

—

1

- PC Packet Tracer

1. IP-

IP-

1. IPv4- ?

IP-

Linux. **ipconfig** Windows **ifconfig** macOS

Home Network.  
Home Network.

a. PC, Desktop ( ) Command  
Prompt ( ).

b. **ipconfig** IPv4 Home PC

C:\> **ipconfig**

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:

Link-local IPv6 Address.....: FE80::240:BFF:FEA6:4D5A

IPv6 Address.....: ::

IPv4 Address.....: **192.168.0.75**

Subnet Mask.....: 255.255.255.0

Default Gateway.....: ::

**192.168.0.1**

<output omitted>

C:\ >

IPv4 — 192.168.0.75,

IPv4-

IPv4-

IPv4-

IPv4-

c.

IPv4-

?

```
IPv4-адрес. . . . . : 192.168.1.114
Маска подсети . . . . . : 255.255.255.0
Основной шлюз. . . . . : 192.168.1.1
```

2. IPv4- ?

Windows **ipconfig**

IPv4-

IPv4-

192.168.0.1.

macOS Linux

route -n.

IPv4-

?

```
IPv4-адрес. . . . . : 192.168.1.114
Маска подсети . . . . . : 255.255.255.0
Основной шлюз. . . . . : 192.168.1.1
```

3.

IPv4-

?

IPv4-

IPv4-

IP-

IPv4-

IPv4-

IPv4-

?

IPv4-

?

a.

« ip».

IPv4-

IPv6-

IPv4-

IPv6.

b.

Packet Tracer

Command Window,

Web Browser.

c.

URL

www.tellmemyip.com

Go.

Packet Tracer.

IPv4-

( )

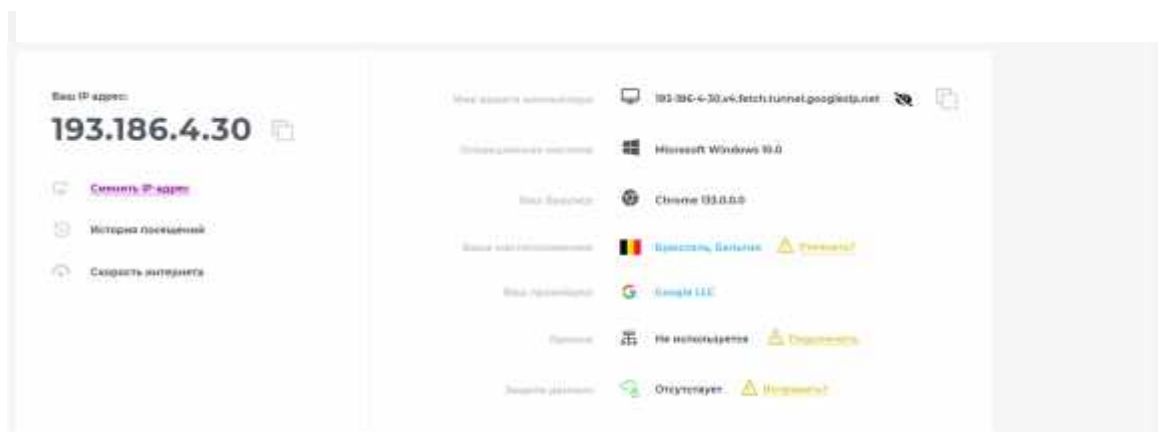
Pacific Grove,

5

d.

« ip»,

IPv4-



4.

YouTube "Tour of Home Network 2020 8-bit guy".

**2.**

**traceroute,**

IP-

**tracert,**  
**tracert** .

« ». Windows  
macOS Linux  
**tracert.**

traceroute.

Home PC    Packet Tracer.

1.

a. Packet Tracer      Home PC      Web Browser,  
Desktop      Command Prompt.

b. **tracert www.hawaii.edu**. Packet Tracer  
**hawaii.edu** IPv4- . **Fast Forward Time** ( , ),

c. traceroute

## Packet Tracer.

IPv4-

IPv4

IPv4-

IPv4-

```
C:\> tracert www.hawaii.edu
```

```
Tracing route to web00.its.hawaii.edu [172.31.149.56]
over a maximum of 30 hops:
```

```
1 3 ms 4 ms 3 ms 10.0.0.1
```

```
2 13 ms 16 ms 11 ms 10.120.89.61
```

3 44 ms 18 ms 18 ms po-302-1222-

rur02.monterey.ca.sfba.comcast.net [10.110.178.133]

```
4 13 ms 14 ms 13 ms po-2-rur01.monterey.ca.sfba.comcast.net [10.139.198.129]
```

```
5 21 ms 17 ms 15 ms be-222-rar01.santaclara.ca.sfba.comcast.net [10.151.78.177]
```

```

6 16 ms 20 ms 19 ms be-39931-cs03.sunnyvale.ca.ibone.comcast.net
[10.110.41.121]
7 27 ms 14 ms 20 ms be-1312-cr12.sunnyvale.ca.ibone.comcast.net [10.110.46.30]
8 24 ms 19 ms 23 ms be-303-cr01.9greateoaks.ca.ibone.comcast.net [10.110.37.178]
9 19 ms 21 ms 17 ms be-2211-pel1.9greateoaks.ca.ibone.comcast.net
[10.110.32.246]
10 16 ms 23 ms 16 ms ae-3.2011.rtsw.sunn.net.internet2.edu [172.16.69.141]
11 24 ms 24 ms 23 ms et-2-3-0.3457.rtsw.losa.net.internet2.edu [172.16.20.255]
12 85 ms 87 ms 85 ms 172.16.47.134
13 87 ms 85 ms 85 ms xe-1-1-0-54-kolanut-re0.uhnet.net [172.30.205.29]
14 87 ms 86 ms 87 ms vl-669-10gigcolol3.uhnet.net [172.30.213.2]
15 * * * Request timed out.
16 * * * Request timed out.
^C

```

C:\ >

Tracing route to 172.31.149.56 over a maximum of 30 hops:

1	1 ms	0 ms	0 ms	192.168.0.1
2	0 ms	7 ms	19 ms	10.120.89.61
3	0 ms	0 ms	0 ms	10.110.178.133
4	7 ms	7 ms	7 ms	10.139.198.129
5	6 ms	0 ms	0 ms	10.151.78.177
6	0 ms	0 ms	0 ms	10.110.41.121
7	6 ms	0 ms	0 ms	10.110.46.30
8	0 ms	0 ms	12 ms	10.110.37.178
9	0 ms	0 ms	0 ms	10.110.32.246
10	*	10 ms	0 ms	172.16.69.141
11	7 ms	6 ms	7 ms	172.16.20.255
12	0 ms	0 ms	6 ms	172.16.47.134
13	*	0 ms	0 ms	172.30.205.29
14	7 ms	0 ms	7 ms	172.30.213.2
15	12 ms	0 ms	7 ms	172.30.1.2
16	6 ms	7 ms	7 ms	172.30.2.2
17	*	0 ms	7 ms	172.31.149.56

Trace complete.

Трассировка маршрута к web3-vip-www00.its.hawaii.edu [128.171.133.42]  
с максимальным числом прыжков 30:

1	2 ms	1 ms	3 ms	192.168.1.1
2	15 ms	12 ms	2 ms	137-194-26-254.novotelecom.ru [37.194.26.254]
3	*	*	*	Превышен интервал ожидания для запроса.
4	13 ms	5 ms	1 ms	10.245.138.242
5	2 ms	2 ms	1 ms	149-128-50.novotelecom.ru [178.49.128.50]
6	52 ms	53 ms	55 ms	87.245.193.175
7	55 ms	124 ms	79 ms	139.45.230.52
8	261 ms	169 ms	176 ms	ae0-8.rtlx.nyc.us.retn.net [87.245.233.113]
9	*	*	165 ms	lag-153.ear2.NewYork6.Level3.net [4.30.181.49]
10	*	*	*	Превышен интервал ожидания для запроса.
11	246 ms	333 ms	231 ms	CENIC.ear1.LosAngeles1.Level3.net [4.35.156.66]
12	234 ms	231 ms	230 ms	losa4-agg-01--lax-agg10--400g--01.cenic.net [137.164.11.111]
13	307 ms	274 ms	380 ms	dc-uh--lax-agg6-10ge.cenic.net [137.164.50.233]
14	273 ms	*	320 ms	et-1-2-0-75-coconut-re0.uhnet.net [205.166.205.51]
15	*	*	*	Превышен интервал ожидания для запроса.
16	*	^C		

- d. time out, 15- 16-  
**Ctrl + C**,  
 30  
 traceroute  
 traceroute.  
 1.
- e. IP-  
 3, 4, 5  
 IPv4- ( ). IP-  
 IPv4- 10.0.0.1.  
 po-302-  
 1222-rur02.monterey.ca.sfba.comcast.net,  
 hawaii.edu,  
 www.netacad.com www.google.com.

```
Трассировка маршрута к www.google.com [142.250.74.164]
с максимальным числом прыжков 30:

 1    1 ms    <1 мс    <1 мс    192.168.1.1
 2    1 ms    1 ms      1 ms     137-194-26-254.novotelecom.ru [37.194.26.254]
 3    *      *        *        Превышен интервал ожидания для запроса.
 4    4 ms    5 ms      8 ms     10.245.138.242
 5    30 ms   38 ms     1 ms     149-128-50.novotelecom.ru [178.49.128.50]
 6    43 ms   40 ms     40 ms     bbr03.spb.ertelecom.ru [188.234.152.203]
 7    108 ms  70 ms     135 ms    188x234x131x53.ertelecom.ru [188.234.131.53]
 8    87 ms   91 ms     119 ms    74.125.244.133
 9    108 ms  63 ms     116 ms    72.14.232.84
10    53 ms   57 ms     62 ms     142.250.238.204
11    57 ms   54 ms     54 ms     192.178.80.157
12    54 ms   51 ms     52 ms     142.251.236.71
13    55 ms   53 ms     79 ms     arn11s12-in-f4.1e100.net [142.250.74.164]

Трассировка завершена.
```

2. traceroute.

2 13 ms 16 ms 11 ms 10.120.89.61

IP-  
 10.120.89.61 — IPv4-  
 POP.  
 POP local loop  
 « ».  
 ( ).

- POP.
- )
- ) DSL ( ),
- ) (WLL),
- )
- )
- )
- a. Packet Tracer Home PC Home Router
- traceroute.
- b. Comcast POP. Comcast POP. POP
- Comcast POP Tracer (CMTS), Comcast-pop-Monterey, Packet Rack
- c. CMT Cable Modem Home Network. Comcast-pop-Monterey, Comcast-pop-Monterey
- DNS-server www.hawaii.edu www.tellmemyip.com  
IPv4. Web-server - www.tellmemyip.com.
- d. ? ? ? ? ? ? ? ? ? ?
- e. POP POP ?
- 137.194.26.254
3. IP- POP
- POP «ip lookup», traceroute?
- IP-

IP. ,

ISP POP		
2	IPv4	: 37.194.26.254
ISP:		Novotelecom Ltd
:		Novosibirsk
:		Novosibirskaya oblast'
:		Russia

- , , .

- .

( ),

, , POP.

, POP.

4. , .

"600 million IP addresses Kansas".

, ( )

600 IP- , - .

, IP- , .

, , .

, , .

5. .

Comcast. traceroute, 2 9  
IPv4-

IP. IP- ,

C:\> tracert www.hawaii.edu

Tracing route to web00.its.hawaii.edu [172.31.149.56]  
over a maximum of 30 hops:

1 3 ms 4 ms 3 ms 10.0.0.1  
2 13 ms 16 ms 11 ms 10.120.89.61  
3 44 ms 18 ms 18 ms po-302-1222-  
rur02.monterey.ca.sfba.comcast.net [10.110.178.133]  
4 13 ms 14 ms 13 ms po-2-rur01.monterey.ca.sfba.comcast.net [10.139.198.129]  
5 21 ms 17 ms 15 ms be-222-rar01.santaclara.ca.sfba.comcast.net [10.151.78.177]



```

6 16 ms 20 ms 19 ms be-39931-
cs03.sunnyvale.ca.ibone.comcast.net [10.110.41.121]
7 27 ms 14 ms 20 ms be-1312-cr12.sunnyvale.ca.ibone.comcast.net [10.110.46.30]
8 24 ms 19 ms 23 ms be-303-cr01.9greateaks.ca.ibone.comcast.net [10.110.37.178]
9 19 ms 21 ms 17 ms be-2211-
pell.9greateaks.ca.ibone.comcast.net [10.110.32.246]
10 16 ms 23 ms 16 ms ae-3.2011.rtsw.sunn.net.internet2.edu [172.16.69.141]
11 24 ms 24 ms 23 ms et-2-3-0.3457.rtsw.losa.net.internet2.edu [172.16.20.255]
12 85 ms 87 ms 85 ms 172.16.47.134
13 87 ms 85 ms 85 ms xe-1-1-0-54-kolanut-re0.uhnet.net [172.30.205.29]
14 87 ms 86 ms 87 ms vl-669-10gigcolol3.uhnet.net [172.30.213.2]
15 * * * Request timed out.
16 * * * Request timed out.
^C

```

C:\ >

- a. Packet Tracer  
monterey.ca .
- b. comcast.net.  
IPv4-  
IPv4 .  
  
Config.  
IPv4- 3- ?  
10.110.178.133  
  
monterey.ca IPv4- ?  
rur02.monterey.ca.sfba.comcast.net  
IPv4- 4- Packet Tracer?  
10.139.198.129  
  
monterey.ca IPv4- ?  
rur01.monterey.ca.sfba.comcast.net  
IP-  
traceroute?  
  
traceroute,

```

2 1 ms 1 ms 1 ms 137-194-26-254.novotelecom.ru [37.194.26.254]
3 * * * Превышен интервал ожидания для запроса.
4 4 ms 5 ms 8 ms 10.245.138.242
5 30 ms 38 ms 1 ms 149-128-50.novotelecom.ru [178.49.128.50]
6 43 ms 40 ms 40 ms bbr03.spb.ertelecom.ru [188.234.152.203]
7 108 ms 70 ms 135 ms 188x234x131x53.ertelecom.ru [188.234.131.53]

```

6. , .  
( )  
Comcast ,  
traceroute  
Comcast ,  
:  
J po-302-1222-rur02.monterey.ca.sfba.comcast.net  
J po-2-rur01.monterey.ca.sfba.comcast.net  
J be-222-rar01.santaclara.ca.sfba.comcast.net

) be-39931-cs03.sunnyvale.ca.ibone.comcast.net  
 ) be-1312-cr12.sunnyvale.ca.ibone.comcast.net  
 ) be-303-cr01.9greateaks.ca.ibone.comcast.net  
 ) be-2211-pe11.9greateaks.ca.ibone.comcast.net

- (sfba), Comcast.  
 ) ( )  
 ) - ( )  
 ) ( )  
 ) - , (9greateaks.ca)  
 Packet Tracer,

monterey.ca :

) po-302-1222-rur02.monterey.ca.sfba.comcast.net  
 ) po-2-rur01.monterey.ca.sfba.comcast.net

?

a. Packet Tracer

monterey.ca.

b.

Intercity. (Packet Tracer

Intercity.)

c.

traceroute.

			IPv4-
5	santaclara.ca	GigabitEthernet0/0	10.151.78.177
6	sunnyvale.ca	GigabitEthernet0	10.110.41.121
7	sunnyvale.ca	GigabitEthernet0	10.110.46.30
8	greateaks.ca	GigabitEthernet0	10.110.37.178
9	greateaks.ca	GigabitEthernet0	10.110.32.246

IPv4-

?

Greateaks.callbone, rtsw.sunn.net.internet2.edu, GigabitEthernet1/0, 172.16.20.254/20

IXP Data Center

IXP (

)

Comcast,

IXP.

«

»

IXP,

« »

(NAP)

IXP,

7.

**Comcast Internet2.**

Comcast  
9.

9 19 ms 21 ms 17 ms be-2211-pe11.9greateaks.ca .ibone.comcast.net  
[10.110.32.246]

, Comcast

a.

Equinix "9 great oaks California",  
9 Great Oaks Boulevard  
Google Maps

Equinix —

(IXP),

Equinix SV5.

Comcast

Internet2.

b.

IXP,

«Inflect data center».

Comcast

Equinix SV5.

c.

9greateaks.ca .

Packet Tracer

Internet2.

10-

traceroute.

10 16 ms 23 ms 16 ms ae-3.2011.rtsw.sunn.net. internet2.edu [172.16.69.141]

10-

?

**GigabitEthernet0**

8.

**Internet2.**

Internet2?

? . Internet2

Internet2.

?

8,8 Тбит/с

"This Man Launched a New Internet Service Provider from His Garage".

9.

tracert Internet2.

11 24 ms 24 ms 23 ms et-2-3-0.3457.rtsw.losa.net.internet2.edu [172.16.20.255]

«internet2 router proxy»

Internet2  
(«sfba»)

«losa»  
Los Angeles,

350

. IP-

a. Packet Tracer

Intercity

Los Angeles.

b. losa.net.internet2.edu

11- tracert?

GigabitEthernet1/0

10.

tracert:

12 85 ms 87 ms 85 ms 172.16.47.134

IP-

IP-

IP-

12

Internet2.

85 , 87 85

(24 , 24 , 23 ).

1- 11- ,

12- ?

12

11

tracert

11

12.

12

2500

Internet2 Peer Exchange (IP2X)

Internet2. IP2X

a.

«

»

?

3

?

SEA-US

?

MAKAHA

?

**SEA-US, Japan-US (JUS), Hawaii Inter-Island Fiber Network (HIFN) и Paniolo Cable Network.**

- b. SEA-US  
RAM Telecom International, Inc. (RTI).

« UH »,

- c. YouTube

- d. Packet Tracer Intercity.

Согласно информации, представленной на сайте Nabr, расстояние между ретрансляторами может достигать **150 километров**.

- e. Honolulu.

- f. i2px-Hawaii.  
I2PX 12- traceroute.  
12- ?

**GigabitEthernet1/0**

11. Internet2

traceroute:

(uhnet.net).

IXP,

i2px.hawaii.

(HIX)

Packet Tracer  
Hawaii

kolanut-re0.uhnet.net.

i2PX-

13-

?

**GigabitEthernet0**

12. IP-

Packet Tracer

uhnet.net

hawaii.edu.

Honolulu

Packet Tracer.

traceroute

15.

C:\> **tracert www.hawaii.edu**

Tracing route to web00.its.hawaii.edu [172.31.149.56]  
over a maximum of 30 hops:

<output omitted>

```

14 87 ms 86 ms 87 ms vl-669-10gigcolol3.uhnet.net [172.30.213.2]
15 * * * Request timed out.
16 * * * Request timed out.
^C

```

14

traceroute

```

) Comcast ISP
) Internet2 ISP
)

```

#### Comcast ISP

```

1 3 ms 4 ms 3 ms 10.0.0.1
2 13 ms 16 ms 11 ms 10.120.89.61
3 44 ms 18 ms 18 ms po-302-1222-rur02.monterey.ca.sfba.comcast.net
[10.110.178.133]
4 13 ms 14 ms 13 ms po-2-rur01.monterey.ca.sfba.comcast.net [10.139.198.129]
5 21 ms 17 ms 15 ms be-222-rar01.santaclara.ca.sfba.comcast.net [10.151.78.177]
6 16 ms 20 ms 19 ms be-39931-cs03.sunnyvale.ca.ibone.comcast.net
[10.110.41.121]
7 27 ms 14 ms 20 ms be-1312-cr12.sunnyvale.ca.ibone.comcast.net [10.110.46.30]
8 24 ms 19 ms 23 ms be-303-cr01.9greatoaks.ca.ibone.comcast.net [10.110.37.178]
9 19 ms 21 ms 17 ms be-2211-pel1.9greatoaks.ca.ibone.comcast.net
[10.110.32.246]

```

#### Internet2 ISP

```

10 16 ms 23 ms 16 ms ae-3.2011.rtsw.sunn.net.internet2.edu [172.16.69.141]
11 24 ms 24 ms 23 ms et-2-3-0.3457.rtsw.losa.net.internet2.edu [172.16.20.255]
12 85 ms 87 ms 85 ms 172.16.47.134

```

#### University of Hawaii

```

13 87 ms 85 ms 85 ms xe-1-1-0-54-kolanut-re0.uhnet.net [172.30.205.29]
14 87 ms 86 ms 87 ms vl-669-10gigcolol3.uhnet.net [172.30.213.2]
15 * * * Request timed out.
16 * * * Request timed out.
^C

```

C:\ >

Comcast, Internet2

(AS).

ASS

ASS.

AS

ISP,

Comcast,

NetFlix,

Cisco

Systems,

Comcast ISP

Internet2

ASS  
AS.

:

,

,

.

!

?

,