Sieci Komputerowe

Konfigurowanie interfejsu

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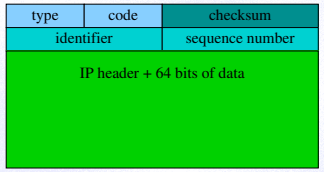
Plan wykładu

- Protokół ICMP.
- Protokół DHCP.
- Testowanie sieci.
- Konfiguracja interfejsów.

Pakiet protokołu ICMP ECHO



Protokół ICMP — RFC 792

Type	Code	Description
8, 0		**Echo Request, Reply**
3		**Destination Unreachable**
	0	net unreachable;
	1	host unreachable;
	2	protocol unreachable;
	3	port unreachable;
	4	fragmentation needed and DF set;
	5	source route failed.
4		**Source Quench**
5		**Redirect**
	0	Redirect datagrams for the Network.
	1	Redirect datagrams for the Host.
	2	Redirect datagrams for the Type of Service and Network.
	3	Redirect datagrams for the Type of Service and Host.
9, 10		**Router Advertisement, Solicitation - RFC 1256**
11		**Time Exceeded**
	0	time to live exceeded in transit;
	1	fragment reassembly time exceeded.
12		**Parameter Problem**
	0	pointer indicates the error.
13, 14		**Timestamp Request, Reply**
15, 16		**Information Request, Reply**

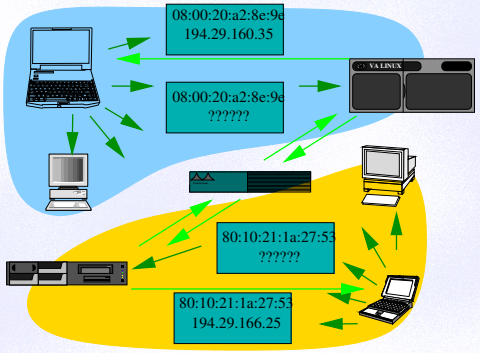
Protokół ICMPv6 — RFC 4443

Type	Code	Description
1		**Destination Unreachable**
	0	No route to destination
	1	Communication with destination administratively prohibited
	2	Beyond scope of source address
	3	Address unreachable
	4	Port unreachable
	5	Source address failed ingress/egress policy.
	6	Reject route to destination
2		**Packet Too Big**
3		**Time Exceeded**
4		**Parameter Problem**
128, 129		**Echo request/reply**
130, 131, 132		**Multicast Listener query/report/done**
133, 134		**Router solicitation/advertisment**
135, 136		**Neighbor solicitation/advertisment**
137		**Redirect Message**
138		**Router Renumbering**
139, 140		**ICMP Node Information query/response**
141, 142		**Inverse Neighbor Discovery Solicitation/Advertisement**
143		**Multicast Listener Discovery (MLDv2) reports**
144, 145		**Home Agent Address Discovery Request/Reply**
146, 147		**Mobile Prefix Solicitation/Advertisement**
148, 149		**Certification Path Solicitation/Advertisement**
151, 152, 153		**Multicast Router Advertisement/Solicitation/Termination**
155		**RPL Control Message**
100, 101, 200, 201		**Private experimentation**
127, 255		**Reserverd**

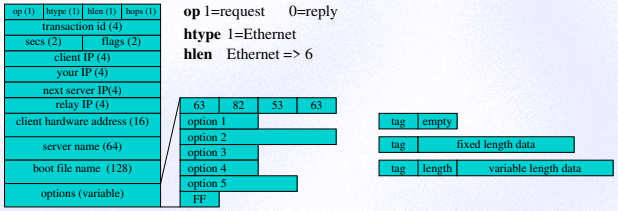
Protokoły RARP, BOOTP, DHCP

RARP	RFC 903	1984	Reverse Address Resolution Protocol
BOOTP	RFC 951	1985	Bootstrap Protocol
DHCP	RFC 1531	1993	Dynamic Host Configuration Protocol
DHCP	RFC 1541	1993	Dynamic Host Configuration Protocol
DHCP	RFC 2131	1997	Dynamic Host Configuration Protocol

Zastosowanie protokołu DHCP



Pakiet protokołu DHCP — RFC 2131



op 1=request 0=reply
htype 1=Ethernet
hlen Ethernet => 6

Opcje DHCP — RFC 1533 (1/2)

Code	Len.	Description
0	1	Padding
255	1	End
1	4	Subnet Mask
2	4	Time Offset
3	$n*4$	Router
4	$n*4$	Time Server
5	$n*4$	IEN 116 Name Server
6	$n*4$	DNS Server
7	$n*4$	Log Server
8	$n*4$	Cookie Server
9	$n*4$	LPR Server
10	$n*4$	Impress Server
11	$n*4$	Resource Location Server - RFC 887
12	n	Host Name
13	2	Boot File Size
14	n	Dump File

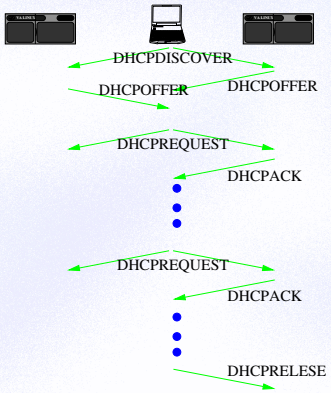
Code	Len.	Description
15	n	Domain Name
16	4	Swap Server
17	n	Root Path
18	n	Extension Path
19	1	IP Forwarding
20	1	Non Local Source Routing
21	$n*8$	Policy Filter
22	2	Maximum Datagram Reassembly Size
23	1	Default TTL
24	4	Path MTU Aging Timeout
25	$n*2$	Path MTU Plateau Table
26	2	MTU
27	1	All Subnets Use Same MTU
28	4	Broadcast
29	1	Perform Mask Discovery
30	1	Mask Supplier

Opcje DHCP — RFC 1533 (2/2)

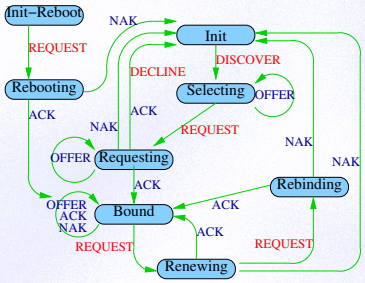
Code	Len.	Description
31	1	Perform Router Discovery
32	4	Router Solicitation Address
33	$n*8$	Static Routes
34	1	Trailer Encapsulation
35	4	ARP Cache Timeout
36	1	Ethernet Encapsulation
37	1	TCP Default TTL
38	4	TCP Keepalive Interval
39	1	TCP Keepalive Garbage
40	n	NIS Domain
41	$n*4$	NIS Servers
42	$n*4$	NTP Servers
43	n	Vendor Specific Information
44	$n*4$	NetBIOS Name Server
45	$n*4$	NetBIOS Datagram Distribution Server
46	1	NetBIOS Node Type
47	n	NetBIOS Scope
48	$n*4$	X Font Servers
49	$n*4$	X Display Managers

Code	Len.	Description
50	4	Requested IP Address
51	4	Lease Time
52	1	Option Overload
53	1	DHCP Message Type
		1=DHCPDISCOVER
		2=DHCPOFFER
		3=DHCPREQUEST
		4=DHCPDECLINE
		5=DHCPACK
		6=DHCPNAK
		7=DHCPRELEASE
54	4	DHCP Server Identifier
55	n	Parameter Request List
56	n	DHCP Error Message
57	2	Maximum DHCP Message Size
58	4	Renewal Time
59	4	Rebinding Time
60	n	Class-identifier
61	n	Client-identifier

Typowa sekwencja pakietów DHCP



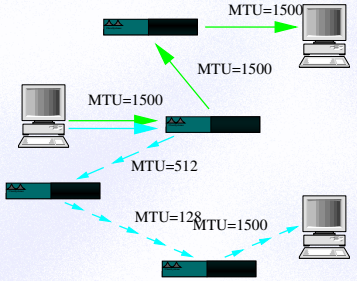
Graf stanów DHCP



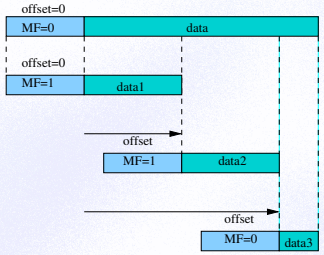
DHCP dla IP v.4 i v.6

	IP v.4	IP v.6
DHCP server address	255.255.255.255	FF02::1:2
DHCP relay address	255.255.255.255	FF05::1:3
DHCP client port	68	546
DHCP server port	67	547
DHCP relay port	67	547

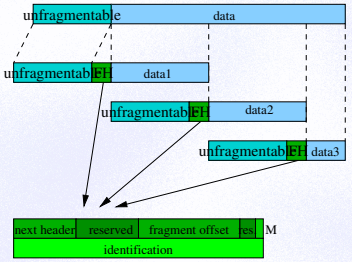
Fragmentacja pakietów IP



Fragmentacja pakietów IP



Fragmentacja protokołu IP v.6



Informacja o interfejsach sieciowych

```
dss<jurek>(130)$ ifconfig -a
lo0: flags=849<UP,LOOPBACK,RUNNING,MULTICAST> mtu 8232
        inet 127.0.0.1 netmask ff000000
le0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu 1500
        inet 148.81.31.27 netmask ffffffe0 broadcast 148.81.31.31
```

Statystyki ruchu z interfejsów sieciowych

```
dss<jurek>(136)$ netstat -in
Name Mtu  Net/Dest     Address       Ipkts Ierrs Opkts Oerrs Collis Queue
lo0  8232 127.0.0.1    127.0.0.1     1039911 0   1039911 0      0      0
le0  1500 148.81.31.27 148.81.31.27 1280046 0   1307194 4      26383  0
```

Działanie polecenia ping

```
dss<jurek>(132)$ ping -s 148.81.31.1
PING 148.81.31.1: 56 data bytes
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=0. time=2. ms
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=1. time=1. ms
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=2. time=1. ms
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=3. time=1. ms
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=4. time=1. ms
64 bytes from csd.ia.pw.edu.pl (148.81.31.1): icmp_seq=5. time=1. ms
^C
----148.81.31.1 PING Statistics----
6 packets transmitted, 6 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 1/1/2
```

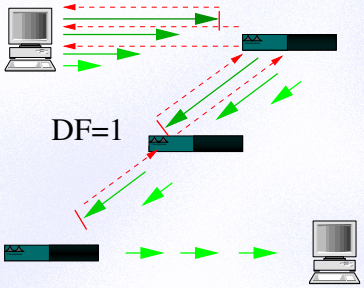
Działanie polecenia traceroute

```
csd<jurek>(1)$ traceroute www.sun.com
traceroute to www.sun.com (64.124.140.199), 30 hops max, 38 byte packets
 1  ia-elka (194.29.166.254)  0.400 ms  0.328 ms  0.298 ms
 2  elka-c-s.routers.pw.edu.pl (194.29.130.117)  1.027 ms  0.706 ms  0.669 ms
 3  COI.routers.pw.edu.pl (194.29.129.50)  4.178 ms  6.658 ms  7.551 ms
 4  pw-r1-at3-0-0-103.warman.nask.pl (148.81.253.69)  99.815 ms  243.858 ms  260.450 ms
 5  z-nask.lod.poznan-gw.622.pol34.pl (212.191.224.93)  16.307 ms  16.392 ms  13.739 ms
 6  pol-34.pl1.pl.geant.net (62.40.103.109)  16.975 ms  11.047 ms  10.512 ms
 7  pl.se1.se.geant.net (62.40.96.113)  35.825 ms  42.990 ms  35.695 ms
 8  so-6-0-0.ar2.CPH1.gblx.net (208.48.23.153)  48.754 ms  54.982 ms  44.214 ms
 9  pos0-0-2488M.cr2.CPH1.gblx.net (67.17.65.181)  45.546 ms pos8-0-2488M.cr1.CPH1.gblx.net \
(67.17.65.197)  46.614 ms  45.122 ms
10  pos0-0-2488M.cr1.LON3.gblx.net (67.17.64.34)  77.056 ms  76.878 ms  77.795 ms
11  so6-0-0-2488M.ar2.LON3.gblx.net (67.17.66.2)  77.295 ms  76.323 ms  77.652 ms
12  902.ge6-1.mpr1.lhr1.uk.above.net (208.185.188.65)  72.651 ms  71.822 ms  72.601 ms
13  so-4-1-0.cr1.lhr3.uk.above.net (208.184.231.174)  73.045 ms  74.313 ms  72.471 ms
14  so-7-0-0.cr1.dca2.us.above.net (64.125.31.186)  150.526 ms  152.176 ms  155.348 ms
15  so-3-0-0.mpr3.sjc2.us.mfnx.net (208.184.233.133)  225.697 ms  226.071 ms  225.525 ms
16  so-0-0-0.cr1.sjc3.us.above.net (208.185.175.153)  230.797 ms  227.265 ms  230.405 ms
17  pos0-0.er2a.sjc3.us.above.net (208.185.175.190)  232.499 ms  230.450 ms  230.185 ms
18  alt1-1.java.sun.com (64.124.128.212)  234.049 ms  225.756 ms  226.885 ms
csd<jurek>(2)$
```

Działanie polecenia mtr

```
                    Matt's traceroute  [v0.48]
csd.ia.pw.edu.pl                                Tue Oct 14 18:21:11 2003
Keys:  D - Display mode    R - Restart statistics    Q - Quit
                                 Packets                 Pings
Hostname                      %Loss  Rcv  Snt  Last  Best  Avg  Worst
 1. ia-elka.ia.pw.edu.pl        0%   34   34     0     0    1     52
 2. elka-c-s.routers.pw.edu.pl  0%   34   34     0     0    0      0
 3. COI.routers.pw.edu.pl       0%   34   34     0     0    9    228
 4. pw-r1-at3-0-0-103.warman.nask.pl  3%  33  34  5  1  8  96
 5. z-nask.lod.poznan-gw.622.pol34.pl  3%  33  34  11  6  10  20
 6. pol-34.pl1.pl.geant.net     3%   33   34     9     6   10     18
 7. pl.se1.se.geant.net         3%   33   34    32    30   40    269
 8. so-6-0-0.ar2.CPH1.gblx.net  6%   32   34    44    44   54    231
 9. pos0-0-2488M.cr2.CPH1.gblx.net  9%  31  34  43  43  49  109
10. pos0-0-2488M.cr1.LON3.gblx.net  12%  30  34  76  74  78  89
11. so6-0-0-2488M.ar2.LON3.gblx.net  10%  30  34  74  74  79  94
12. 902.ge6-1.mpr1.lhr1.uk.above.net  0%  33  33  70  69  82  310
13. so-4-1-0.cr1.lhr3.uk.above.net  7%  31  33  72  69  74  85
14. so-7-0-0.cr1.dca2.us.above.net  4%  32  33  148  146  149  159
15. so-3-0-0.mpr3.sjc2.us.mfnx.net  4%  32  33  227  217  221  233
16. so-0-0-0.cr1.sjc3.us.above.net  4%  32  33  219  217  221  230
17. pos0-0.er2a.sjc3.us.above.net  0%  33  33  218  217  227  438
18. 64.124.140.199.sun.com     4%   32   33    221   217  224   257
```

Testowanie MTU



Polecenie – ifconfig

`ifconfig` *interface* [*address_family*] [*address*] [up] [down] [netmask *mask*] [broadcast *address*]

address family – rodzina adresów

address – adres interfejsu

up down – włączenie/wyłączenie interfejsu

netmask – maska podsieci

broadcast – adres broadcastowy

Plik /etc/hosts

IP-address official-host-name nicknames...

IP-address – adres IP

official-host-name – oficjalna nazwa maszyny

nicknames – alternatywne nazwy maszyny

Przykład:

```
#
# Internet host table
#
127.0.0.1 localhost loghost
148.81.31.1 csd
148.81.31.2 csd1

::1     localhost ip6-localhost ip6-loopback
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

Plik /etc/networks

official-network-name network-number aliases

official-network-name – oficjalna nazwa sieci

network-number – numer IP sieci

nicknames – alternatywne nazwy sieci

Przykład:

```
# Default address is used during DHCP address assignment
default         0.0.0.0

# Loopback address is used only for intra-machine communication
loopback        127.0.0.0

# Automatic Private IP Addressing - APIPA
link-local      169.254.0.0
```

Polecenie – ip 1/2

```
ip help                     - wyswietlenie opisu polecenia
ip link show                - wyswietlenie listy interfejsów
ip link show DEV            - wyswietlenie wybranego interfejsu
ip link set DEV up          - włączenie interfejsu
ip link set DEV down        - wyłączenie interfejsu
ip addr                     - wyswietlenie listy adresów wszystkich interfejsów
ip addr show                - wyswietlenie listy adresów wszystkich interfejsów
ip addr show dev DEV        - wyswietlenie listy adresów interfejsu
ip addr add ADDR dev DEV    - dodanie adresu do interfejsu
ip addr del ADDR dev DEV    - skasowanie adresu z interfejsu
```

Polecenie – ip 2/2

```
ip route                                - wyswietlenie tablicy routingu
ip route show                           - wyswietlenie tablicy routingu
ip route add ADDR/BITS dev DEV          - dodanie trasy do interfejsu
ip route add ADDR/BITS via GW           - dodanie trasy przez router
ip route add default via GW             - dodanie trasy domyslnej przez router
ip route delete ADDR/BITS via GW        - skasowanie trasy
ip neigh                                - wyswietlenie tablicy ARP
ip neigh add ADDR addr MAC dev DEV      - dodanie adresu do tablicy ARP
```

Polecenia – ifup, ifdown

```
ifup interface    - włączenie interfejsu
ifdown interface  - wyłączenie interfejsu
```

Plik – /etc/network/interfaces

```
source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
        address 194.29.180.10/27
        gateway 194.29.180.30
        dns-nameservers 194.29.180.10 194.29.180.22
        dns-search      elka.pw.edu.pl

auto eth0:1
iface eth0:1 inet static
address 192.168.133.33/24

allow-hotplug eth1
iface eth1 inet dhcp
```

Plik – /etc/netplan/01-netcfg.yaml

```
network:
  version: 2
  renderer: networkd
  ethernets:
    ens18:
      # Statyczna konfiguracja interfejsu
      addresses: [194.29.160.35/27]
      gateway4: 194.29.160.62
      nameservers:
        addresses: [194.29.160.10,192.29.160.22]
      dhcp4: no
```

Dziękuję za uwagę

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