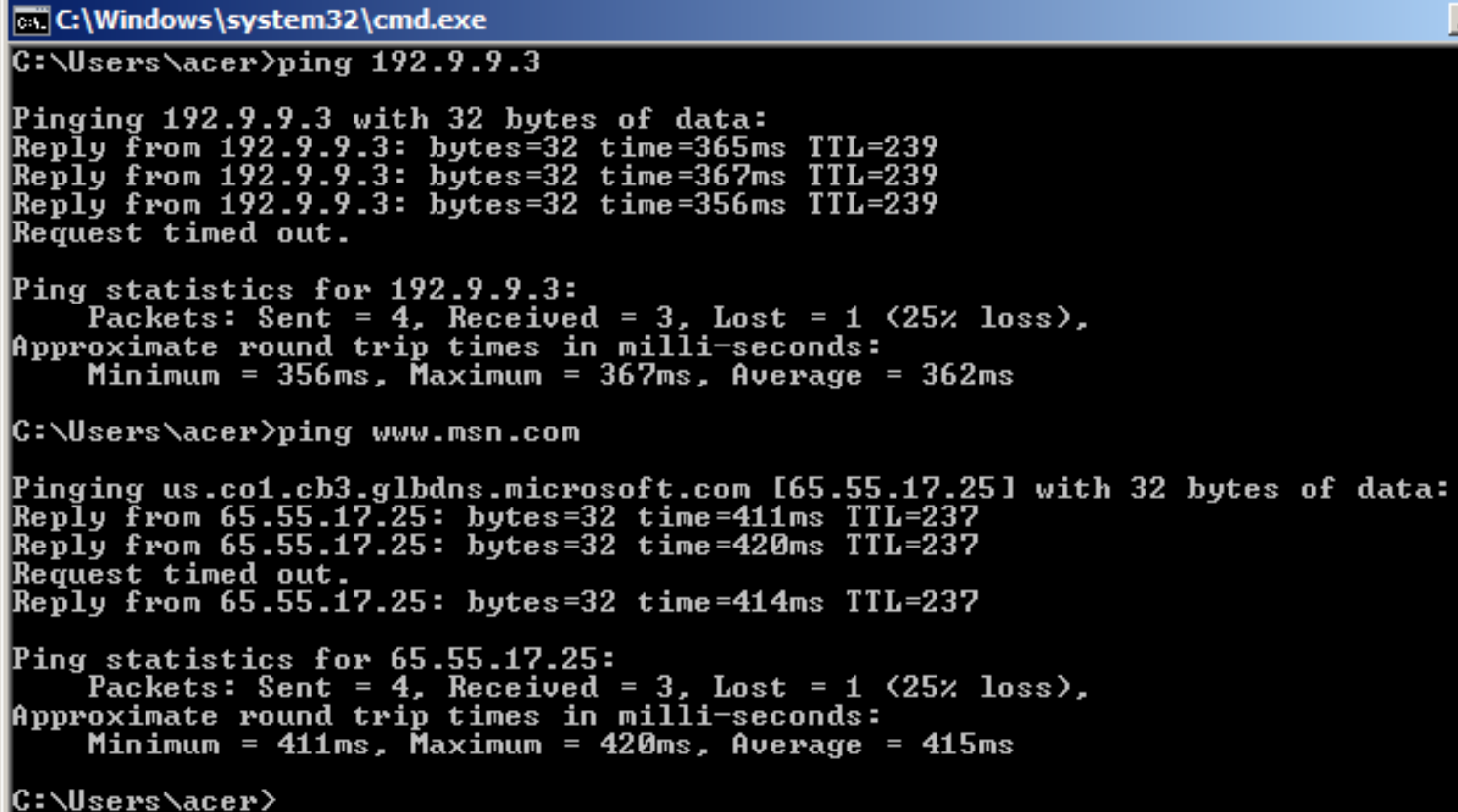
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه



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C:\Windows\system32\cmd.exe
C:\Users\acer>ping 192.9.9.3

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Request timed out.
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237

Ping statistics for 65.55.17.25:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 411ms, Maximum = 420ms, Average = 415ms

C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Users\acer>ping 192.9.9.3
```

```
Pinging 192.9.9.3 with 32 bytes of data:  
Reply from 192.9.9.3: bytes=32 time=365ms TTL=239  
Reply from 192.9.9.3: bytes=32 time=367ms TTL=239  
Reply from 192.9.9.3: bytes=32 time=356ms TTL=239  
Request timed out.
```

```
Ping statistics for 192.9.9.3:  
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 356ms, Maximum = 367ms, Average = 362ms
```

```
C:\Users\acer>ping www.msn.com
```

```
Pinging us.co1.cb3.glb dns.microsoft.com [65.55.17.25] with 32 bytes of data:  
Reply from 65.55.17.25: bytes=32 time=411ms TTL=237  
Reply from 65.55.17.25: bytes=32 time=420ms TTL=237  
Request timed out.  
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237
```

```
Ping statistics for 65.55.17.25:  
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 411ms, Maximum = 420ms, Average = 415ms
```

```
C:\Users\acer>
```

```
C:\>Ping <IP Address> or <url>
```

```
C:\>tracert <IP Address> or <url>
```

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Users\acer>ping 192.9.9.3
```

```
Pinging 192.9.9.3 with 32 bytes of data:  
Reply from 192.9.9.3: bytes=32 time=365ms TTL=239  
Reply from 192.9.9.3: bytes=32 time=367ms TTL=239  
Reply from 192.9.9.3: bytes=32 time=356ms TTL=239  
Request timed out.  
  
Ping statistics for 192.9.9.3:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 356ms, Maximum = 367ms, Average = 362ms
```

```
C:\Users\acer>ping www.msn.com  
  
Pinging us.co1.cb3.glb dns.microsoft.com [65.55.17.25] with 32 bytes of data:  
Reply from 65.55.17.25: bytes=32 time=411ms TTL=237  
Reply from 65.55.17.25: bytes=32 time=420ms TTL=237  
Request timed out.  
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237  
  
Ping statistics for 65.55.17.25:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 411ms, Maximum = 420ms, Average = 415ms
```

```
C:\Users\acer>
```

```
C:\>Ping <IP Address> or <url>
```

```
C:\>tracert <IP Address> or <url>
```

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
C:\Users\acer>ping 192.9.9.3

Pinging 192.9.9.3 with 32 bytes of data:
Reply from 192.9.9.3: bytes=32 time=365ms TTL=239
Reply from 192.9.9.3: bytes=32 time=367ms TTL=239
Reply from 192.9.9.3: bytes=32 time=356ms TTL=239
Request timed out.

Ping statistics for 192.9.9.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 356ms, Maximum = 367ms, Average = 362ms

C:\Users\acer>ping www.msn.com

Pinging us.co1.cb3.glb dns.microsoft.com [65.55.17.25] with 32 bytes of data:
Reply from 65.55.17.25: bytes=32 time=411ms TTL=237
Reply from 65.55.17.25: bytes=32 time=420ms TTL=237
Request timed out.
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237

Ping statistics for 65.55.17.25:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 411ms, Maximum = 420ms, Average = 415ms

C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
C:\Users\acer>ping 192.9.9.3

Pinging 192.9.9.3 with 32 bytes of data:
Reply from 192.9.9.3: bytes=32 time=365ms TTL=239
Reply from 192.9.9.3: bytes=32 time=367ms TTL=239
Reply from 192.9.9.3: bytes=32 time=356ms TTL=239
Request timed out.

Ping statistics for 192.9.9.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 356ms, Maximum = 367ms, Average = 362ms

C:\Users\acer>ping www.msn.com

Pinging us.co1.cb3.glb dns.microsoft.com [65.55.17.25] with 32 bytes of data:
Reply from 65.55.17.25: bytes=32 time=411ms TTL=237
Reply from 65.55.17.25: bytes=32 time=420ms TTL=237
Request timed out.
Reply from 65.55.17.25: bytes=32 time=414ms TTL=237

Ping statistics for 65.55.17.25:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 411ms, Maximum = 420ms, Average = 415ms

C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:

  0  3 ms    1 ms    1 ms    192.168.1.1
  1  50 ms   50 ms   50 ms   192.168.90.1
  2  53 ms   54 ms   54 ms   172.16.21.1
  3  91 ms   88 ms   91 ms   172.16.35.4
  4  89 ms   90 ms   87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms   90 ms   217.219.64.115
  6  93 ms   91 ms   92 ms   217.218.158.42
  7  75 ms   *       77 ms   10.10.53.61
  8  *       190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239
.193.202]
 10  212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 11  276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.1
58]
 12  298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 13  298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.

C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
C:\Users\acer>tracert www.yahoo.com
Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:
  0  3 ms    1 ms    1 ms    192.168.1.1
  1  50 ms   50 ms   50 ms   192.168.90.1
  2  53 ms   54 ms   54 ms   172.16.21.1
  3  91 ms   88 ms   91 ms   172.16.35.4
  4  89 ms   90 ms   87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms   90 ms   217.219.64.115
  6  93 ms   91 ms   92 ms   217.218.158.42
  7  75 ms   *       77 ms   10.10.53.61
  8  *       190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239
.193.202]
 10  212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 11  276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.1
58]
 12  298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 13  298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:

  0  0 ms  0 ms  0 ms  192.168.0.1
  1  3 ms  1 ms  1 ms  192.168.1.1
  2  50 ms  50 ms  50 ms  192.168.0.1
  3  53 ms  54 ms  54 ms  172.16.21.1
  4  91 ms  88 ms  91 ms  172.16.35.4
  5  89 ms  90 ms  87 ms  dci-mashhad.aftab.ws [82.115.22.1]
  6  92 ms  92 ms  90 ms  217.219.64.115
  7  93 ms  91 ms  92 ms  217.218.158.42
  8  75 ms  *  77 ms  10.10.53.61
  9  *  190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
 10 200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239
.193.202]
 11 212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 12 276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.1
58]
 13 298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 14 298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 15 300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 16 309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:
  0  0 ms    0 ms    0 ms    172.16.17.1
  1  50 ms   50 ms   50 ms   192.168.90.1
  2  53 ms   54 ms   54 ms   172.16.21.1
  3  91 ms   88 ms   91 ms   172.16.35.4
  4  89 ms   90 ms   87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms   90 ms   217.219.64.115
  6  93 ms   91 ms   92 ms   217.218.158.42
  7  75 ms   *       77 ms   10.10.53.61
  8  *       190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239
.193.202]
 10  212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 11  276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.1
58]
 12  298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 13  298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:

  0  3 ms    1 ms    1 ms    192.168.1.1
  1  50 ms   50 ms   50 ms   192.168.90.1
  2  53 ms   54 ms   54 ms   172.16.21.1
  3  71 ms   68 ms   71 ms   172.16.133.1
  4  89 ms   90 ms   87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms   90 ms   217.219.64.115
  6  93 ms   91 ms   92 ms   217.218.158.42
  7  75 ms   *       77 ms   10.10.53.61
  8  *       190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239
.193.202]
 10  212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 11  276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.1
58]
 12  298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 13  298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:

  0  3 ms    1 ms    1 ms    192.168.1.1
  1  50 ms   50 ms   50 ms   192.168.90.1
  2  53 ms   54 ms   54 ms   172.16.21.1
  3  91 ms   88 ms   91 ms   172.16.35.4
  4  89 ms   90 ms   87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms   90 ms   217.219.64.115
  6  93 ms   91 ms   92 ms   217.218.158.42
  7  75 ms   *       77 ms   10.10.55.61
  8  *       190 ms  193 ms  static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms  198 ms  turktelekom-ic-143692-adm-b5.c.telia.net [80.239.193.202]
 10  212 ms  200 ms  200 ms  adm-b5-link.telia.net [80.239.193.201]
 11  276 ms  279 ms  280 ms  yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.158]
 12  298 ms  314 ms  305 ms  UNKNOWN-66-196-65-X.yahoo.com [66.196.65.81]
 13  298 ms  293 ms  292 ms  ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms  307 ms  te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms  325 ms  ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

ICMP: Internet Control Message Protocol

دیدگاه های نرم افزاری شبکه

```
C:\Windows\system32\cmd.exe
^C
C:\Users\acer>tracert www.yahoo.com

Tracing route to eu-fp3.wa1.b.yahoo.com [87.248.112.181]
over a maximum of 30 hops:

  0  3 ms    1 ms     1 ms    192.168.1.1
  1  50 ms   50 ms    50 ms   192.168.90.1
  2  53 ms   54 ms    54 ms   172.16.21.1
  3  91 ms   88 ms    91 ms   172.16.35.4
  4  89 ms   90 ms    87 ms   dci-mashhad.aftab.ws [82.115.22.1]
  5  92 ms   92 ms    90 ms   217.219.64.115
  6  93 ms   91 ms    92 ms   217.218.158.42
  7  75 ms   *        77 ms   10.10.53.61
  8  *       190 ms   193 ms   static.turktelekom.com.tr [212.156.90.29]
  9  200 ms  197 ms   198 ms   turktelekom-ic-143692-adm-b5.c.telia.net [80.239.193.202]
 10  212 ms  200 ms   200 ms   turktelekom-ic-143692-adm-b5.c.telia.net [80.239.193.201]
 11  276 ms  279 ms   280 ms   yahoo-ic-141065-adm-b5.c.telia.net [213.248.71.181]
 12  298 ms  314 ms   305 ms   UNKNOWN-66-196-65-x.yahoo.com [66.196.65.81]
 13  298 ms  293 ms   292 ms   ae-1.msri.ird.yahoo.com [66.196.67.231]
 14  300 ms  303 ms   307 ms   te-8-4.bas-b2.ird.yahoo.com [87.248.101.109]
 15  309 ms  324 ms   325 ms   ir1.fp.vip.ird.yahoo.com [87.248.112.181]

Trace complete.

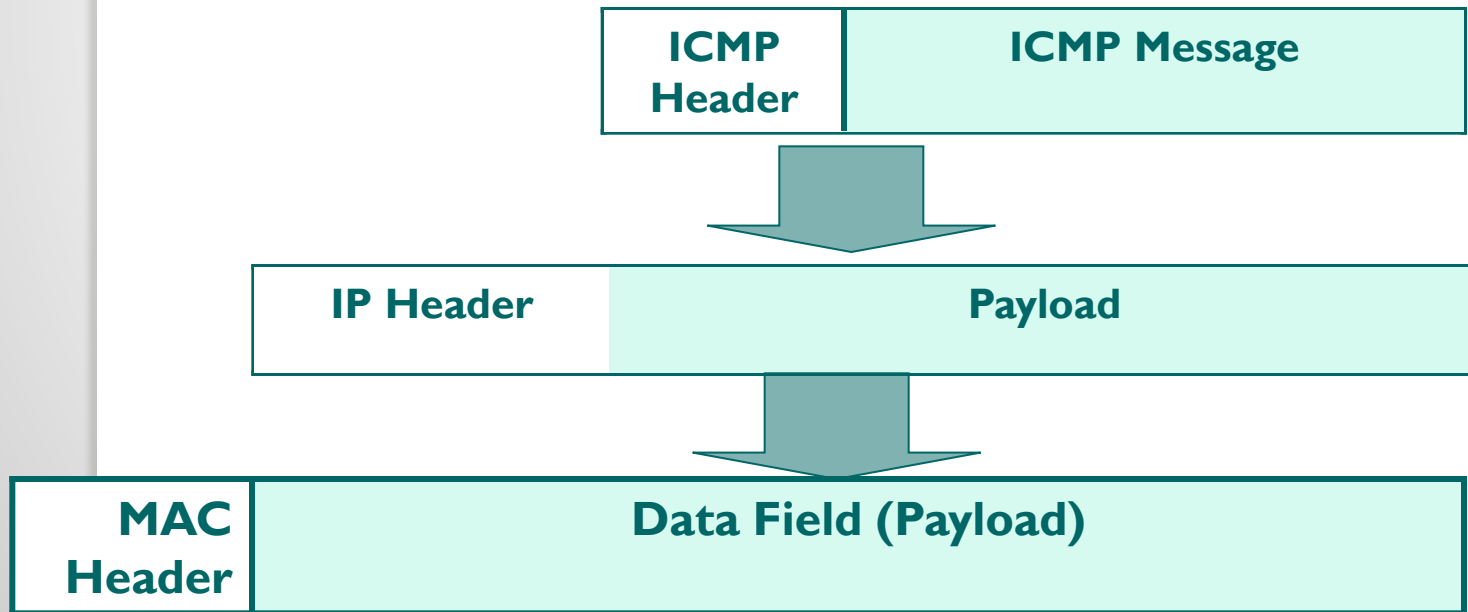
C:\Users\acer>
```

C:\>Ping <IP Address> or <url>

C:\>tracert <IP Address> or <url>

پروتکل ICMP: Internet Control Message Protocol

- بررسی انواع خطا و ارسال پیام برای مبدأ بسته در صورت بروز خطا و اعلام نوع خطا
- یک سیستم گزارش خطا
- قرارگرفتن پیام ICMP درون بسته IP



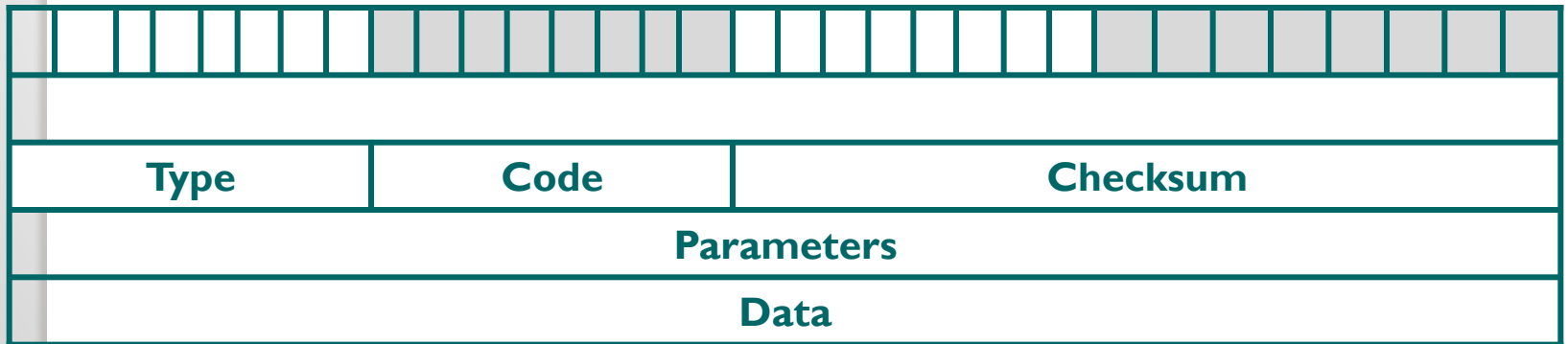
قالب پیام ICMP

فیلد **Type**: مشخص کننده نوع پیام

فیلد **Code**: مشخص کننده کد زیرنوع

فیلد **Checksum**: جهت سنجش اعتبار و درستی بسته ICMP

۳۲ بیت



انواع پیامهای ICMP

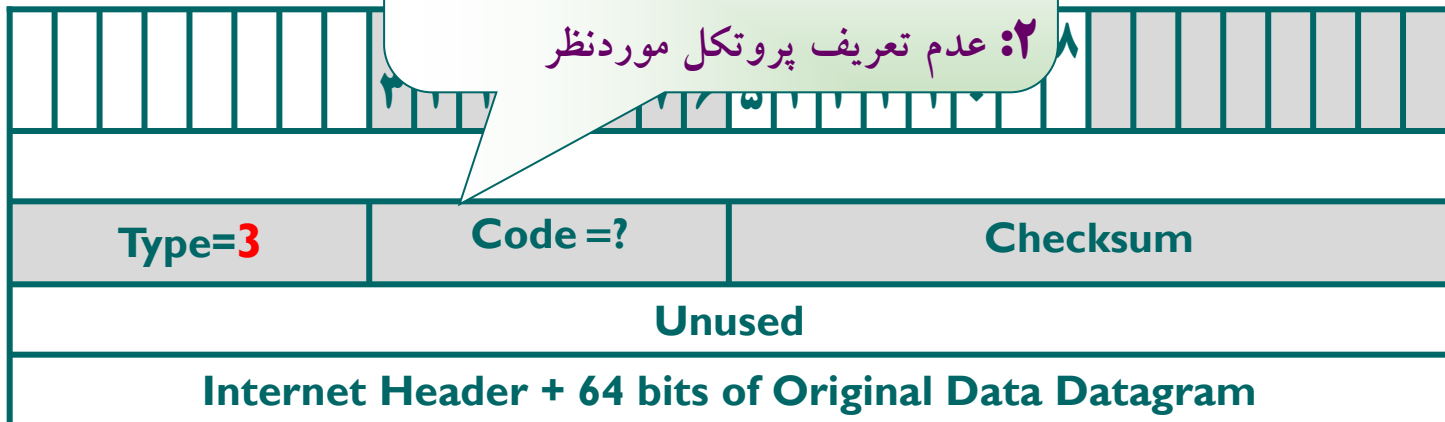
1) پیام Destination Unreachable

- عدم تشخیص آدرس توسط مسیریاب و یا زیر شبکه
- نرسیدن بسته به مقصد به هر علت

♦ در دسترس نبودن شبکه مورد نظر

۱: در دسترس نبودن ماشین میزبان

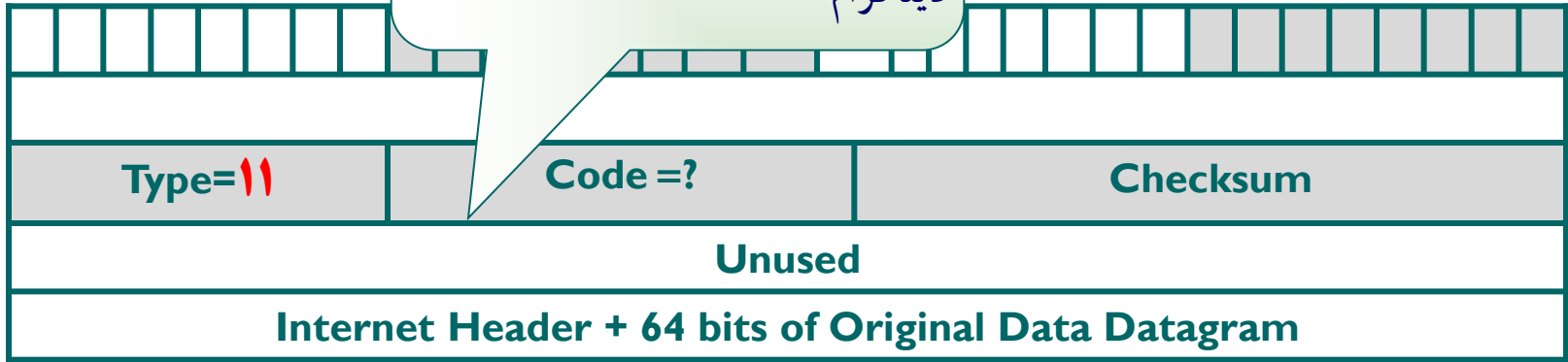
۲: عدم تعریف پروتکل مورد نظر



٢) پیام Time Exceeded

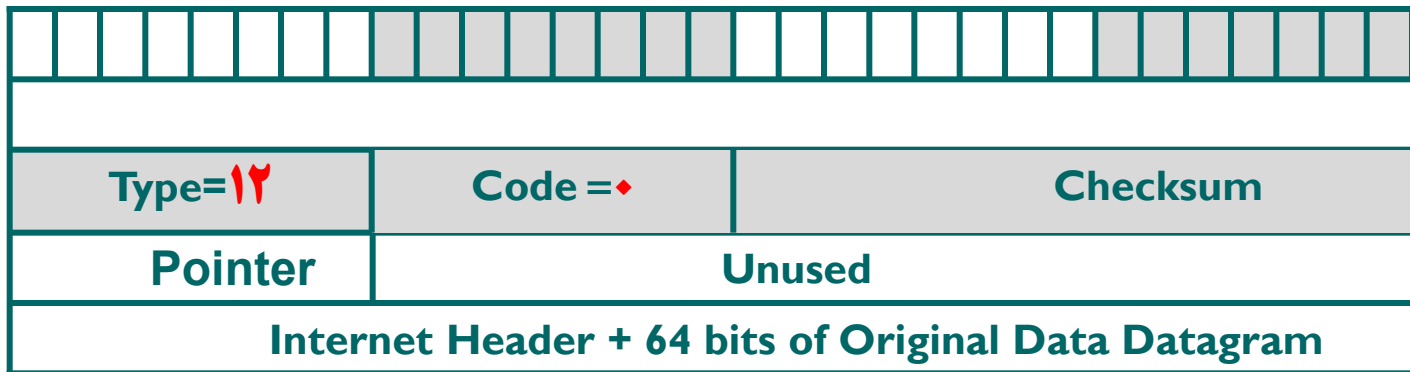
ارسال پیام به فرستنده بسته جهت آگاهی از اتمام طول عمر بسته و حذف آن توسط مسیریاب

• = اتمام زمان حیات بسته
۱ = اتمام زمان بازسازی قطعات یک دیتاگرام



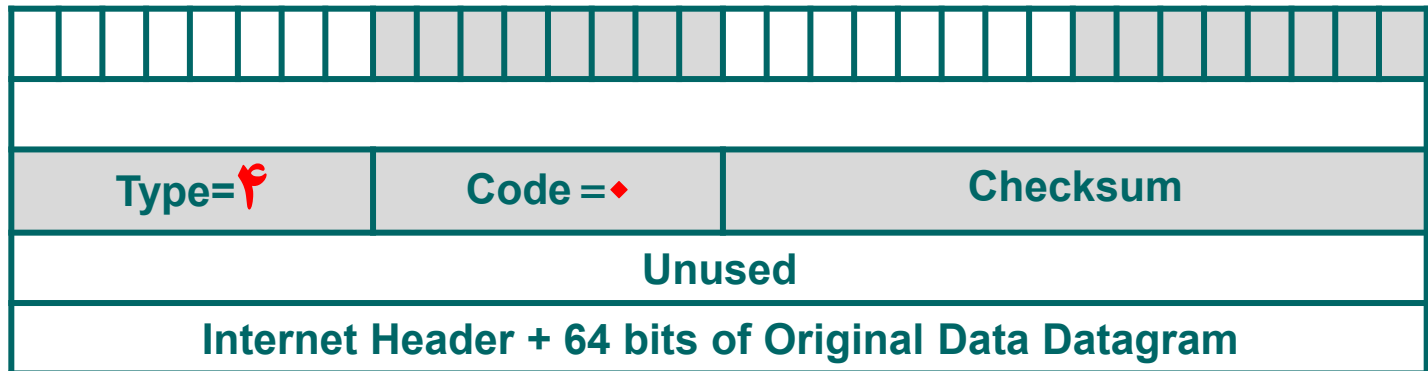
۳) پیام Parameter Problem

نشان‌دهنده وجود مقدار نامعتبر در یکی از فیلدهای سرآیند بسته
IP



Source Quench پیام (۴)

تقاضای کاهش نرخ تولید و ارسال بسته‌های IP از ماشین میزبان



۵) پیام Redirect

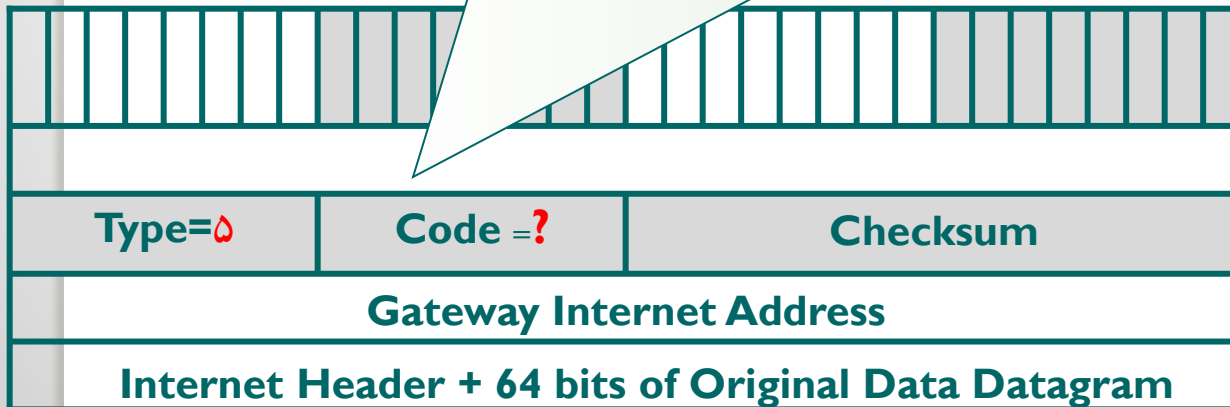
وجود اشکال در مسیریابی

۰ = تغییر مسیر به شبکه‌ای که آدرس آن مشخص شده است.

۱ = تغییر مسیر به ماشینی که آدرس آن مشخص شده است.

۲ = تغییر مسیر به شبکه‌ای که آدرس آن مشخص شده است جهت تأمین سرویس ویژه
Type of service درخواستی مشخص شده در فیلد

۳ = تغییر مسیر به ماشینی که آدرس آن مشخص شده است جهت تأمین سرویس ویژه
Type of service درخواستی مشخص شده در فیلد



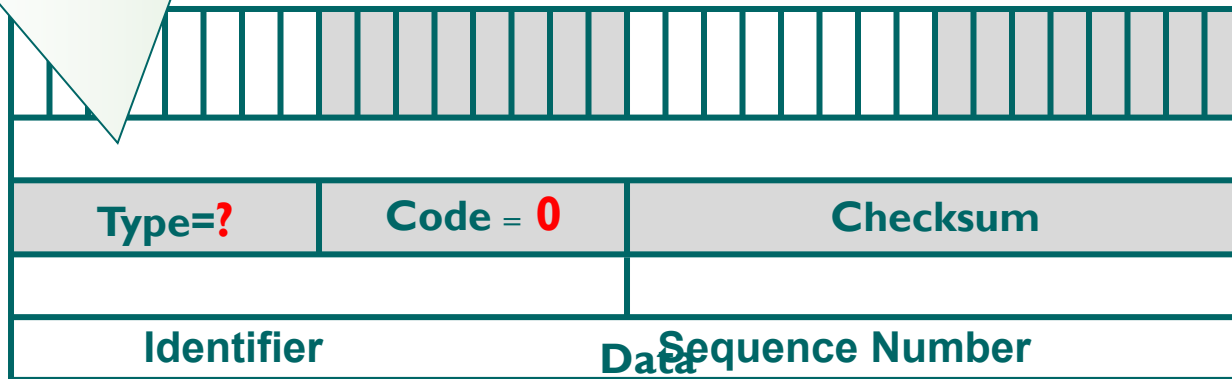
۶ پیامهای Echo Request , Echo Reply

پیام **Echo Request** : موجود و قابل دسترس بودن یک ماشین خاص

در شبکه توسط مسیریاب

پیام **Echo Reply** : پاسخ مقصد مبنی بر دریافت پیام **Echo Request**

8 : برای مشخص کردن پیام **Echo Request**
0 : برای مشخص کردن پیام **Echo Reply**



پیامهای Timestamp Request و Timestamp Reply (۷)

دریافت کننده پیام **Timestamp Request** زمان دریافت و زمان ارسال بسته را نیز مشخص می کند.

13 : برای مشخص کردن پیام **Timestamp Request**
14 : برای مشخص کردن پیام **Timestamp Reply**

Type=?				Code=0				Checksum							
Identifier								Sequence Number							
Originate Timestamp															
Receive Timestamp															
Transmit Timestamp															

دیدگاه های نرم افزارى شبکه

پروتکل تخصیص آدرس به میزبان ها ...

Dynamic Host Configuration Protocol (DHCP)

دیدگاه های نرم افزارى شبکه

پروتکل تخصیص آدرس به میزبان ها ...

- Dynamic Host Configuration Protocol v4 (DHCPv4) assigns IPv4 addresses and other network configuration information dynamically
- The DHCPv4 server dynamically assigns, or leases, an IPv4 address from a pool of addresses for a limited period of time chosen by the server, or until the client no longer needs the address
- Clients lease the information from the server for an administratively defined period.
- Administrators configure DHCPv4 servers to set the leases to time out at different intervals.
- The lease is typically anywhere from 24 hours to a week or more. When the lease expires, the client must ask for another address, although the client is typically reassigned the same address.

DHCPv4 Operation

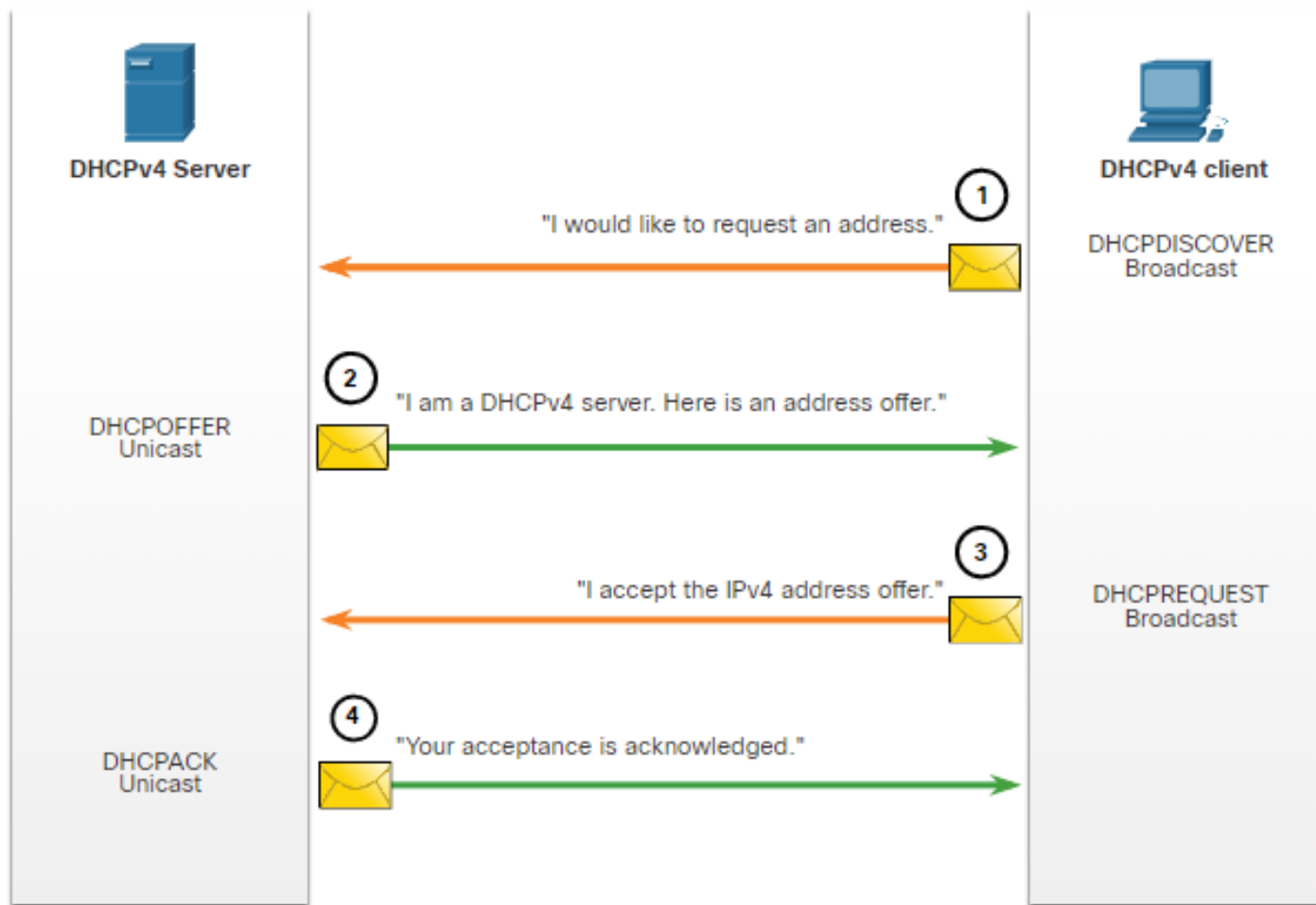
DHCPv4 works in a client/server mode. When a client communicates with a DHCPv4 server, the server assigns or leases an IPv4 address to that client

- The client connects to the network with that leased IPv4 address until the lease expires. The client must contact the DHCP server periodically to extend the lease
- This lease mechanism ensures that clients that move or power off do not keep addresses that they no longer need
- When a lease expires, the DHCP server returns the address to the pool where it can be reallocated as necessary

دیدگاه های نرم افزاری شبکه

DHCPv4 Operation

پروتکل تخصیص آدرس به میزبان ها ...



DHCPv4 Operation

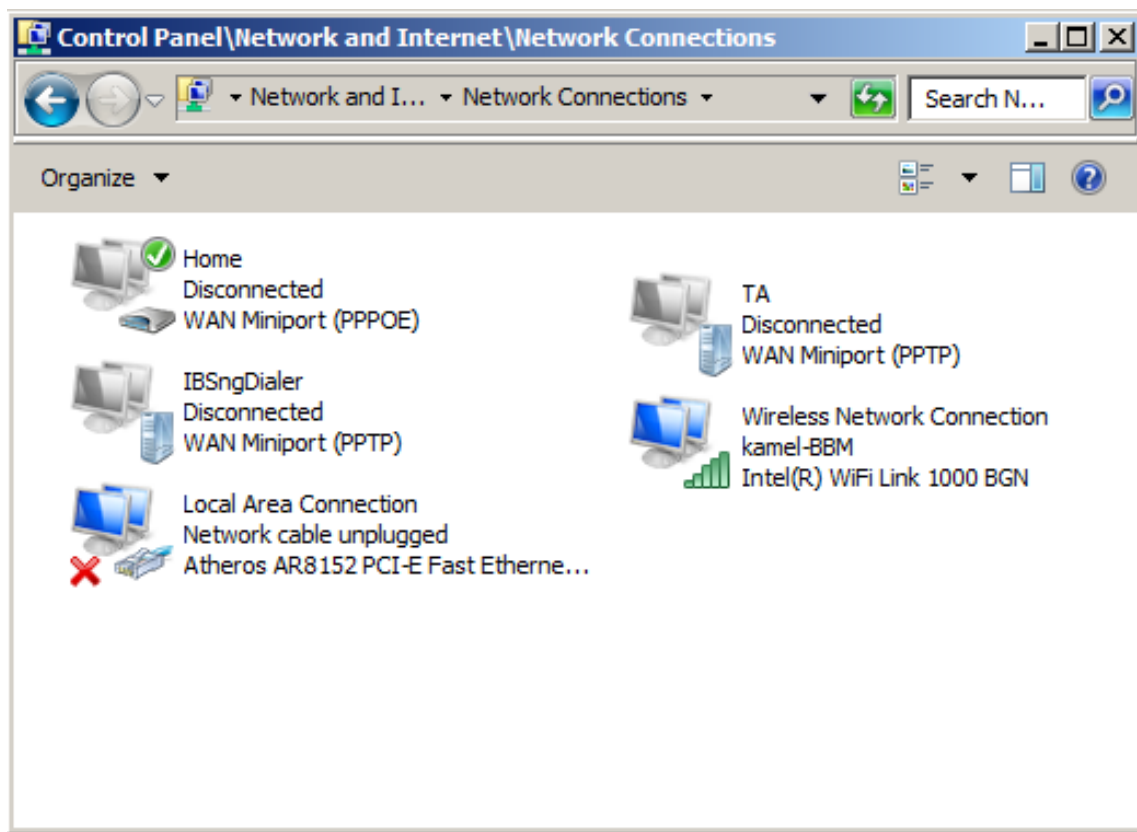
When the client boots (or otherwise wants to join a network), it begins a four-step process to obtain a lease:

1. DHCP Discover (DHCPDISCOVER)
2. DHCP Offer (DHCPOFFER)
3. DHCP Request (DHCPREQUEST)
4. DHCP Acknowledgment (DHCPACK)

پروتکل (IP) Internet Protocol

دیدگاه های نرم افزاری شبکه

تنظیم میزبان ها برای دریافت آدرس خودکار ...



پروتکل (IP) Internet Protocol

دیدگاه های نرم افزاری شبکه

تنظیم میزبان ها برای دریافت آدرس خودکار ...

Control Panel\Network and Internet\Network and Sharing Center

Organize

- Home Disconnected WAN Miniport (PPPOE)
- IBSngDialer Disconnected WAN Miniport (PPTP)
- Local Area Connection** Network cable unplugged Atheros AR8152 PCI-E Fast Eth

Disable
Status
Diagnose
Create Shortcut
Delete
Rename
Properties

Local Area Connection Properties

Networking

Connect using:
Atheros AR8152 PCI-E Fast Ethernet Controller (NDIS 6.2)
Configure...

This connection uses the following items:

- Client for Microsoft Networks
- QoS Packet Scheduler
- File and Printer Sharing for Microsoft Networks
- Internet Protocol Version 6 (TCP/IPv6)
- Internet Protocol Version 4 (TCP/IPv4)**
- Link-Layer Topology Discovery Mapper I/O Driver
- Link-Layer Topology Discovery Responder

Install... Uninstall Properties

Description

پروتکل (IP) Internet Protocol

دیدگاه های نرم افزاری شبکه

تنظیم میزبان ها برای دریافت آدرس خودکار ...

The image shows two overlapping windows from a Windows operating system. The background window is titled "Local Area Connection Properties" and is in the "Networking" tab. It shows a list of installed network components, with "Internet Protocol Version 4 (TCP/IPv4)" highlighted in blue. The foreground window is titled "Internet Protocol Version 4 (TCP/IPv4) Properties" and is in the "General" tab. It shows options for obtaining IP and DNS addresses. The "Obtain an IP address automatically" option is selected and highlighted with a red box. Below it, the "Obtain DNS server address automatically" option is also selected. The "Validate settings upon exit" checkbox is unchecked. The "Advanced..." button is visible at the bottom right of the dialog.

Local Area Connection Properties

Networking

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- Link-Layer Topology Discovery Responc

Install... Uninstall

Description

Internet Protocol Version 4 (TCP/IPv4) Properties

General Alternate Configuration

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically

Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

Obtain DNS server address automatically

Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

Validate settings upon exit

Advanced...

OK Cancel

پروتکل (IP) Internet Protocol

دیدگاه های نرم افزاری شبکه

تنظیم میزبان ها برای دریافت آدرس خودکار ...

```
C:\Windows\system32\cmd.exe

Windows IP Configuration

Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix . . . : 
    Link-local IPv6 Address . . . . . : fe80::d3d:1849:1d7a:8979%11
    IPv4 Address. . . . . : 192.168.1.2
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Ethernet adapter Local Area Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : mshome.net
```

```
C:\>ipconfig
```

```
C:\>ipconfig /all
```

دیدگاه های نرم افزاری شبکه

پروتکل زمان ...

Network Time Protocol (NTP)

Network Time Protocol (NTP)

- Network Time Protocol (NTP) synchronizes clocks of hosts and routers in the Internet
- Over 100,000 NTP peers deployed in the Internet and its tributaries all over the world
- Provides nominal accuracies of low tens of milliseconds on WANs, submilliseconds on LANs, and submicroseconds using a precision time source such as a cesium oscillator or GPS receiver

Network Time Protocol (NTP)

Application of NTP ...

- ❑ Stock market sale and buy orders and confirmation timestamps
- ❑ Network fault isolation, reporting and restoral
- ❑ Network monitoring, measurement and control
- ❑ Distributed multimedia stream synchronization
- ❑ RPC at-most-once transactions; replay defenses; sequence-number disambiguation
- ❑ Research experiment setup, measurement and control
- ❑ Cryptographic key management and lifetime control

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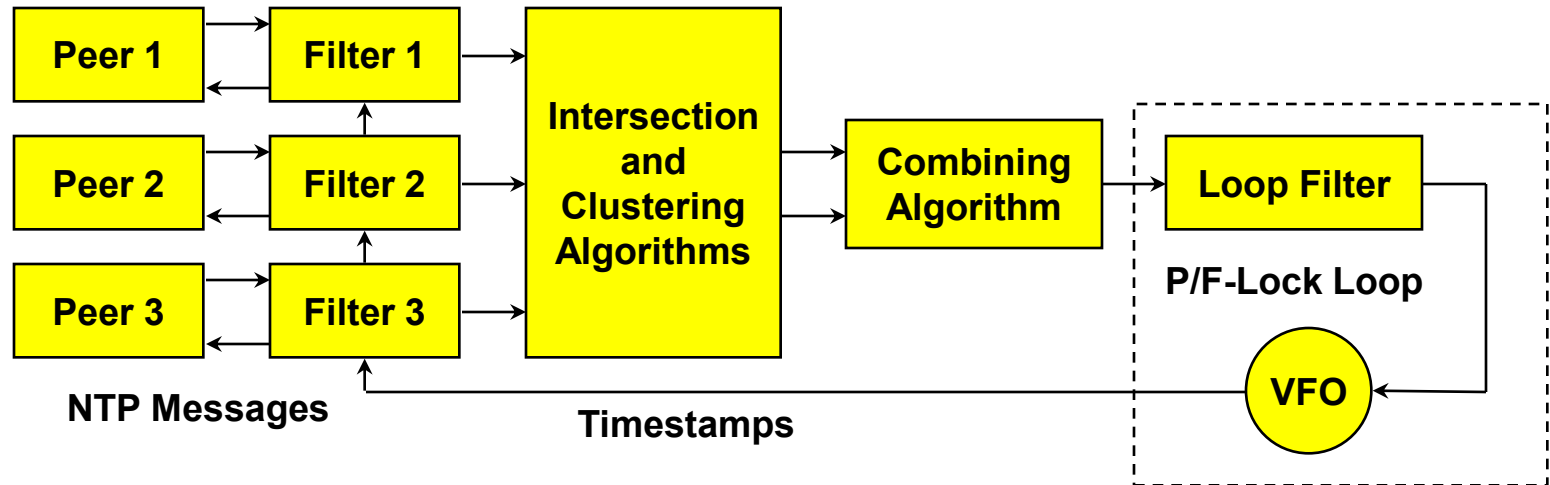
Network Time Protocol (NTP)

How it works ...

- ❑ Primary (stratum 1) servers synchronize to national time standards via radio, satellite and modem
- ❑ Secondary (stratum 2, ...) servers and clients synchronize to primary servers via hierarchical subnet
- ❑ Clients and servers operate in master/slave, symmetric or multicast modes with or without cryptographic authentication
- ❑ Reliability assured by redundant servers and diverse network paths
- ❑ Engineered algorithms reduce jitter, mitigate multiple sources and avoid improperly operating servers
- ❑ System clock is disciplined in time and frequency using an adaptive algorithm responsive to network time jitter and clock oscillator frequency wander

Network Time Protocol (NTP)

How it works ...



- Multiple synchronization peers provide redundancy and diversity
- Clock filters select best from a window of eight clock offset samples
- Intersection and clustering algorithms pick best subset of servers believed to be accurate and fault-free
- Combining algorithm computes weighted average of offsets for best accuracy
- Phase/frequency-lock feedback loop disciplines local clock time and frequency to maximize accuracy and stability

Other common protocols in LANs

- Port 37: Time
- Port 49: TACACS
- Port 53: DNS
- Port 67: DHCP/BOOTP server
- Port 68: DHCP/BOOTP client
- Port 69: TFTP
- Port 137: NetBIOS name service
- Port 138: NetBIOS datagram service