

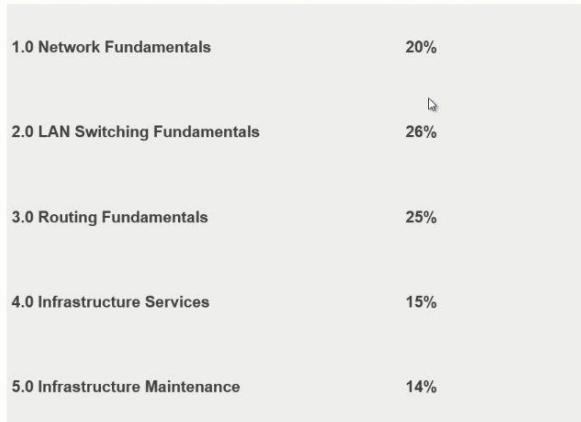
Egzaminy Cisco

Cisco Certified Entry Networking Technician (CCENT) 100-105
(ICND1)

Egzaminy Cisco

Cisco Certified Entry Networking Technician (CCENT) 100-105 (ICND1)

https://learningcontent.cisco.com/cln_storage/text/cln/marketing/exam-topics/100-105-icnd1-v3.pdf



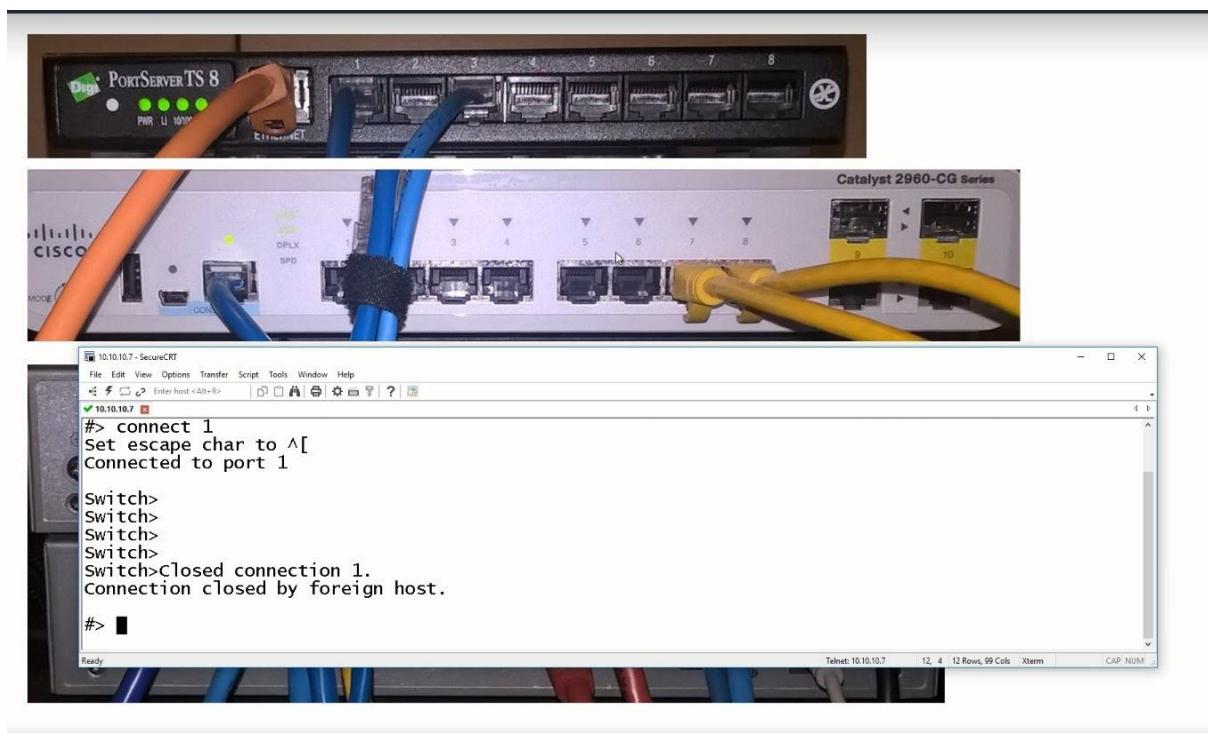
Jak przygotować się do egzaminu?

- ✓ Przerobienie wszystkich lekcji
- ✓ Samodzielna nauka
- ✓ Dokładna analiza dodatkowych źródeł
- ✓ Pytania testowe
- ✓ Własny lab
 - Symulatory, emulatory
 - Sprzęt (Cisco 890/880/860)
 - Rack rentals

www.ccierackrentals.com

www.cconlinelabs.com





Egzamin CCENT



- ✓ 45-55 pytań
- ✓ 90 minut
- ✓ Pytania wielokrotnego wyboru, drag&drop oraz symulacje
- ✓ Egzamin jest dosyć trudny!

Informacje o egzaminie

<https://learningnetwork.cisco.com/community/certifications/ccna/icnd1>

Poradnik:

http://www.cisco.com/web/learning/wwtraining/certprog/training/cert_exam_tutorial.html

Zapisz się na egzamin:

<http://www.pearsonvue.com/cisco>

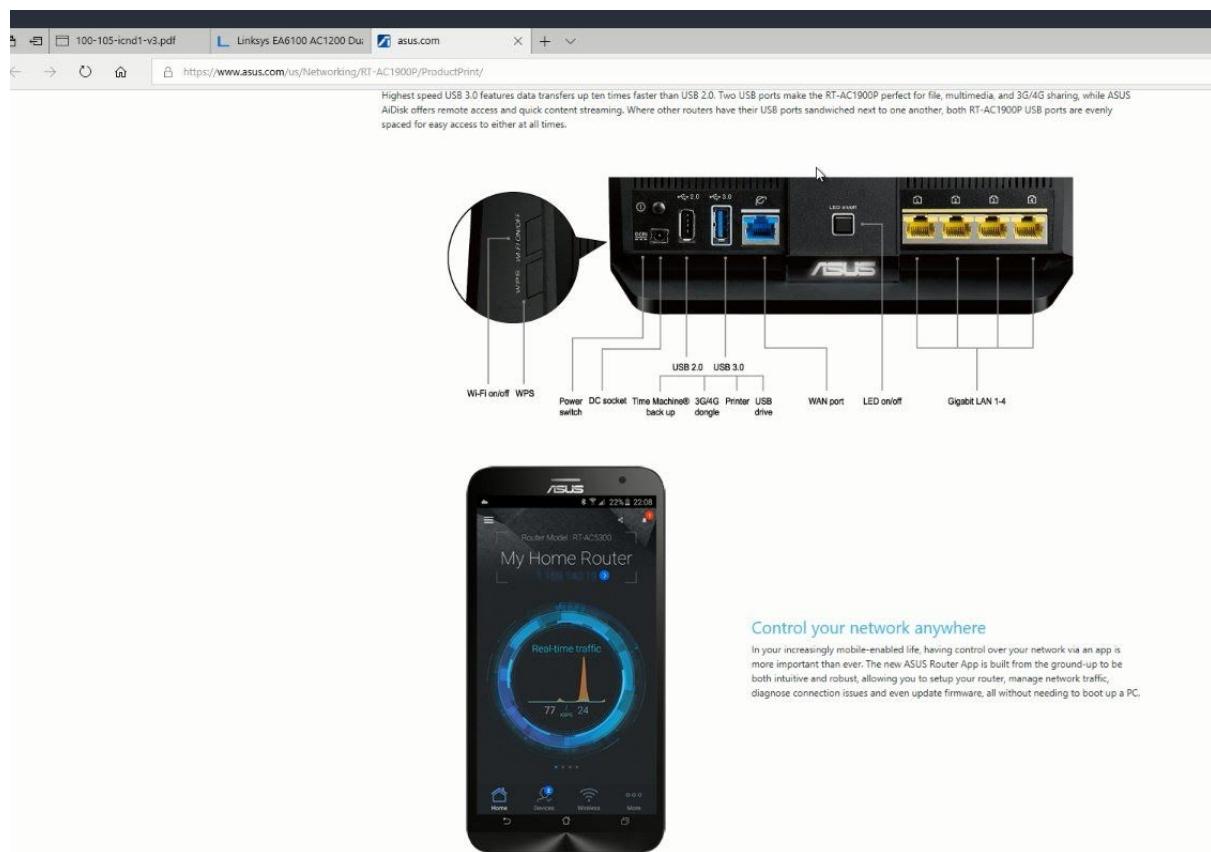
1.0 Network Fundamentals

- 1.1 Compare and contrast OSI and TCP/IP models
- 1.2 Compare and contrast TCP and UDP protocols
- 1.3 Describe the impact of infrastructure components in an enterprise network
 - 1.3.a Firewalls
 - 1.3.b Access points
 - 1.3.c Wireless controllers
- 1.4 Compare and contrast collapsed core and three-tier architectures
- 1.5 Compare and contrast network topologies
 - 1.5.a Star
 - 1.5.b Mesh
 - 1.5.c Hybrid
- 1.6 Select the appropriate cabling type based on implementation requirements
- 1.7 Apply troubleshooting methodologies to resolve problems
 - 1.7.a Perform fault isolation and document
 - 1.7.b Resolve or escalate
 - 1.7.c Verify and monitor resolution
- 1.8 Configure, verify, and troubleshoot IPv4 addressing and subnetting
- 1.9 Compare and contrast IPv4 address types
 - 1.9.a Unicast
 - 1.9.b Broadcast
 - 1.9.c Multicast
- 1.10 Describe the need for private IPv4 addressing
- 1.11 Identify the appropriate IPv6 addressing scheme to satisfy addressing requirements in a LAN/WAN environment
- 1.12 Configure, verify, and troubleshoot IPv6 addressing
- 1.13 Configure and verify IPv6 Stateless Address Auto Configuration
- 1.14 Compare and contrast IPv6 address types
 - 1.14.a Global unicast
 - 1.14.b Unique local
 - 1.14.c Link local
 - 1.14.d Multicast
 - 1.14.e Modified EUI 64
 - 1.14.f Autoconfiguration
 - 1.14.g Anycast

Co to jest sieć komputerowa?

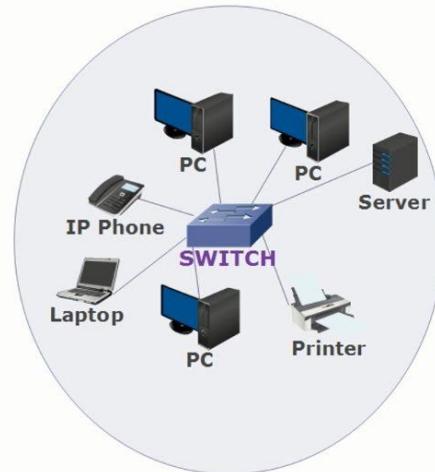
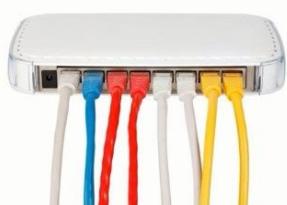
Sieć tworzymy **podłączając**
dwa urządzenia ze sobą i
przesyłając między nimi dane.
(na przykład laptop, drukarka,
serwer, tablet wifi, głośnik
bluetooth...)





Network Types

Sieć lokalna (LAN) – pozwala na dostęp i komunikacje w ograniczonym obszarze, na przykład w domu lub biurze. Podstawowym urządzeniem jest przełącznik (**switch**).

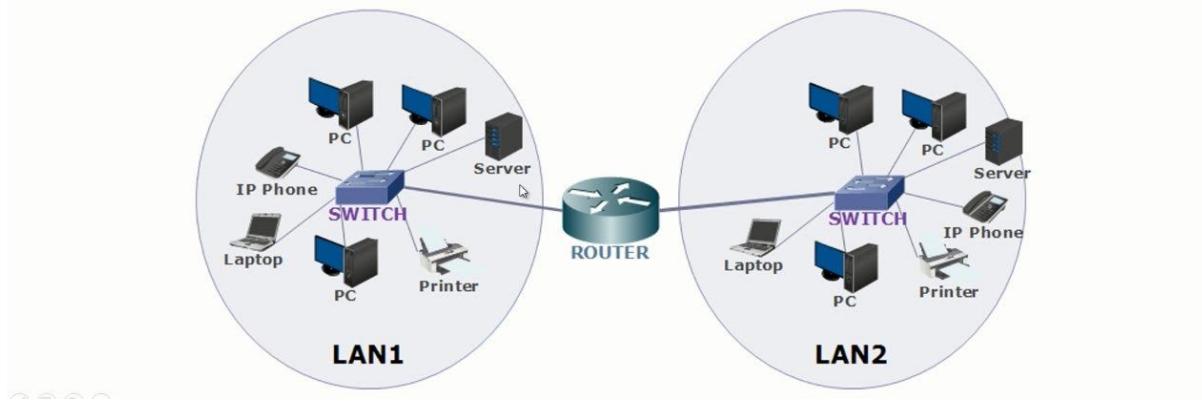


Network Types

Sieć rozległa (WAN)

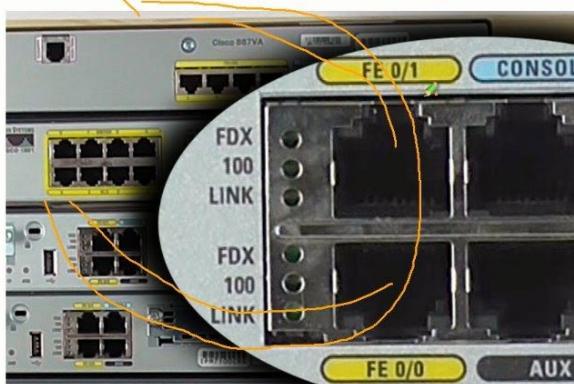
obejmuje duży obszar, łączy dwie lub więcej sieci lokalnych.

Podstawowe urządzenie to ruter (router).



Network Devices

Router – łączy dwie lub więcej sieci,
jest naszą bramą domyślną, pozwala na dostęp do
Internetu. Router odpowiada za routing.

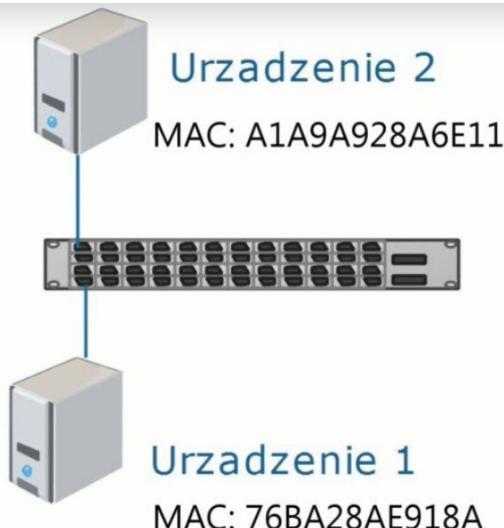


Network Devices

Przełącznik (switch) –

wykorzystywany w sieciach lokalnych, pozwala na komunikacje takich urządzeń jak laptopy, komputery, drukarki.

Switches używają specjalnego rodzaju adresu **MAC**.



Hub jest urządzeniem warstwy pierwszej, jest to bardzo prosty odpowiednik switcha.

Network Devices

A screenshot of a Windows Command Prompt window titled 'cmd.exe'. The window displays network configuration information for two adapters:

```
Select C:\WINDOWS\system32\cmd.exe

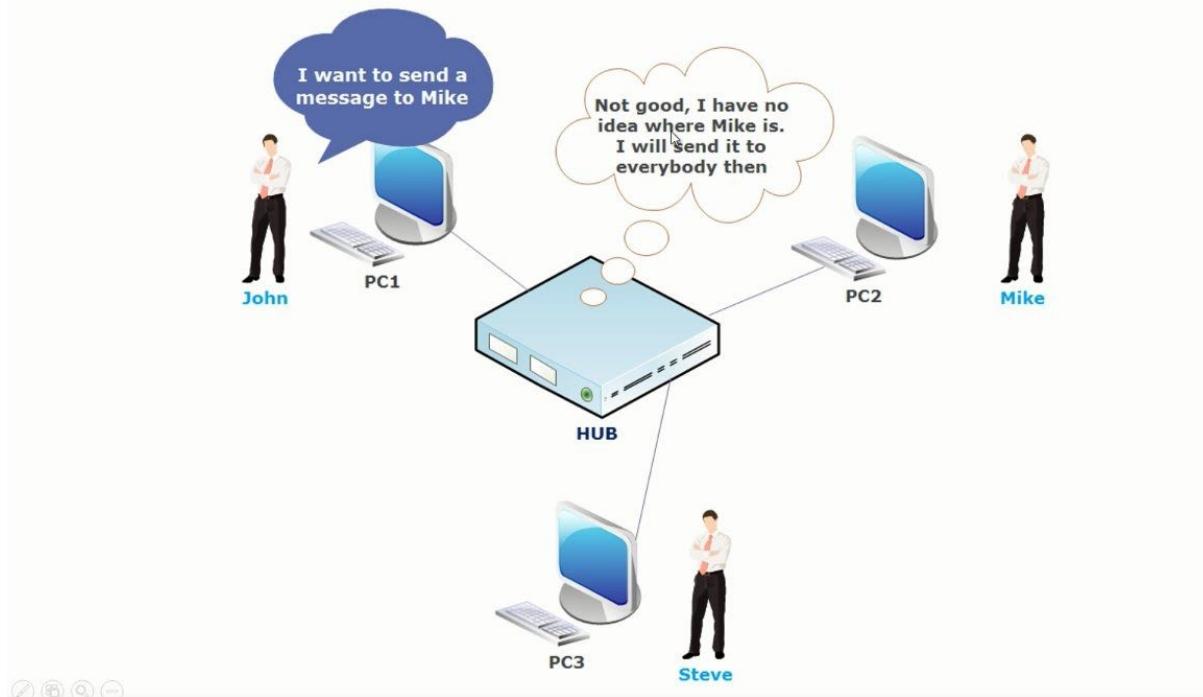
Wireless LAN adapter Wi-Fi:
  Connection-specific DNS Suffix  . : 
  Description . . . . . : Intel(R) Dual Band Wireless-AC 8265
  Physical Address . . . . . : 00-24-D6-E8-61-BF
  DHCP Enabled. . . . . : Yes
  Autoconfiguration Enabled . . . . . : Yes
  Link-local IPv6 Address . . . . . : fe80::1103:8b21:ca34:8fe2%22(Preferred)
    IPv4 Address. . . . . : 192.168.1.102(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
  Lease Obtained. . . . . : 17 August 2018 10:27:18
  Lease Expires . . . . . : 17 August 2018 12:27:20
  Default Gateway . . . . . : 192.168.1.1
  DHCP Server . . . . . : 192.168.1.1
  DHCPv6 IAID . . . . . : 83895510
  DHCPv6 Client DUID. . . . . : 00-01-00-01-22-79-C5-3F-94-C6-91-1A-88-FD
  DNS Servers . . . . . : 192.168.1.1
  NetBIOS over Tcpip. . . . . : Enabled

Ethernet adapter Bluetooth Network Connection 2:
  Media State . . . . . : Media disconnected
  Connection-specific DNS Suffix . :
  Description . . . . . : Bluetooth Device (Personal Area Network) #2
  Physical Address . . . . . : 00-24-D6-E8-61-C3
  DHCP Enabled. . . . . : Yes
  Autoconfiguration Enabled . . . . . : Yes

C:\Users\admin>
```

KOMENDA DO PRZEJRZENIA PARAMETRÓW SIECIOWYCH Z ROZSZERZENIEM -
M.IN. ADRES MAC DO **ipconfig /all**

Komunikacja w sieci



Połączmy się z routерem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh

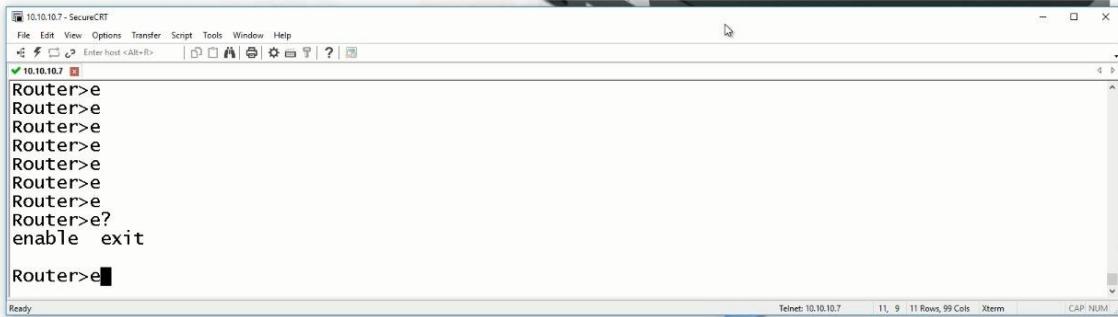


ROUTER PODPOWIADA KOMENDY, WYSTARCZY WCISAC POCZATEK KOMENDY I KLIKNACZ "TAB" - UZYSKAMY DOPEŁNIENIE KOMENDY.
SPRAWDZANEJ CZY JEST DANA KOMENDA TO WPISUJEMY POCZATEK KOMENDY ZE ZNAKIEM ZAPYTANIA + ENTER I WYPISZE NAM MOŻLIWOŚCI

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh



A screenshot of the SecureCRT application window titled "10.10.10.7 - SecureCRT". The window shows a command-line interface with the following session history:
Router>e
Router>e
Router>e
Router>e
Router>e
Router>e
Router>e?
enable exit

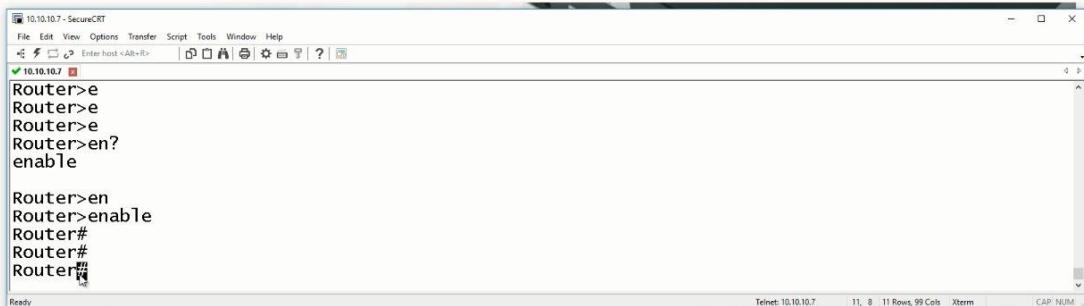
Router>e

The status bar at the bottom right indicates "Telnet: 10.10.10.7", "11, 9", "11 Rows, 99 Cols", "Xterm", and "CAP NUM".

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

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A screenshot of the SecureCRT application window titled "10.10.10.7 - SecureCRT". The window shows a command-line interface with the following session history:
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Router>e
Router>e
Router>en?
enable

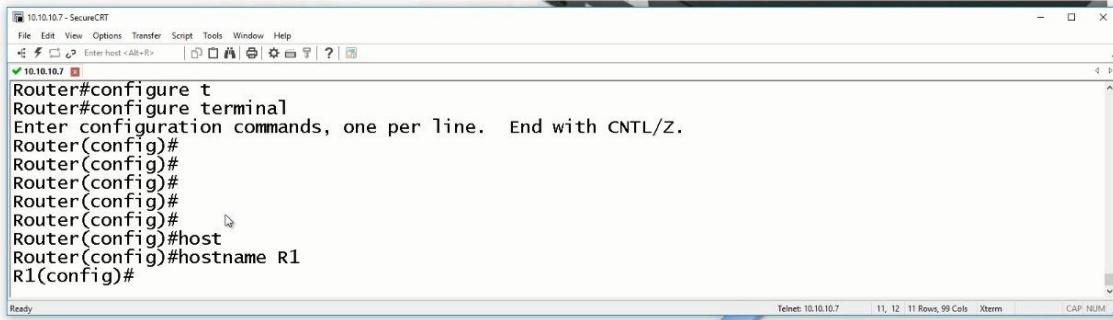
Router>en
Router>enable
Router#
Router#
Router#

The status bar at the bottom right indicates "Telnet: 10.10.10.7", "11, 8", "11 Rows, 99 Cols", "Xterm", and "CAP NUM".

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh



The screenshot shows a terminal window titled "10.10.10.7 - SecureCRT". The window has a menu bar with File, Edit, View, Options, Transfer, Script, Tools, Window, and Help. Below the menu is a toolbar with icons for copy, paste, cut, find, and others. The main pane displays the following configuration commands:

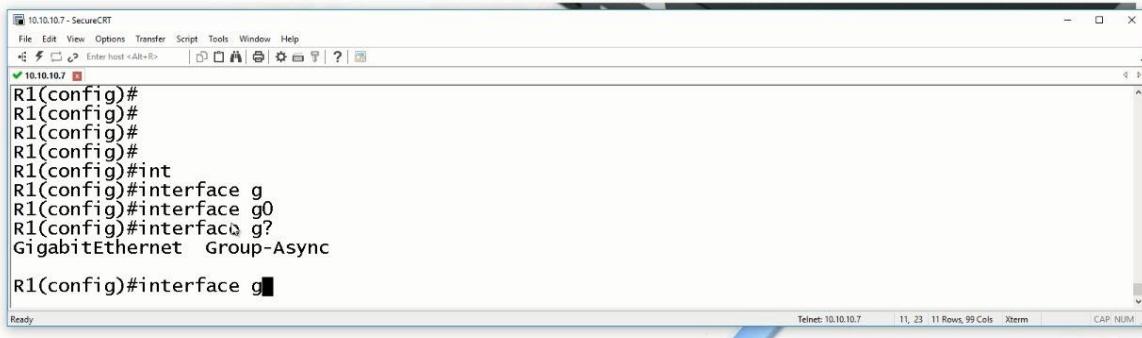
```
Router#configure t
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#host
Router(config)#hostname R1
R1(config)#
Ready
```

At the bottom of the window, there is status information: Telnet: 10.10.10.7, 11, 12 | 11 Rows, 99 Cols, Xterm, CAP NUM.

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh

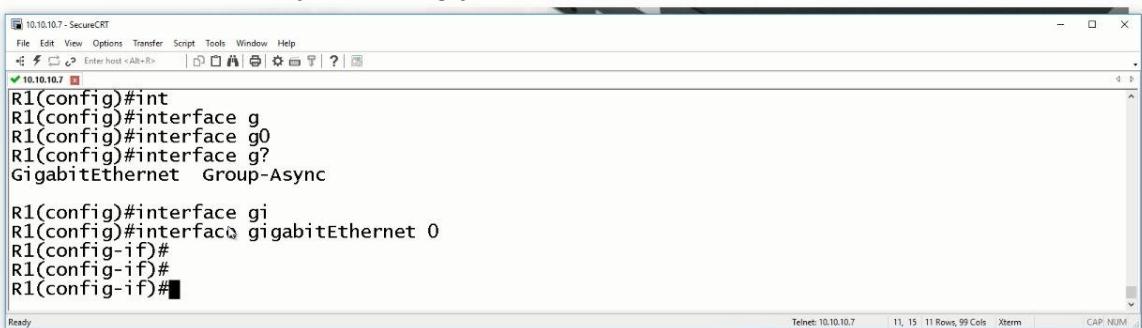


```
R1(config)#  
R1(config)#  
R1(config)#  
R1(config)#  
R1(config)#  
R1(config)#int  
R1(config)#interface g  
R1(config)#interface g0  
R1(config)#interface g?  
R1(config)#GigabitEthernet Group-Async  
R1(config)#interface g?
```

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh

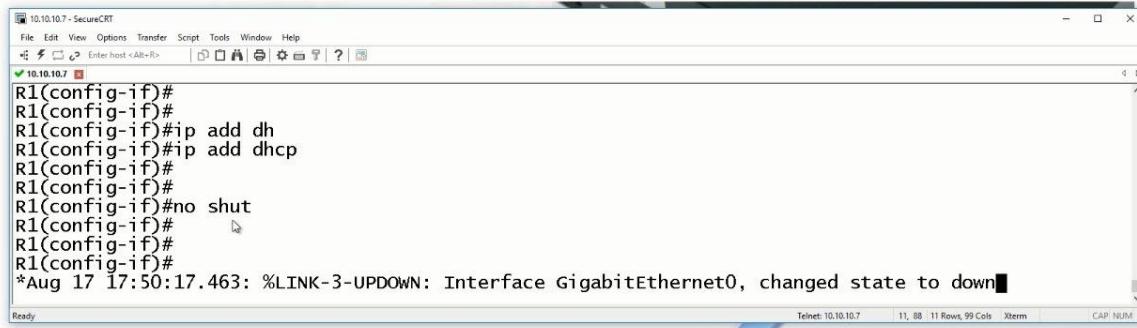


```
R1(config)#int  
R1(config)#interface g  
R1(config)#interface g0  
R1(config)#interface g?  
R1(config)#GigabitEthernet Group-Async  
R1(config)#interface gi  
R1(config)#interface gigabitEthernet 0  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#[
```

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh



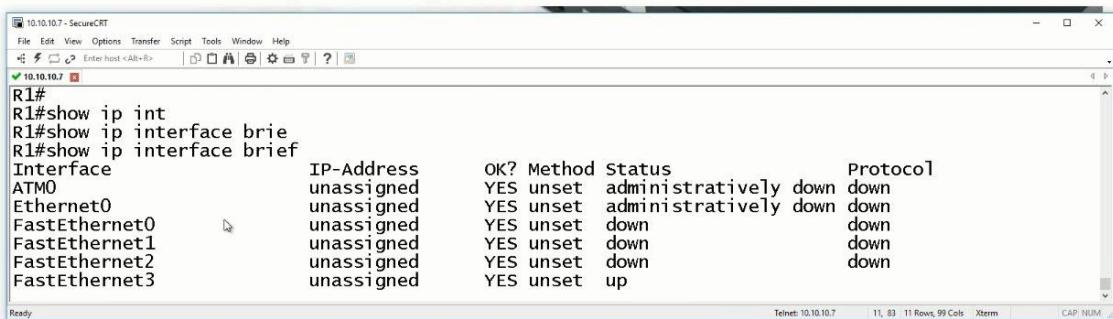
The screenshot shows a window titled "10.10.10.7 - SecureCRT". The menu bar includes File, Edit, View, Options, Transfer, Script, Tools, Window, and Help. The toolbar contains icons for file operations like Open, Save, and Print. A status bar at the bottom shows "Telnet: 10.10.10.7", "11, 88", "11 Rows, 99 Cols", "Xterm", and "CAP NUM". The main terminal window displays the following configuration commands:

```
R1(config-if)#  
R1(config-if)#  
R1(config-if)#ip add dh  
R1(config-if)#ip add dhcp  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#no shut  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#  
*Aug 17 17:50:17.463: %LINK-3-UPDOWN: Interface GigabitEthernet0, changed state to down
```

Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh



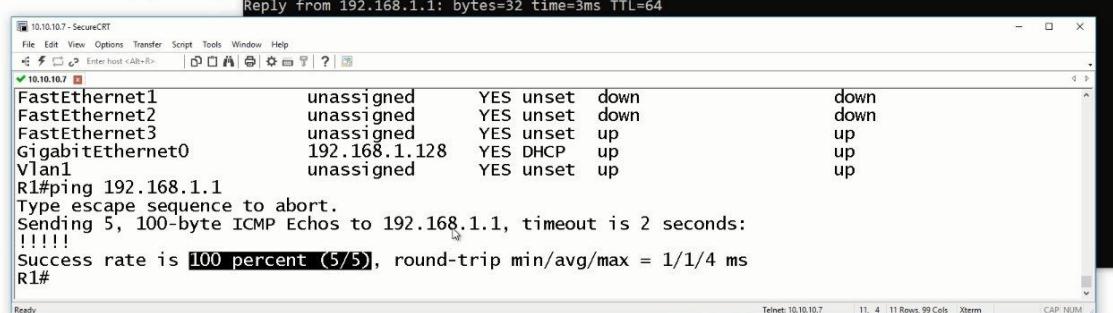
A screenshot of the SecureCRT application window titled "10.10.10.7 - SecureCRT". The interface shows the command-line prompt "R1#". Below it, the output of the "show ip int brief" command is displayed in a table format. The table has columns for Interface, IP-Address, OK?, Method, Status, and Protocol. The interfaces listed are ATM0, Ethernet0, FastEthernet0, FastEthernet1, FastEthernet2, and FastEthernet3. All interfaces show an unassigned IP address, YES for OK? and Method, administratively down for Status, and down for Protocol.

Interface	IP-Address	OK?	Method	Status	Protocol
ATM0	unassigned	YES	unset	administratively down	down
Ethernet0	unassigned	YES	unset	administratively down	down
FastEthernet0	unassigned	YES	unset	down	down
FastEthernet1	unassigned	YES	unset	down	down
FastEthernet2	unassigned	YES	unset	down	down
FastEthernet3	unassigned	YES	unset	up	

Połączmy się z routerem!

Jak zarządzamy Cisco?

- ✓ podłączając bezpośrednio
- ✓ zdalnie



A screenshot showing two windows. The top window is a Windows Command Prompt (cmd.exe) titled "Microsoft Windows [Version 10.0.17134.228]" with the path "C:\Users\admin>". It shows the command "ping 192.168.1.1" and its output, which includes four successful replies from the target IP address. The bottom window is the same SecureCRT session as the previous image, showing the "show ip int brief" command output for Cisco R1, with FastEthernet1 through FastEthernet3 listed as down and FastEthernet3 as up.

Network Devices

Punkt dostępowy (access point)

urządzenie pozwalające na bezprzewodowe połączenie z siecią.



Network Devices

Firewall – urządzenie mające na celu zapewnienie bezpieczeństwa w sieci komputerowej, może posiadać dodatkowe funkcje, na przykład skanowanie antywirusowe czy ochrona przed SPAMem.



Wireless LAN Controller (WLC)

Protokoły:

Control and Provisioning of Wireless Access Points protocol (CAPWAP)

oraz

Lightweight Access Point Protocol (LWAPP)

WLC możemy zarządzać używając komend oraz HTTP

Adresy IP

Adres IP – pozwala na identyfikację urządzeń w sieci komputerowej. Aktualnie używamy IPv4, dynamicznie rozwija się nowsza wersja IPv6.

Default Gateway

– router

```
C:\Users\admin>ipconfig
Windows IP Configuration

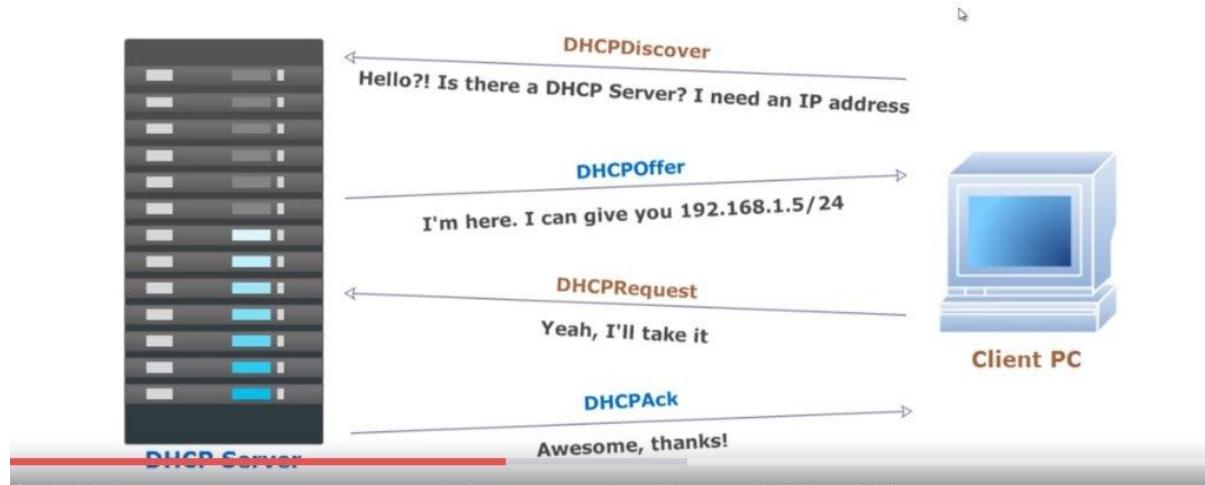
Wireless LAN adapter Local Area Connection* 4:
  Media State . . . . . : Media disconnected
  Connection-specific DNS Suffix . . . . . : 

Wireless LAN adapter Local Area Connection* 2:
  Media State . . . . . : Media disconnected
  Connection-specific DNS Suffix . . . . . : 

Wireless LAN adapter Wi-Fi:
  Connection-specific DNS Suffix . . . . . : fe80::a075:fd4c:42fd:341b%3
  Link-local IPv6 Address . . . . . : 192.168.1.192
  Subnet Mask . . . . . : 255.255.255.0
  Default Gateway . . . . . : 192.168.1.1
  Kontynuuj ▶
```

Adresy IP

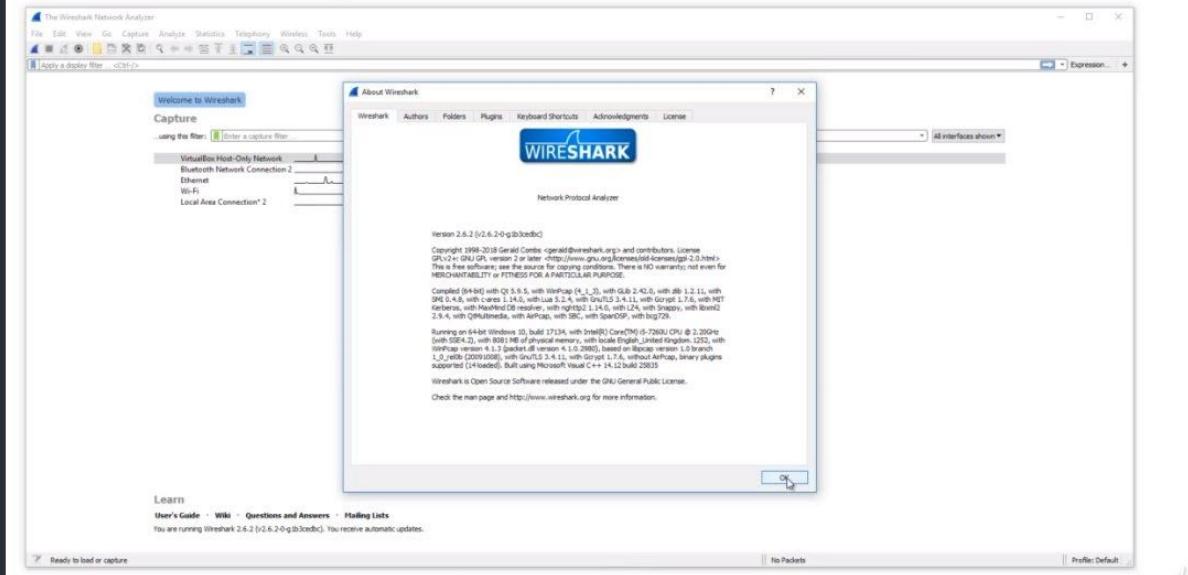
DHCP (Dynamic Host Configuration Protocol)



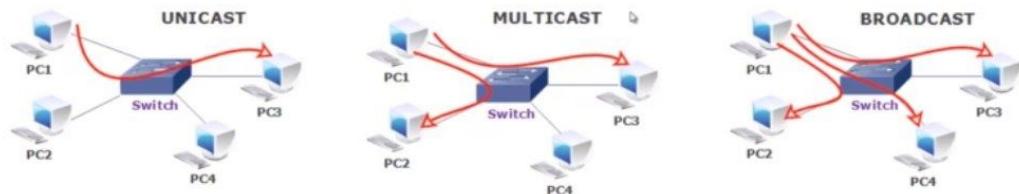
DNS (Domain Name System) – tłumaczy nazwy na adresy IP.

```
Command Prompt
C:\>ping google.com
Pinging google.com [216.58.209.46] with 32 bytes of data:
Reply from 216.58.209.46: bytes=32 time=7ms TTL=57
Reply from 216.58.209.46: bytes=32 time=3ms TTL=57
Reply from 216.58.209.46: bytes=32 time=4ms TTL=57
Reply from 216.58.209.46: bytes=32 time=4ms TTL=57
Ping statistics for 216.58.209.46:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 7ms, Average = 4ms
C:\>
```

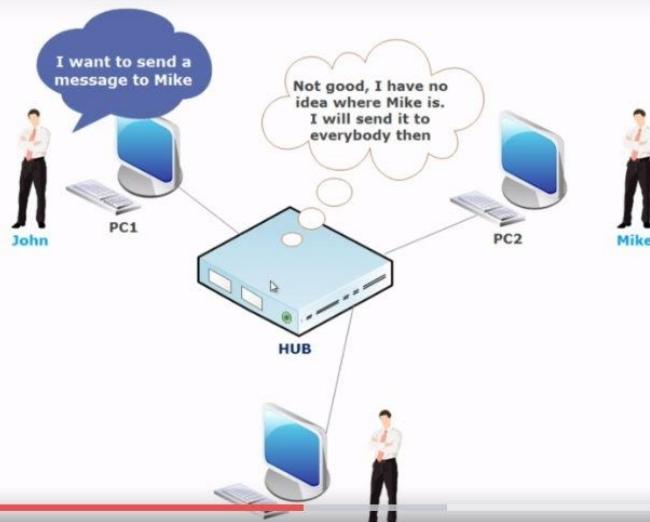
Komunikacja w sieci



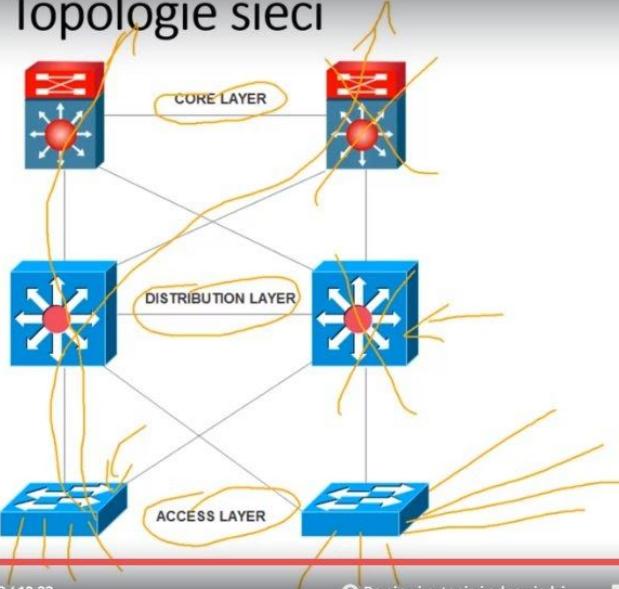
Rodzaje komunikacji



Komunikacja w sieci



Topologie sieci

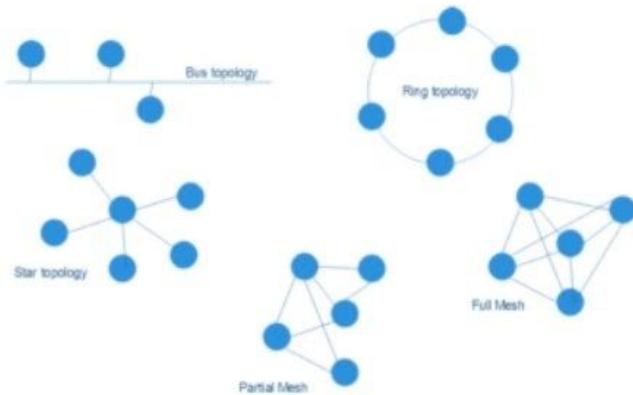


09:33 / 10:23

Przejrzyj pytania i odpowiedzi

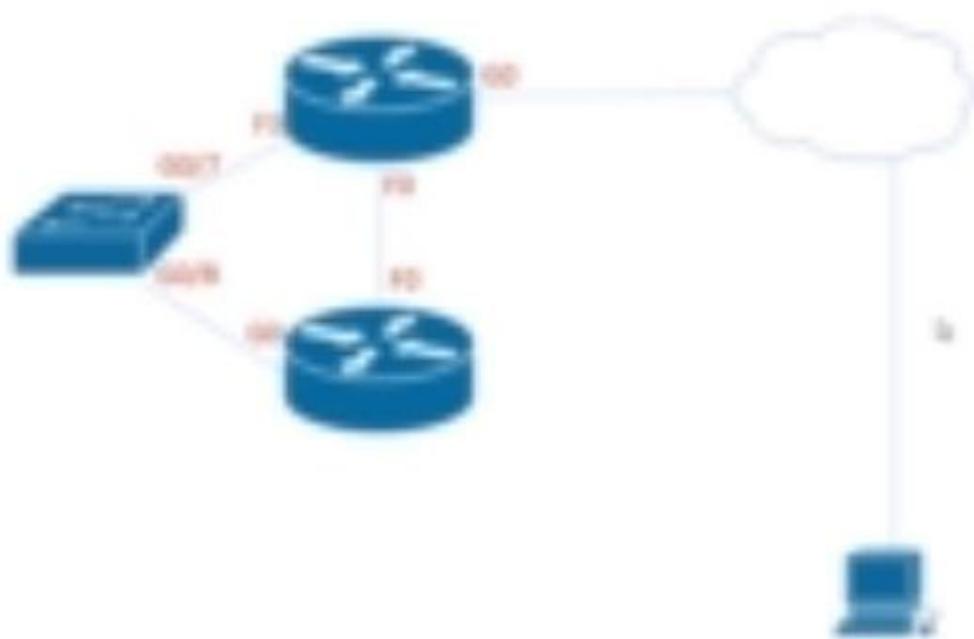
Dodaj do zakładek

Kontynuuj



laboratorium

wykład 13



e laboratorium

wykład 13

IOS

Prz

Cisco IOS – oprogramowanie na urządzeniach Cisco. Wiele dodatkowych funkcji wymaga aktywacji oraz licencji.

Używamy CLI (command line interface).



Połączmy się z routerem!

Jak zarządzać urządzeniem Cisco:

- ✓ podłączając bezpośrednio **console cable**
- ✓ zdalnie za pomocą protokołu telnet lub ssh



Basic Router Configuration

Modes:

- ✓ User Exec Mode

```
Router>show

usb          USB Interface
users        Display information about terminal lines
version      System hardware and software status
vlan-switch  VTP VLAN status
vpdn         VPDN information
vrrp         VRRP information
vtp          VTP information
wrr-queue    WRR queue
wsma         Show Web Services Management Agents information
xos          Cross-OS Library Information and Traces
xsd-format   Show the ODM XSD for the command

Router>show
```

Basic Router Configuration

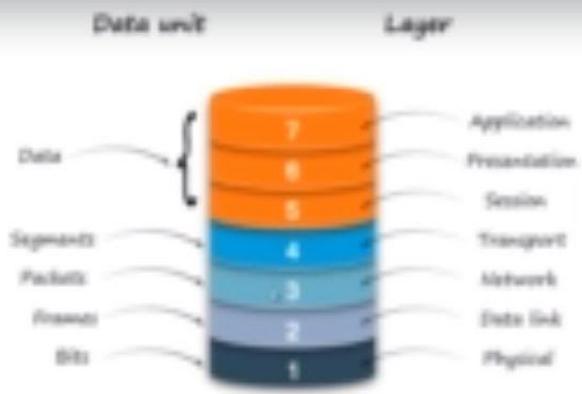
Modes:

- ✓ User Exec Mode
- ✓ Privileged Mode
- ✓ Global Configuration Mode
- ✓ Interface Configuration Mode

```
R1>enable  
Password:  
R1#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#
```

The OSI Model

Open System
Interconnection
(OSI) model
stworzony w 1984
aby ustanowić zasadę komunikacji w sieci.
Mamy 7 warstw w modelu OSI.



OSI model

The OSI Model

Po co nam OSI oraz inne standardy?

- ✓ Kompatybilność pomiędzy producentami
- ✓ Pomaga stopniowo rozwiązywać problemy (the layer approach)
- ✓ Łatwiej zarządzać siecią oraz uczyć się zasad działania



The Application Layer (L7)

An interface and set of protocols used for communication.

Aplikacje takie jak Firefox, Outlook czy IE nie są w tej warstwie, używają protokołów z tej warstwy!

Przykłady:

DHCP, DNS, HTTP, SNMP, FTP, TFTP, SMTP



The Presentation Layer (L6)

Responsible for **translation, conversion, compression and encryption**.

It helps the Application Layer process and shows a message.

Przykłady: JPEG, GIF, MIDI, ASCII



The Session Layer (L5)

Keeps an eye on all **sessions** and **downloads** and makes sure that a message arrives at the correct place.

This layer **manages connections** (opens and closes sessions).

Works very close with the Transport Layer.

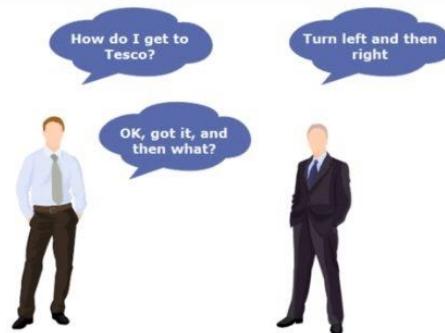


The Transport layer (L4)

TCP

✓ Connection-oriented

- ✓ Reliable (acknowledgments and sequence numbers)
- ✓ Flow Control, windowing
- ✓ Stream oriented
- ✓ Slow, a bigger header (20 bytes)
- ✓ Used for reliable services: HTTP, SSH, TELNET, SMTP etc.



UDP

✓ Connectionless

- ✓ Unreliable, no acknowledgments
- ✓ No retransmissions. Best-effort only
- ✓ Message oriented
- ✓ Smaller header (8 bytes), faster than TCP
- ✓ Examples: streaming music and video, VOIP, TFTP, SNMP, DNS

The Transport layer (L4)

TCP Segment Header

Source Port	Destination Port					
Sequence Number						
Acknowledgment Number						
Data Offset	Reserved	Flags	Window Size			
Checksum			Urgent Pointer			
Options						

UDP Segment Header

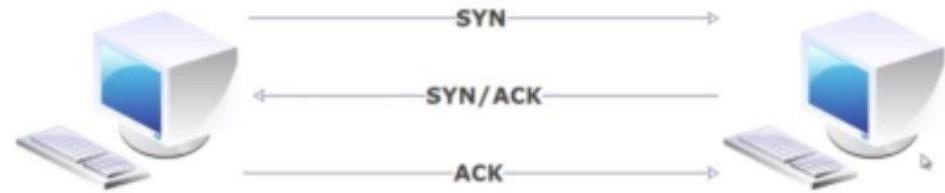
Source Port	Destination Port
Length	Checksum

Warto przeczytać:

www.rhyshaden.com/tcp.htm

www.lifewire.com/tcp-headers-and-udp-headers-explained-817970

The Three-Way Handshake



Windowing

Window Size

The amount of data before getting an acknowledgement



Porty

Identyfikacja procesów i serwisów.

80 - HTTP

20/21 - FTP

23 – Telnet

25 - SMTP

110 - POP3

443 - HTTPS

3389 - RDP

53 - DNS



Tak zwane 'well known ports' sa zarządzane przez organizacje IANA i zawierają porty 0 -1023.

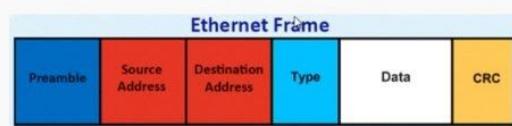
Porty dynamiczne to 49152 - 65535

The Data Link Layer (L2)

Używany adres w L2 to **MAC Address**, nazywany **physical / hardware address**. Switche uczą się tych adresów i umieszczają w specjalnej tablicy. Ważnym protokołem warstwy drugiej jest **ARP**.

Dwie podwarstwy:

- ✓ Media Access Control (**MAC**)
- ✓ Logical Link Control (**LLC**)



dpowiada warstwa L2?

wykład 18

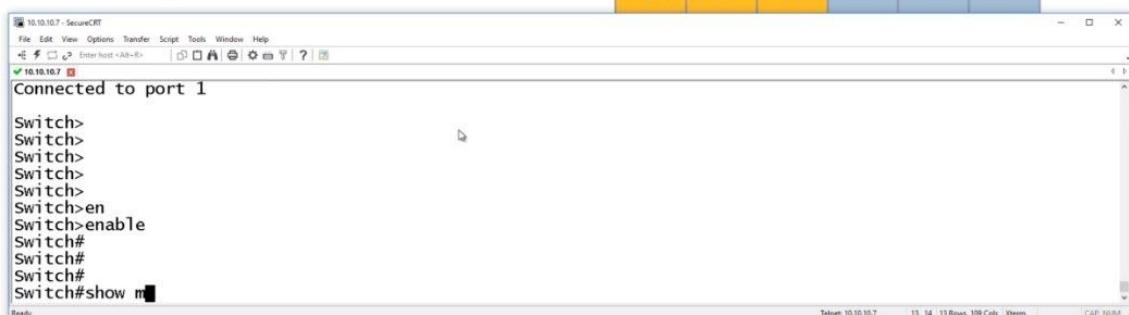
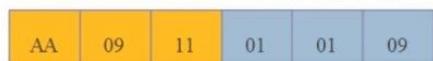
Prz

MAC Address

Adres MAC jest przypisywany przez producentów i musi być unikalny.

48 bity, 12 hex.

Media Access Control Address(MAC)



dpowiada warstwa L2?

wykład 18

MAC Address

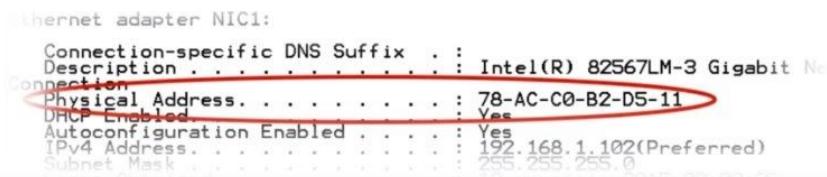
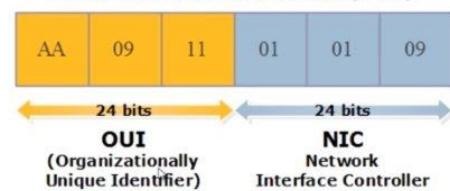
Adres MAC jest przypisywany przez producentów i musi być unikalny.

48 bity, 12 hex.

Adresy MAC są przechowywane

W tablicy **CAM** na switchu.

Media Access Control Address(MAC)



ARP

The Address Resolution Protocol (ARP)

Tłumacz IP na adresy MAC.

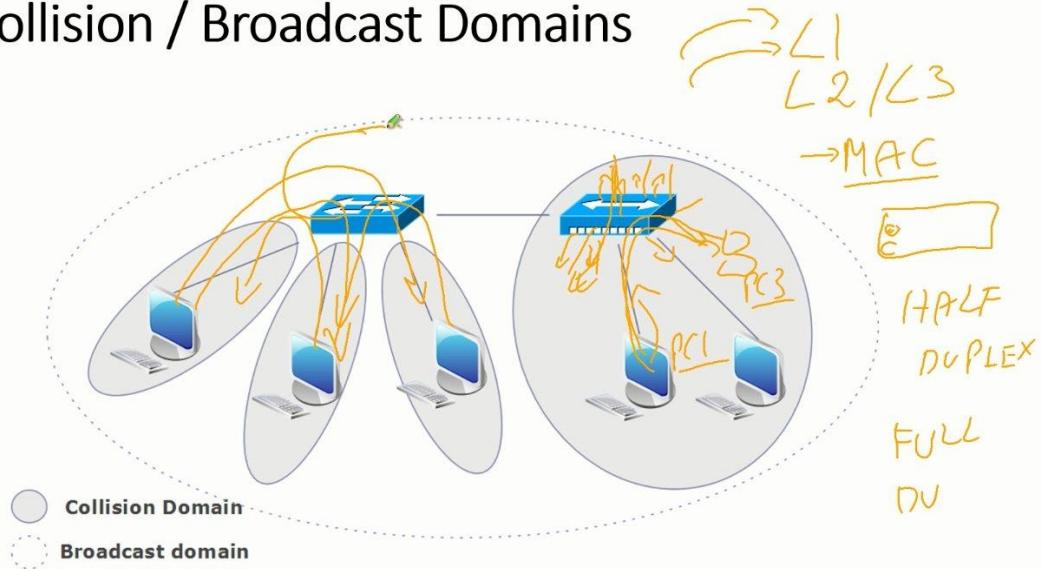
```
C:\>arp -a
Interface: 192.168.1.102 --- 0xb
  Internet Address      Physical Address      Type
  192.168.1.5          c0-48-00-a2-ef-4a    dynamic
  192.168.1.5          28-1a-7b-0c-e1-6b    dynamic
  192.168.1.100        48-50-73-c3-52-90    dynamic
  192.168.1.103        28-b2-bd-d3-c0-89    dynamic
  192.168.1.255        ff-ff-ff-ff-ff-ff    static
  224.0.0.2             01-00-5e-00-00-02    static
  224.0.0.252           01-00-5e-00-00-fc    static
  239.255.255.250      01-00-5e-7f-ff-fa    static
  255.255.255.255      ff-ff-ff-ff-ff-ff    static
```

C:\>

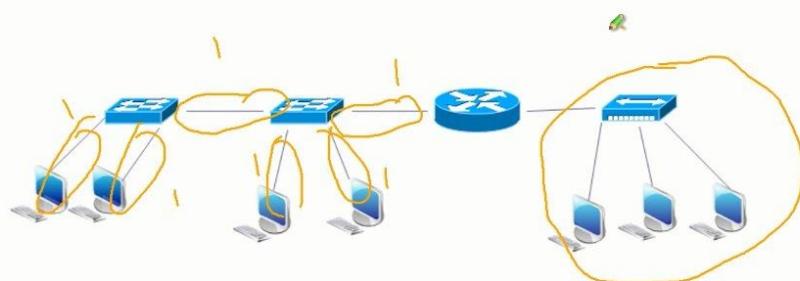
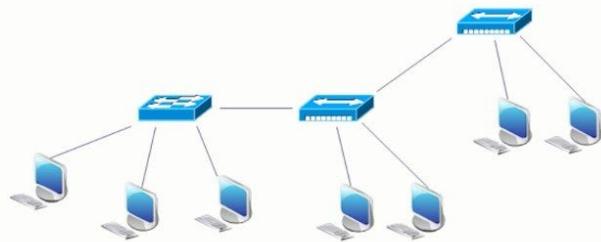
On Cisco devices:

show arp

Collision / Broadcast Domains



Collision and Broadcast Domains



CSMA/CA and CSMA/CD

Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
Check if it is OK to transmit, used for wireless networks.

Carrier Sense Multiple Access with Collision Detection (CSMA/CD)

Just send data, if a collision occurs, we can detect it.

Full duplex rozwiązuje problemy CSMA/CD.



Warto poczytać:

www.cisco.com/c/en/us/support/docs/interfaces-modules/port-adapters/12768-eth-collisions.html

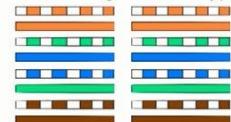
www.cisco.com/c/en/us/support/docs/switches/catalyst-6000-series-switches/24048-148.html

Physical Layer (L1)

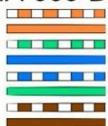
Kable, kable, kable!



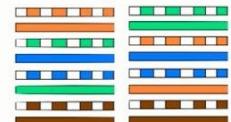
Straight-through Cable
connecting different type of devices



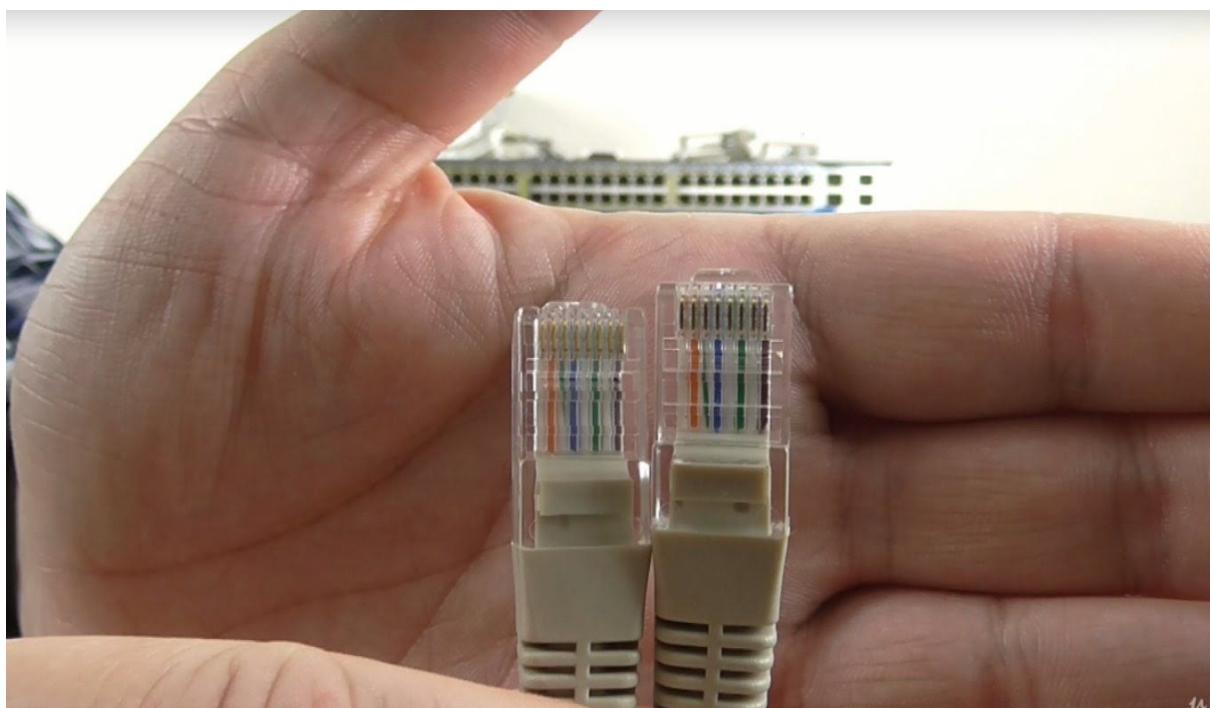
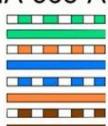
TIA/EIA-568-B



Crossover Cable
connecting same type of devices



TIA/EIA-568-A





Physical Layer (L1)

Prędkości oraz standardy

- ✓ Fast Ethernet
- ✓ Gigabit Ethernet
- ✓ 10-Gigabit Ethernet



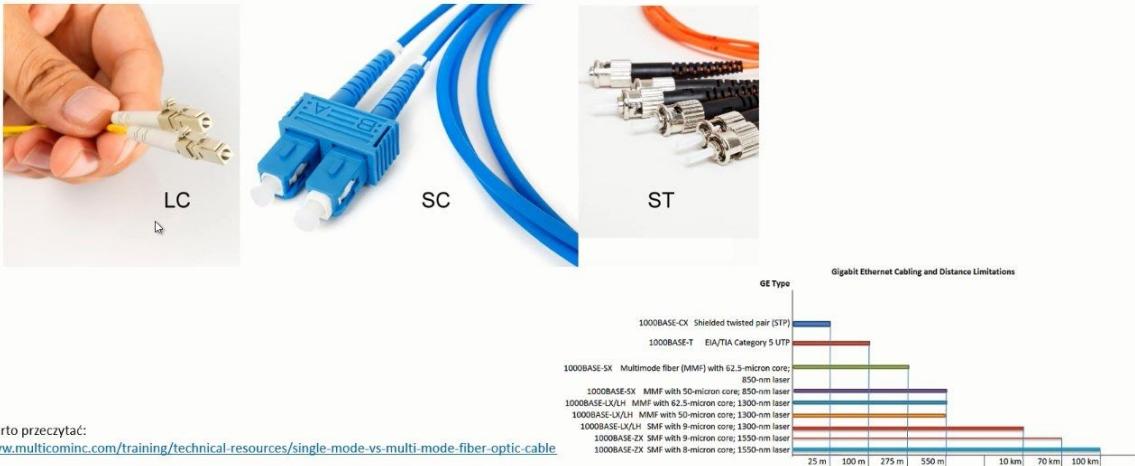
1000 Mbps = 125 MB/s (**1 MBps = 8Mbps**)

W większości przypadków urządzenia potrafią negocjować prędkość oraz ustawienia duplex.

Technologia **Auto MDI-MDI_X** pozwala „zapomnieć” o kablach cross-over.

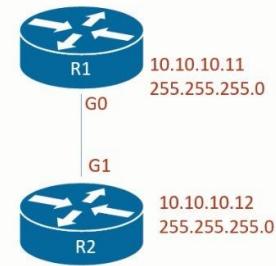
Physical Layer (L1)

Kable optyczne



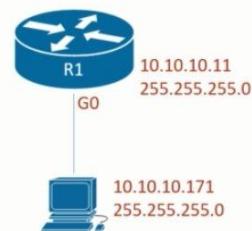
Basic Router Configuration

- ✓ Hostname and Domain Name
- ✓ IP addresses
- ✓ Passwords
- ✓ Telnet and SSH access
- ✓ Backup



Basic Router Configuration

- ✓ Hostname and Domain Name
- ✓ IP addresses
- ✓ Passwords
- ✓ Telnet and SSH access
- ✓ Backup



Basic Router Configuration

Modes:

- ✓ User Exec Mode
- ✓ Privileged Mode
- ✓ Global Configuration Mode
- ✓ Interface Configuration Mode

```
R1>enable  
Password:  
R1#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#
```



Basic Router Configuration

Passwords

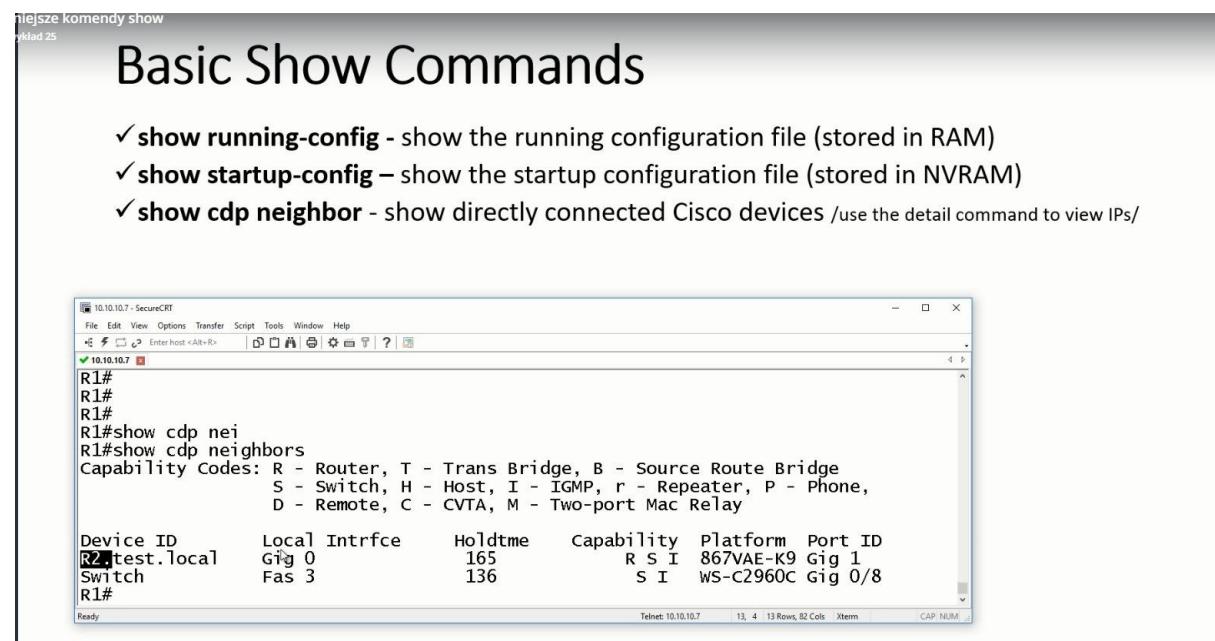
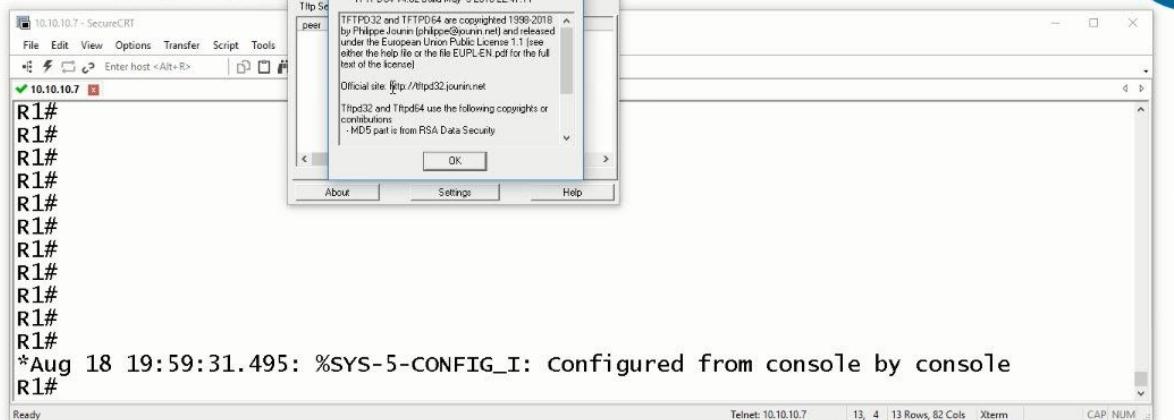
- ✓ Enable password
- ✓ VTY, Console, Aux (Lines)

You can use a password, local database or a dedicated server.

To connect to a router remotely, we use telnet (clear text) or ssh (more secure).

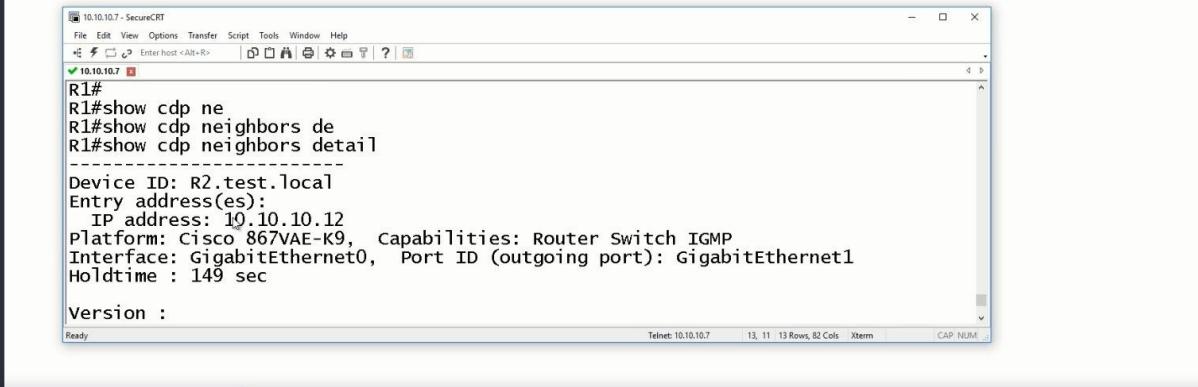
Basic Router Configuration

- ✓ Hostname and Domain Name
- ✓ IP addresses
- ✓ Passwords



Basic Show Commands

- ✓ **show running-config** - show the running configuration file (stored in RAM)
- ✓ **show startup-config** – show the startup configuration file (stored in NVRAM)
- ✓ **show cdp neighbor** - show directly connected Cisco devices /use the detail command to view IPs/



The screenshot shows a SecureCRT window titled "10.10.10.7 - SecureCRT". The session is connected to host "10.10.10.7". The terminal window displays the following output:

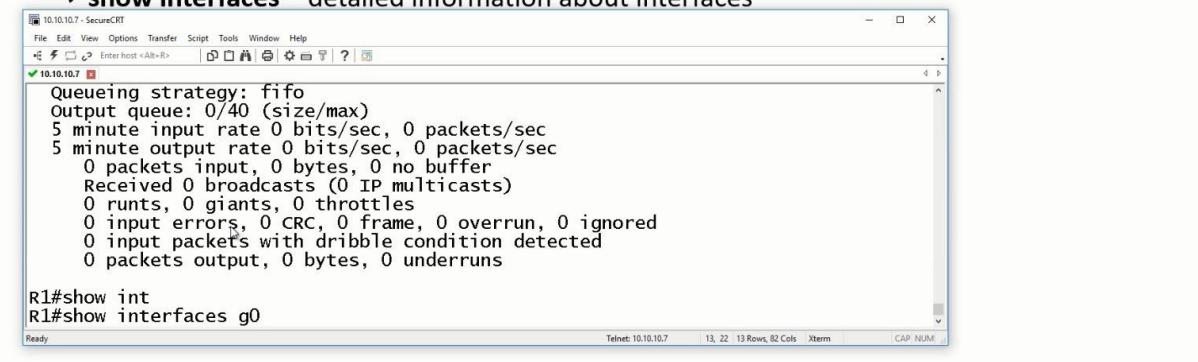
```
R1#
R1#show cdp ne
R1#show cdp neighbors de
R1#show cdp neighbors detail
-----
Device ID: R2.test.local
Entry address(es):
 IP address: 19.10.10.12
Platform: Cisco 867VAE-K9, Capabilities: Router Switch IGMP
Interface: GigabitEthernet0/0, Port ID (outgoing port): GigabitEthernet1
Holdtime : 149 sec
Version :
```

At the bottom of the window, status information is shown: Telnet: 10.10.10.7, 13, 11, 13 Rows, 82 Cols, Xterm, CAP NUM.

5

Basic Show Commands

- ✓ **show running-config** - show the running configuration file (stored in RAM)
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- ✓ **show cdp neighbor** - show directly connected Cisco devices /use the detail command to view IPs/
- ✓ **show ip interface brief** – view interface information, IPs, status
- ✓ **show interfaces** – detailed information about interfaces



The screenshot shows a SecureCRT window titled "10.10.10.7 - SecureCRT". The session is connected to host "10.10.10.7". The terminal window displays the following output:

```
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  0 packets input, 0 bytes, 0 no buffer
  Received 0 broadcasts (0 IP multicasts)
  0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
  0 input packets with dribble condition detected
  0 packets output, 0 bytes, 0 underruns

R1#show int
R1#show interfaces go
```

At the bottom of the window, status information is shown: Telnet: 10.10.10.7, 13, 22, 13 Rows, 82 Cols, Xterm, CAP NUM.

Basic Show Commands

- ✓ **show running-config** - show the running configuration file (stored in RAM)
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- ✓ **show interfaces** – detailed information about interfaces

```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | D C P A S T ? |
10.10.10.7
65536K bytes system flash allocated

Configuration register is 0x2102

R1#show inv
R1#show inventory
NAME: "867VAE", DESCRIPT: "867VAE chassis, Hw Serial#: GMK174703EH, Hw Revision: 0.3"
PID: CISCO867VAE      , VID: V02 , SN: GMK174703EH

R1#
```

Ready Telnet: 10.10.10.7 13, 4 13 Rows, 82 Cols Xterm CAP NUM

Basic Show Commands

- ✓ **show running-config** - show the running configuration file (stored in RAM)
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- ✓ **show cdp neighbor** - show directly connected Cisco devices /use the detail command to view IPs/
- ✓ **show ip interface brief** – view interface information, IPs, status
- ✓ **show interfaces** – detailed information about interfaces

```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | D C P A S T ? |
10.10.10.7
FastEthernet3 is up, Line protocol is up
GigabitEthernet0 is up, line protocol is up
    Internet address is 10.10.10.11/24
Vlan1 is up, Line protocol is up
R1#show clo
R1#show clock
*10:08:32.232 UTC Sun Aug 19 2018
R1#clo
R1#clock se
R1#clock set ?
hh:mm:ss Current Time

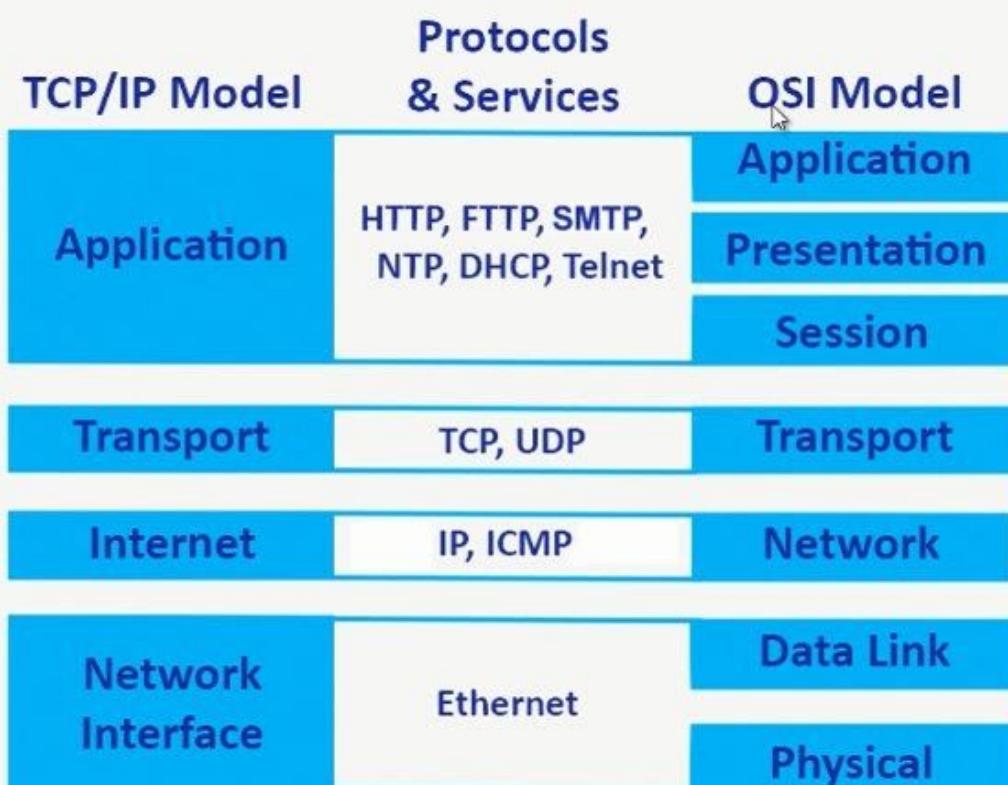
R1#NTP
```

Ready Telnet: 10.10.10.7 13, 7 13 Rows, 82 Cols Xterm CAP NUM

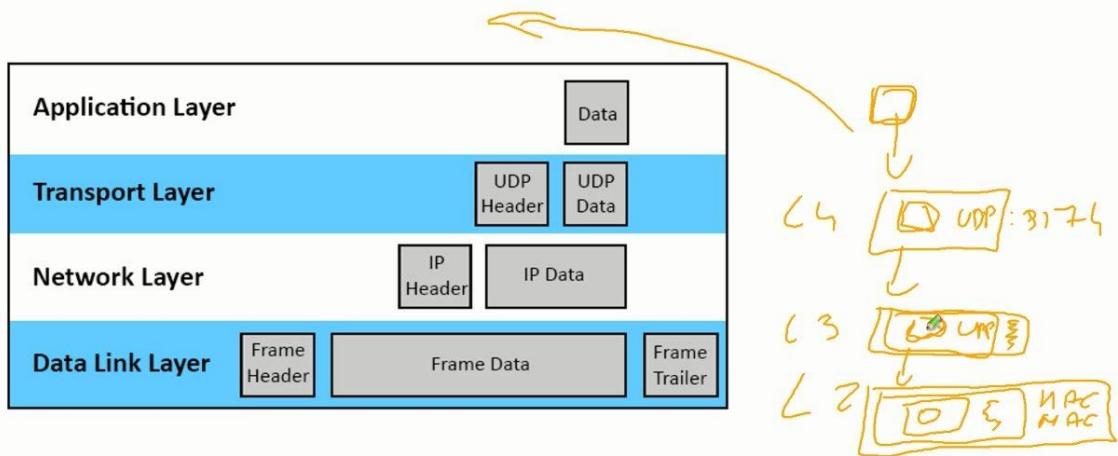
Basic Show Commands

- ✓ **show running-config** - show the running configuration file (stored in RAM)
- ✓ **show startup-config** – show the startup configuration file (stored in NVRAM)
- ✓ **show cdp neighbor** - show directly connected Cisco devices /use the detail command to view IPs/
- ✓ **show ip interface brief** – view interface information, IPs, status
- ✓ **show interfaces** – detailed information about interfaces
- ✓ **show version** – verify the IOS version, uptime of a router, memory etc.
- ✓ **show inventory** – show detailed information about hardware, chassis etc.
- ✓ **show protocols** - show protocols
- ✓ **show ip protocols** – show routing protocols
- ✓ **show clock** - show date and time on a router
- ✓ **show flash** – show files saved on flash (IOS, CCP)
- ✓ **show ip route** - show the routing table
- ✓ **show arp** - show the arp cache

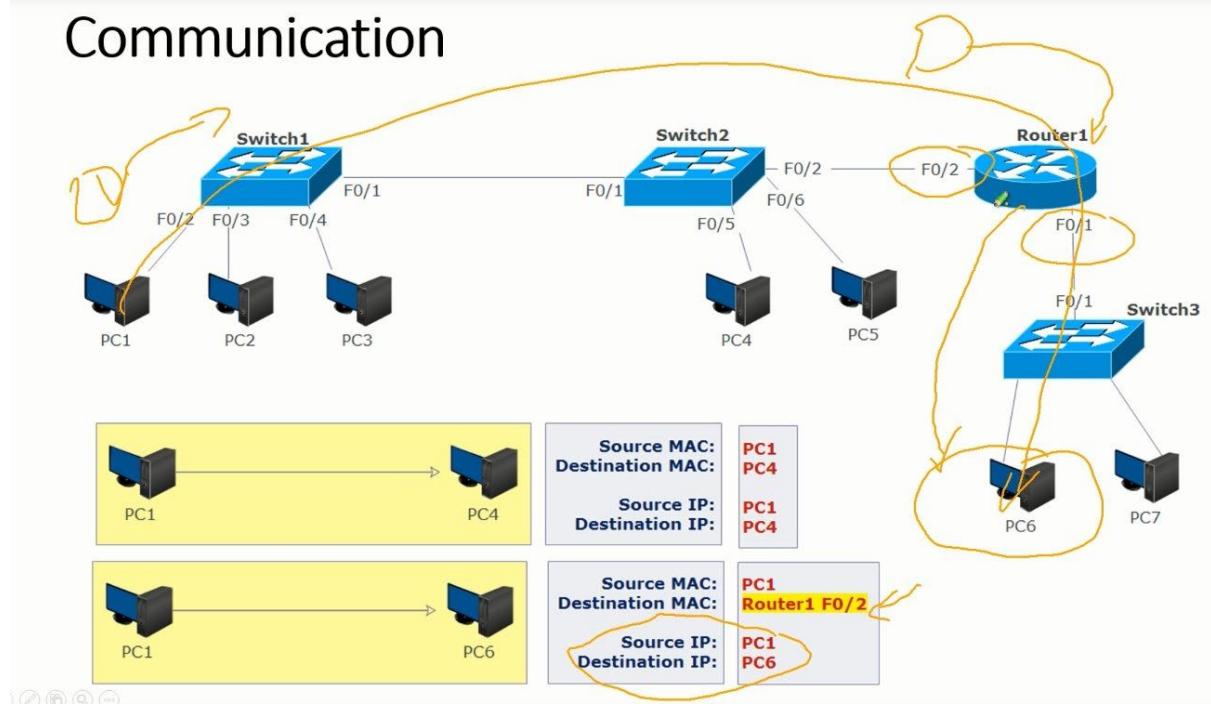
TCP/IP vs OSI



Encapsulation



Communication

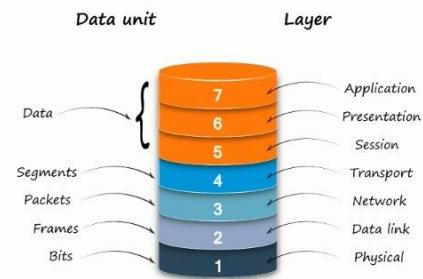


Challenge

Identify a Layer!



- ✓ Hub
- ✓ A reliable connection
- ✓ Decides how to send data
- ✓ DNS
- ✓ Firefox



OSI model

clayton

Switching Modes

Store and Forward

A switch has to wait for the whole frame to arrive, perform a CRC and then forward a frame.

Cut-through

A switch needs the destination MAC address of a frame only (first 6 bytes). Much faster than Store and Forward.

Fragment-Free

A switch will wait for the first 64 bytes of a frame to make sure the frame is OK.

Switching Modes

```
Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 10.0.17134.228]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\admin>arp -a

Interface: 192.168.56.1 --- 0x8
Internet Address      Physical Address      Type
192.168.56.255        ff-ff-ff-ff-ff-ff    static
224.0.0.2              01-00-5e-00-00-02    static
224.0.0.22             01-00-5e-00-00-16    static
224.0.0.251            01-00-5e-00-00-fb    static
224.0.0.252            01-00-5e-00-00-fc    static
239.255.255.250        01-00-5e-7f-ff-fa    static

All
All
All Interface: 10.10.10.171 --- 0xb
All Internet Address      Physical Address      Type
All 10.10.10.7           00-40-9d-28-24-83    dynamic
All 10.10.10.11          a8-0c-0d-a0-e6-05    dynamic
All 10.10.10.255          ff-ff-ff-ff-ff-ff    static
All 192.168.1.1           d4-6e-0e-4f-45-b6    dynamic
All 192.168.1.83          b0-c5-54-25-66-c6    dynamic
Total 1
Total 224.0.0.2           01-00-5e-00-00-02    static
Total 224.0.0.22          01-00-5e-00-00-16    static
Total 224.0.0.251         01-00-5e-00-00-fb    static
Total 224.0.0.252         01-00-5e-00-00-fc    static
Total 239.255.255.250     01-00-5e-7f-ff-fa    static

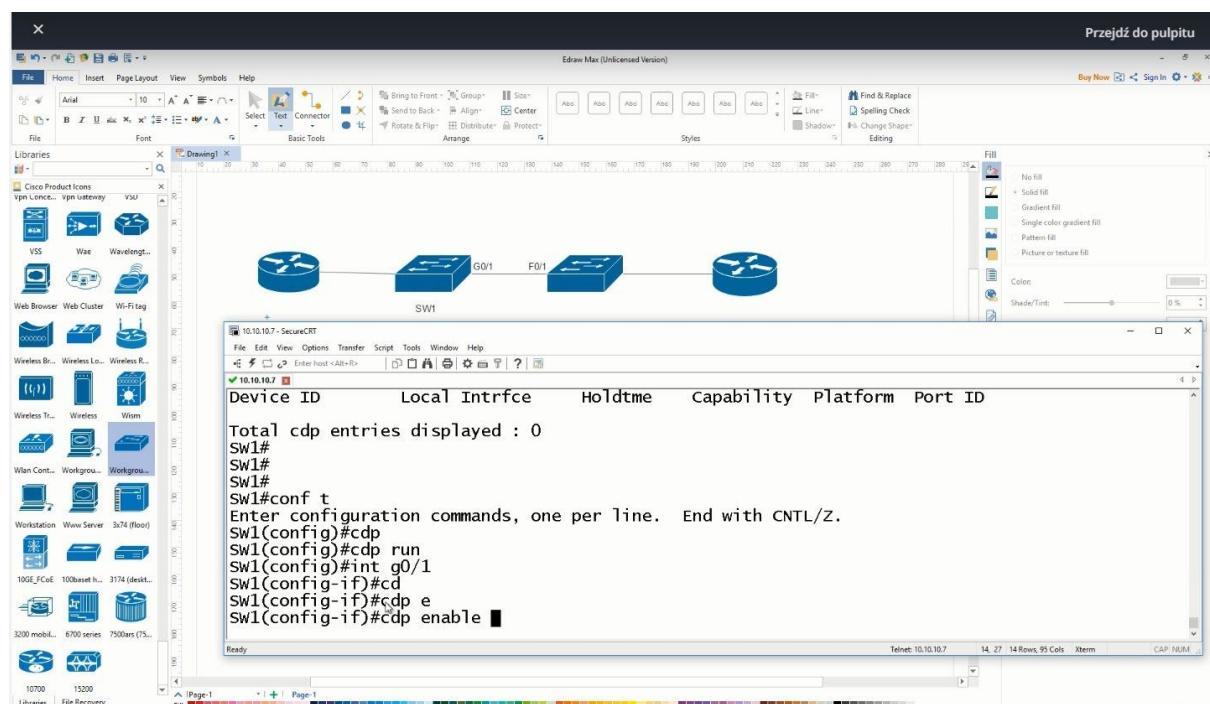
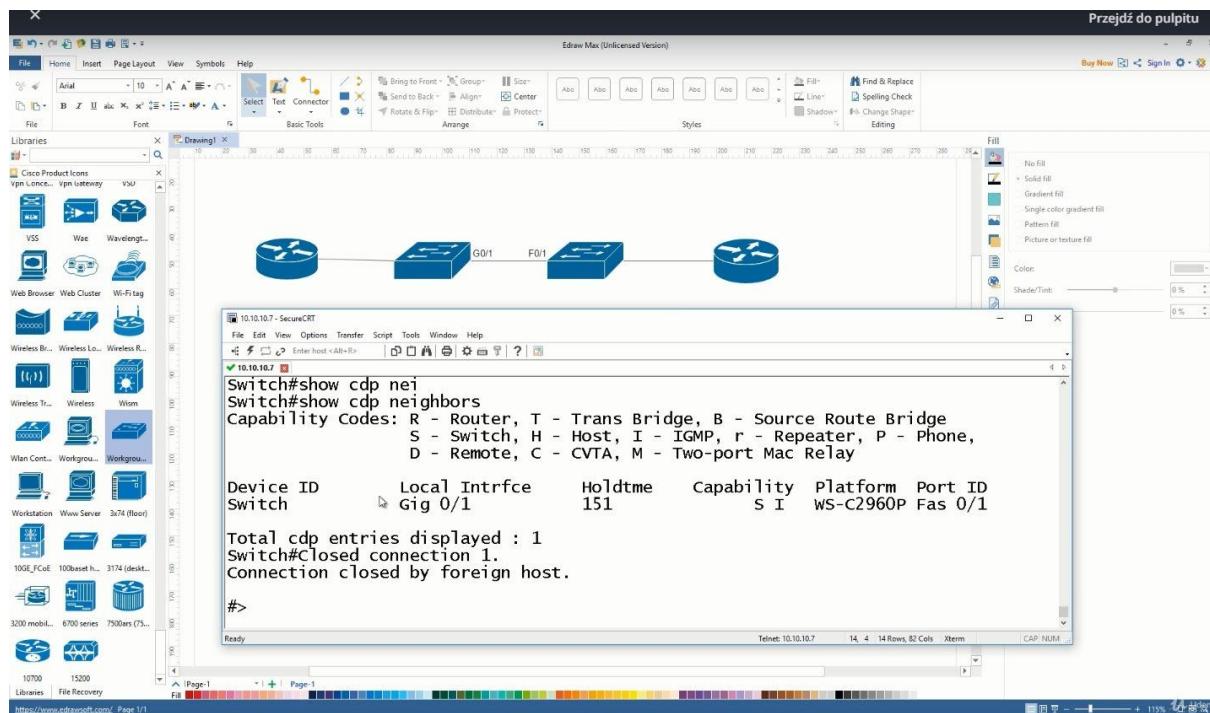
Interface: 192.168.1.101 --- 0x16
Internet Address      Physical Address      Type
192.168.1.1           d4-6e-0e-4f-45-b6    dynamic
```

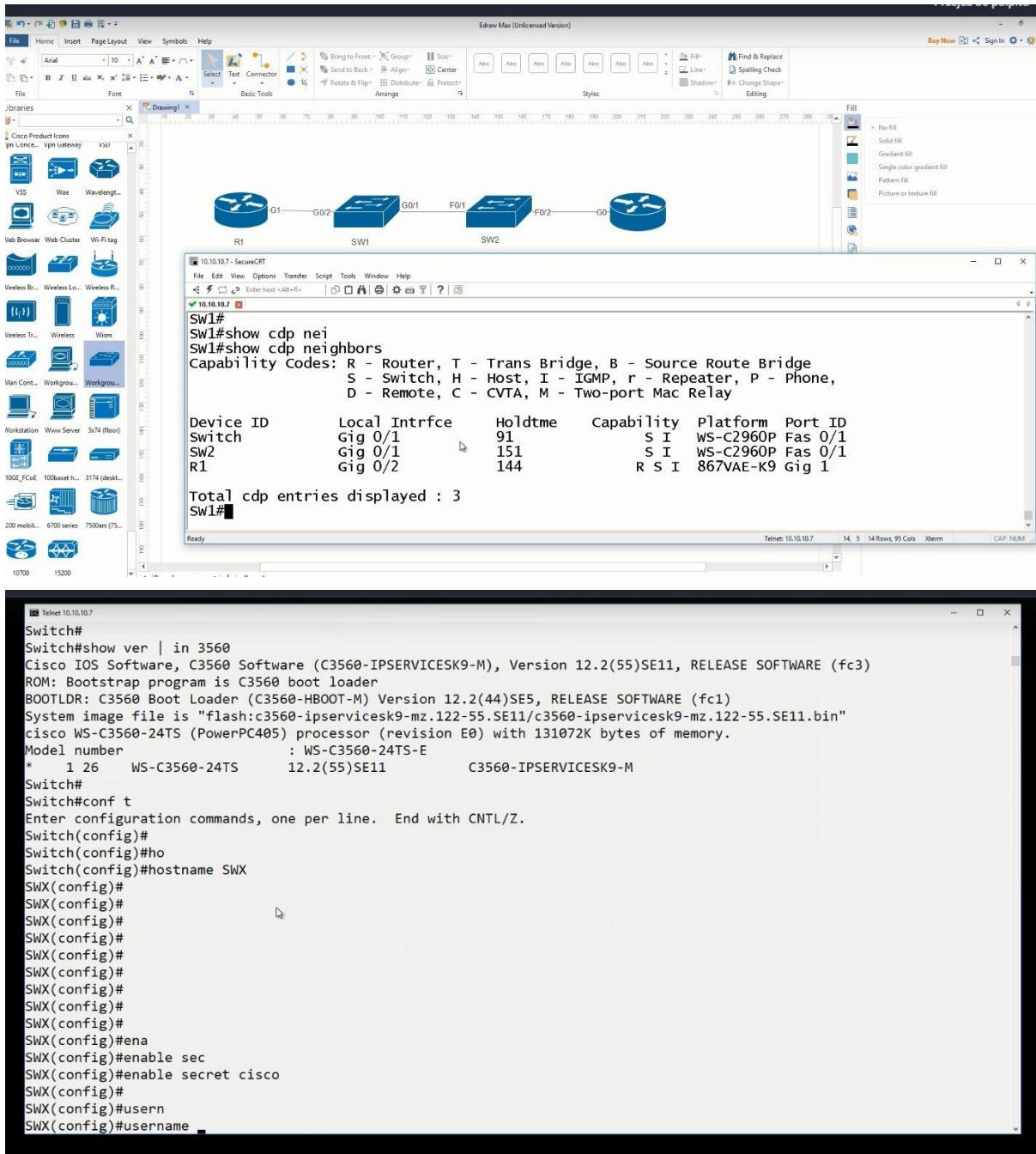
Basic Switch Configuration

If you know how to configure a Router, you know how to configure a switch!

- ✓ Hostname and Domain Name
- ✓ IP addresses
- ✓ Passwords
- ✓ Telnet and SSH access







```
[Telnet 10.10.10.7]
SWX(config-line)#tra
SWX(config-line)#transport in
SWX(config-line)#transport input ssh telnet
SWX(config-line)#
SWX(config-line)#exi
SWX(config)#
SWX(config)#ip doma
SWX(config)#ip domain-n
SWX(config)#ip domain-name test.local
SWX(config)#
SWX(config)#cry
SWX(config)#crypto ke
SWX(config)#crypto key g
SWX(config)#crypto key generate rs
SWX(config)#crypto key generate rsa
The name for the keys will be: SWX.test.local
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]:
% Generating 512 bit RSA keys, keys will be non-exportable...[OK]

*Mar 1 00:14:04.028: RSA key size needs to be atleast 768 bits for ssh version 2
SWX(config)#
*Mar 1 00:14:04.028: %SSH-5-ENABLED: SSH 1.5 has been enabled
SWX(config)#
SWX(config)#
SWX(config)#
SWX(config)#
```

```
  Select Telnet 10.10.10.7
SWX(config)#^Z
SWX#sho
SWX#show
*Mar  1 00:14:16.141: %SYS-5-CONFIG_I: Configured from console by consoleip i
SWX#show ip int brie
Interface          IP-Address      OK? Method Status       Protocol
Vlan1              192.168.1.20   YES DHCP    up           up
FastEthernet0/1    unassigned     YES unset   up           up
FastEthernet0/2    unassigned     YES unset   down         down
FastEthernet0/3    unassigned     YES unset   down         down
FastEthernet0/4    unassigned     YES unset   down         down
FastEthernet0/5    unassigned     YES unset   down         down
FastEthernet0/6    unassigned     YES unset   down         down
FastEthernet0/7    unassigned     YES unset   down         down
FastEthernet0/8    unassigned     YES unset   down         down
FastEthernet0/9    unassigned     YES unset   down         down
FastEthernet0/10   unassigned     YES unset   down         down
FastEthernet0/11   unassigned     YES unset   down         down
FastEthernet0/12   unassigned     YES unset   down         down
FastEthernet0/13   unassigned     YES unset   down         down
FastEthernet0/14   unassigned     YES unset   down         down
FastEthernet0/15   unassigned     YES unset   down         down
FastEthernet0/16   unassigned     YES unset   down         down
FastEthernet0/17   unassigned     YES unset   down         down
FastEthernet0/18   unassigned     YES unset   down         down
FastEthernet0/19   unassigned     YES unset   down         down
FastEthernet0/20   unassigned     YES unset   down         down
FastEthernet0/21   unassigned     YES unset   down         down
SWX#
```

```
  Telnet 10.10.10.7
SWX(config-if)#no swi
SWX(config-if)#no switchport
SWX(config-if)#
SWX(config-if)#
*Mar  1 00:15:50.798: %LINK-3-UPDOWN: Interface FastEthernet0/15, changed state to down
SWX(config-if)#ip add
SWX(config-if)#ip address 1.1.1.1 255.255.255.0
SWX(config-if)#
SWX(config-if)#do show ip int brie
Interface          IP-Address      OK? Method Status       Protocol
Vlan1              192.168.1.20   YES DHCP    up           up
FastEthernet0/1    unassigned     YES unset   up           up
FastEthernet0/2    unassigned     YES unset   down         down
FastEthernet0/3    unassigned     YES unset   down         down
FastEthernet0/4    unassigned     YES unset   down         down
FastEthernet0/5    unassigned     YES unset   down         down
FastEthernet0/6    unassigned     YES unset   down         down
FastEthernet0/7    unassigned     YES unset   down         down
FastEthernet0/8    unassigned     YES unset   down         down
FastEthernet0/9    unassigned     YES unset   down         down
FastEthernet0/10   unassigned     YES unset   down         down
FastEthernet0/11   unassigned     YES unset   down         down
FastEthernet0/12   unassigned     YES unset   down         down
FastEthernet0/13   unassigned     YES unset   down         down
FastEthernet0/14   unassigned     YES unset   down         down
FastEthernet0/15   1.1.1.1      YES manual  down        down
FastEthernet0/16   unassigned     YES unset   down         down
FastEthernet0/17   unassigned     YES unset   down         down
FastEthernet0/18   unassigned     YES unset   down         down
FastEthernet0/19   u             YES unset   down         down
```

```
! Telnet 10.10.10.7
SWX(config)#ip default-gateway ?
A.B.C.D IP address of default gateway

SWX(config)#bann
SWX(config)#banner ?
LINE           c banner-text c, where 'c' is a delimiting character
config-save   Set message for saving configuration
exec         Set EXEC process creation banner
incoming     Set incoming terminal line banner
login        Set login banner
motd         Set Message of the Day banner
prompt-timeout Set Message for login authentication timeout
slip-ppp      Set Message for SLIP/PPP

SWX(config)#banner mo
SWX(config)#banner motd ?
LINE           c banner-text c, where 'c' is a delimiting character

SWX(config)#banner motd !
Enter TEXT message. End with the character '!'
-----
MAKE SURE YOU ARE AUTHORIZED TO LOG IN

-----
!
```

```
pc Select Telnet 10.10.10.7
SWX(config)#banner
LINE c banner-te
-----
SWX(config)#banner MAKE SURE YOU ARE AUTHORIZED TO LOG IN
Enter TEXT message.
-----
User Access Verification
MAKE SURE YOU ARE A
Username: -_
!
SWX(config)#
SWX(config)#^Z
SWX#
*Mar 1 00:19:35.07
SWX#show ip int bri
Interface
Vlan1
FastEthernet0/1
FastEthernet0/24
SWX#
SWX#
```

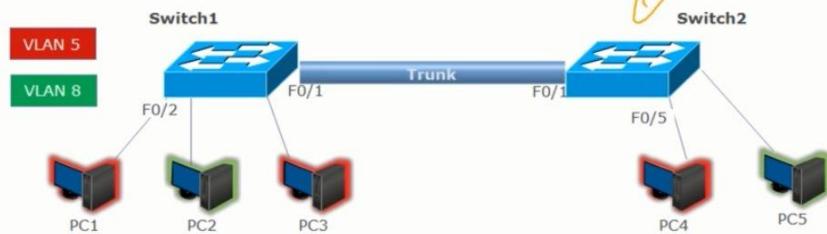
A Virtual Local Area Network (VLAN)

Allows you to group users and end devices in a logical way.

Remember:

VLAN = broadcast domain

VLAN = subnet



A Virtual Local Area Network (VLAN)

The standard we use today for VLANs is dot1q (802.1q).

There is an old standard ISL (Cisco proprietary) as well.

A switch tags a frame with VLAN information and recalculates the original Frame Check Sequence (FCS) value.

All ports on a new Switch belong to VLAN 1 (default VLAN).



A Virtual Local Area Network (VLAN)

The standard we use today for VLANs is dot1q (802.1q).
There is an old standard ISL (Cisco proprietary) as well.

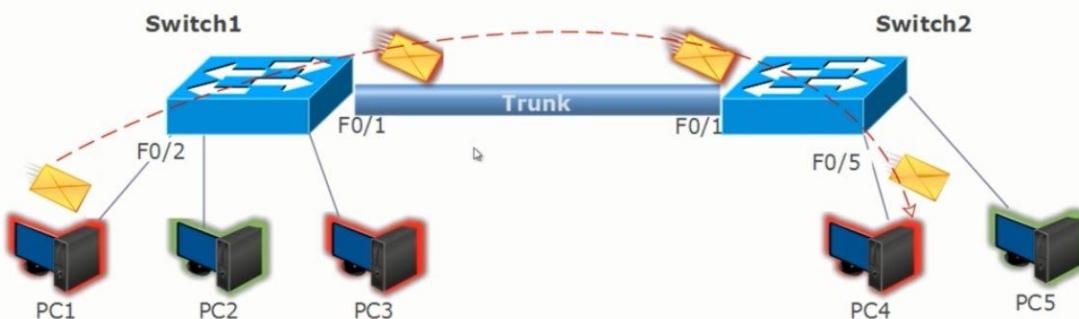
A switch tags a frame with VLAN information and recalculates the original Frame Check Sequence (FCS) value.

All ports on a new Switch belong to VLAN 1 (default VLAN).



A Virtual Local Area Network (VLAN)

If you want to send a frame with VLAN information between two switches, you need a **trunk** to be formed.

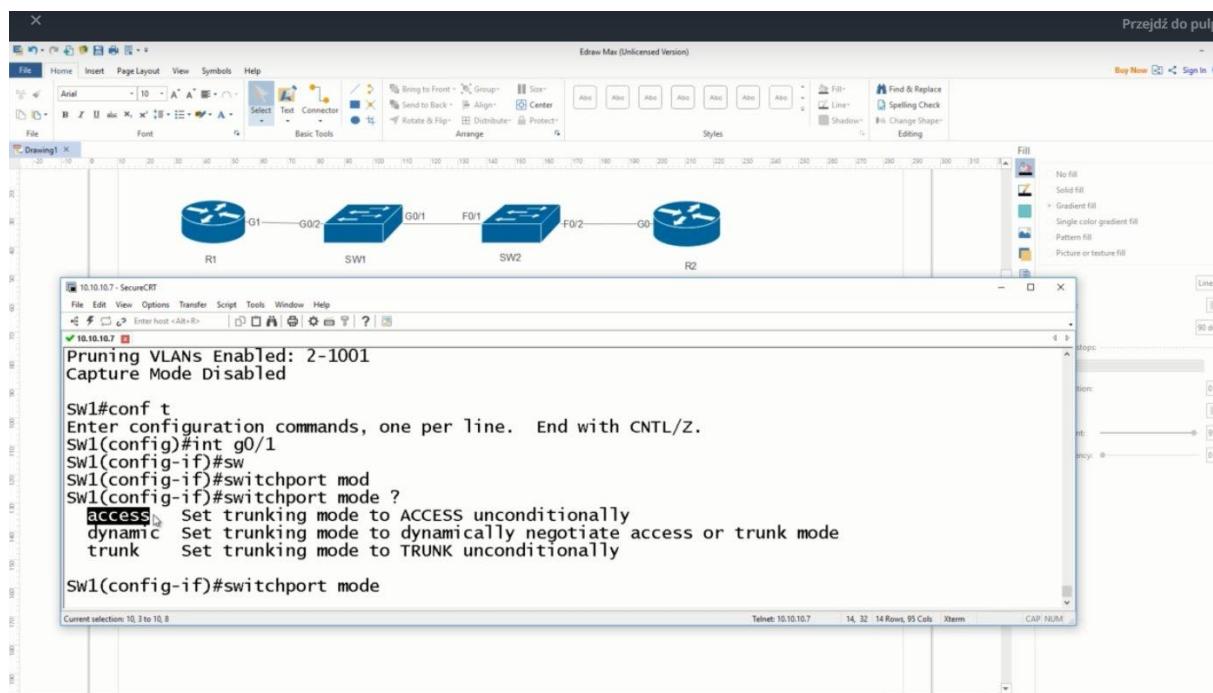


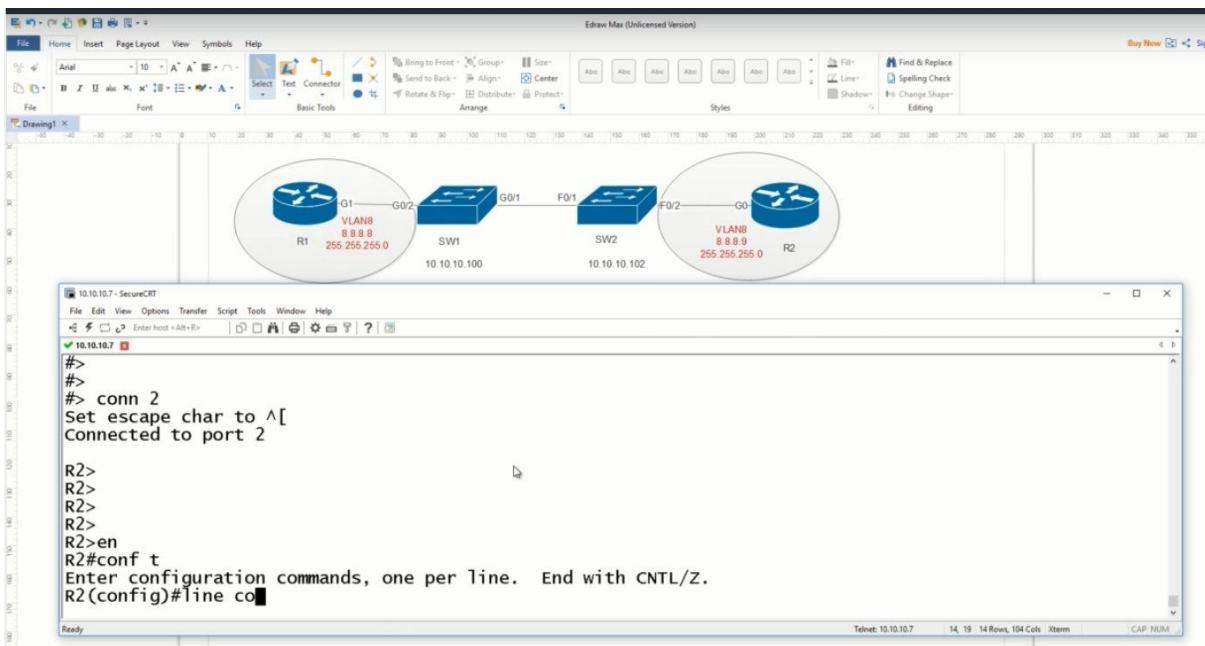
Dynamic Trunking Protocol (DTP)

A trunk can be negotiated between two switches using DTP.

Modes:

- ✓ Dynamic Desirable
- ✓ Dynamic Auto
- ✓ Trunk
- ✓ Nonegotiate
- ✓ Access



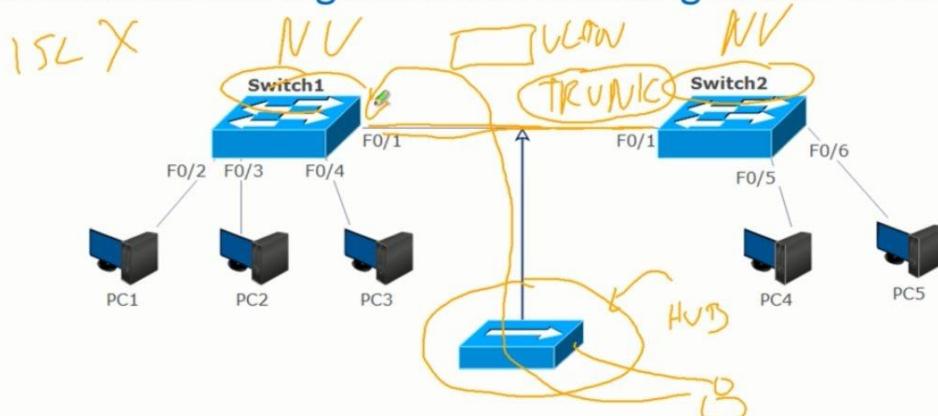


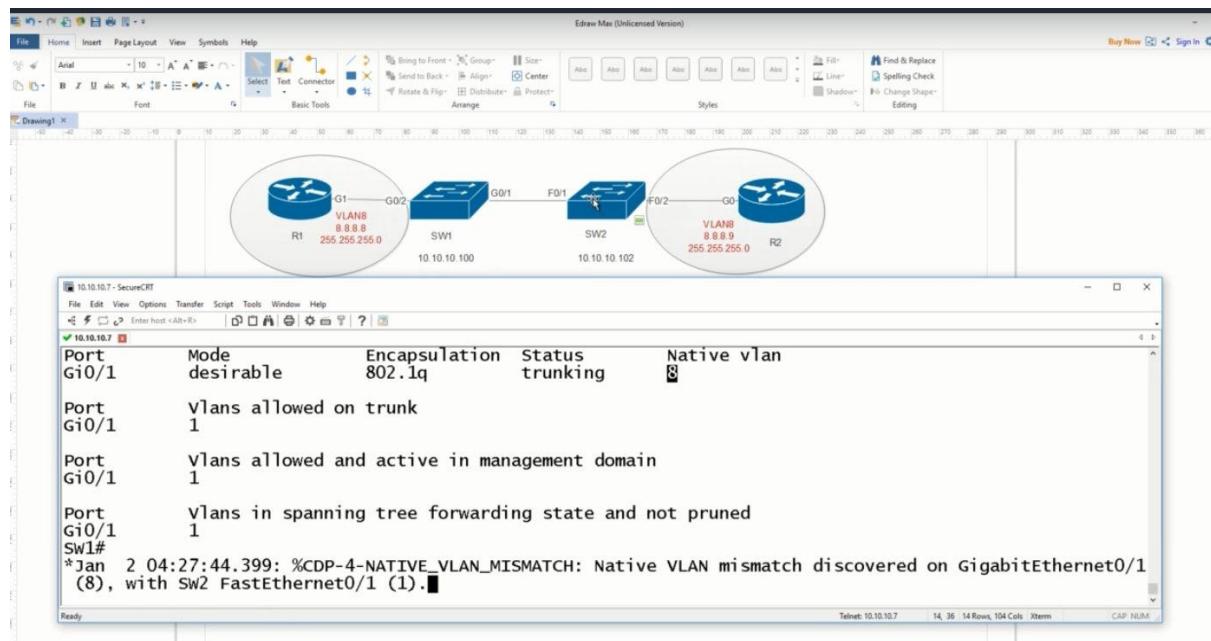
Native VLAN

POZ. lg

If your switch receives a frame with **no VLAN** information, it assumes this frame belongs to the Native VLAN.

Switches do not tag frames that belong to the native VLAN.

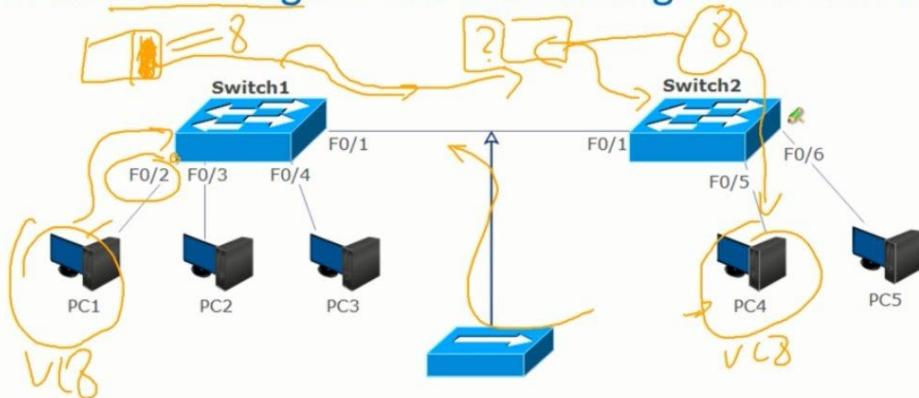




Native VLAN

If your switch receives a frame with **no VLAN** information, it assumes this frame belongs to the Native VLAN.

Switches do not tag frames that belong to the native VLAN.



Przejdz do pulpitu

Subnetting made EASY!

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Przejdz do pulpitu

Network Calculators

Subnet Mask Calculator
Enter the TCP/IP Network Address:
Force as Class:
Enter the required number of sub-networks:
OR enter the required number of nodes/hosts per network
(including network & broadcast addresses)***:

Network Class: Default Class A Class B Class C
Subnet Mask: 255.0.0.0 or /8
Subnets: 1
Nodes/Hosts per Network (including network and broadcast addresses)***: 16777216
Calculate
List Networks
Explain

Network/Node Calculator
Enter the Subnet Mask:
Enter the TCP/IP Address:
Network: 10.0.0.0
Node/Host: 0.0.0.0
Broadcast Address: 10.255.255.255
Calculate
Explain

IP Address Converter
Enter the dotted decimal TCP/IP Address:
or Enter the binary TCP/IP Address:
or Enter the hex TCP/IP Address:
or Enter the decimal TCP/IP Address:

00001010	00000000	00000000	00000000
0A	00	00	00
167772160			

Calculate
Calculate
Calculate
Calculate
Explain

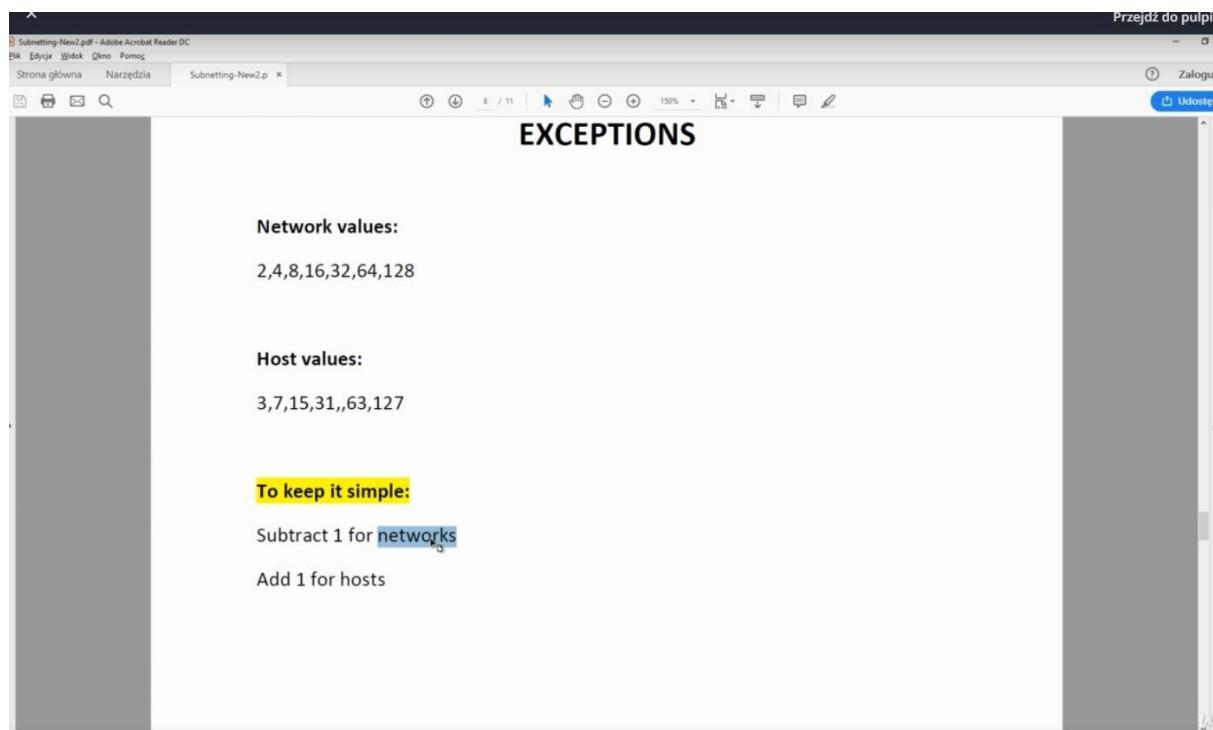
Subnet Mask Converter
Enter the dotted decimal Subnet Mask:
or Enter the number of bits in the subnetmask:

255	0	0	0
/8			

Calculate
Calculate

Phonexia Speech Platform
Phonexia
Enhance your revenue and performance with comprehensive speech analytics solution.
[OPEN](#)

Udemy



The screenshot shows a web page from www.easysubnetting.net/index.php/basic-subnetting-quiz/. The page displays the following content:

The network address 192.168.1.0/26 gives us 64 hosts.

True False

Check

Question: 4 of 50 questions

Rating: 4.9/5. From 15 votes.

At the bottom of the page, there is a footer with links:

Home | Study Plan | What is an IP address? | What is a subnet mask? | Binary | CIDR | Learn how to subnet | How to subnet faster – Tips&Tricks | Basic Subnetting Quiz | Final Exam (CCENT/CCNA) | VLSM – Overview | VLSM Practice Questions | Cheat Sheets | Interesting links | EasyBlog | Privacy Policy

Easy Subnetting - The only place on the Internet you need for subnetting for a Cisco, Microsoft, and ComTIA exam

Screenshot of a web browser showing the Subnet Calculator at <https://www.iplocation.net/subnet-calculator>. The calculator interface includes fields for entering an IP address and subnet mask, and a note about wildcard masks. The results section shows the subnet details for the input 5.173.216.118/24.

Demand disrupts. Disrupt it back with intent-based Infrastructure. 

Subnet Calculator is used to divide an IP network into subnetworks by calculating network address, subnet mask, broadcast address and host IP address range. Please use the form below to enter an IP address and Subnet Mask, and we'll provide you with necessary information you'll need.

Enter a IP/Mask or IP/CIDR: 10.00000000

Example IP Address Inputs
IP & CIDR Netmask: 10.0.0.1/8
IP & Netmask: 192.168.0.1 255.255.255.240
IP & Wildcard mask: 172.16.2.1 0.0.1.255

*Note: Wildcard mask is inverse of subnet mask.

Subnet Results

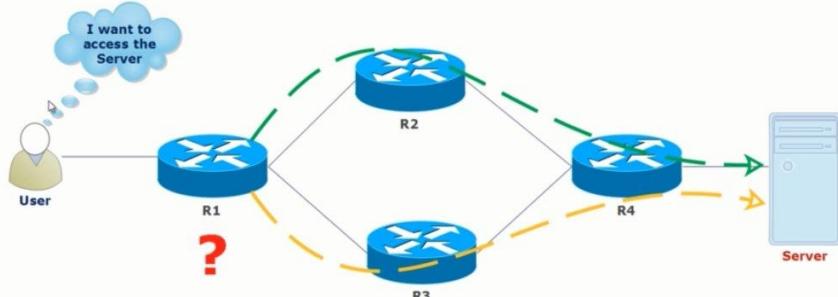
Here is the subnet calculator results for 5.173.216.118/24.

IP Address	5.173.216.118
------------	---------------

Routing

Routery wybierają najlepszą trasę. Rodzaje routingu

- ✓ Statyczny
- ✓ Dyamiczny
(RIP, EIGRP, OSPF, BGP)



Tablica routingu - routing table

Routers and Routing

Używana jest metryka (metric) aby zdecydować jak dobra jest trasa. Mniejsza jest lepsza.

Administrative Distance – weryfikacja, który protokół routingu jest bardziej wiarygodny

IGP

EIGRP / OSPF / BGP

EGP

ROUTER#show ip route

Gateway of last resort is 192.168.1.1 to network 0.0.0.0

S* 0.0.0.0/0 [254/0] via 192.168.1.1
1.0.0.0/24 is subnetted, 1 subnets
S 1.1.1.0 [1/0] via 192.168.1.5
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/84 is directly connected, GigabitEthernet0

Name	Default AD
Directly Connected	0
Static route	1
EIGRP	90
OSPF	110
RIP	120
Internal BGP	200

Destination address AD Metric Next Hop IP Address

→ 2 120 R

Routing



```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | ☰ 🔍 🛡️ 🛡️ 🛡️ 🛡️ 🛡️ 🛡️ ? 🛡️
10.10.10.7
R1(config)#*Aug 6 08:40:05.351: %CONTROLLER-5-UPDOWN: Controller VDSL 0, changed state to administratively down
R1(config)#
R1(config)#
R1(config)#
R1(config)#
R1(config)#
R1(config)#line con 0
R1(config-line)#logg syn
R1(config-line)#
R1(config-line)#
R1(config-line)#
R1(config-line)#
R1(config-line)#
R1(config-line)#
R1(config)#
Ready
Telnet: 10.10.10.7 14, 12 14 Rows, 104 Cols Xterm CAP. NUM
```

Routing



```
R1(config-line)#  
R1(config-line)#exit  
R1(config)#int g1  
R1(config-if)#ip add 1.1.1.1 255.255.255.252  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#no shut  
R1(config-if)#  
R1(config-if)#  
R1(config-if)#Closed connection 1.  
Connection closed by foreign host.  
  
#> conn 3
```

Routing



```
R1#  
R1#  
R1#  
R1#  
R1#  
R1#  
R1#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#ip route ?  
A.B.C.D Destination prefix  
profile Enable IP routing table profile  
static Allow static routes  
R1(config)#ip route ■
```

Routing

Process switching

Every single packet is analyzed by the router using the CPU.

Fast switching

A router checks the first packet in a flow using the CPU.

Cisco Express Forwarding (CEF)

Works like a pre-built cache. There are two tables: Adjacency Table and Forwarding Information Base (FIB).

Routing

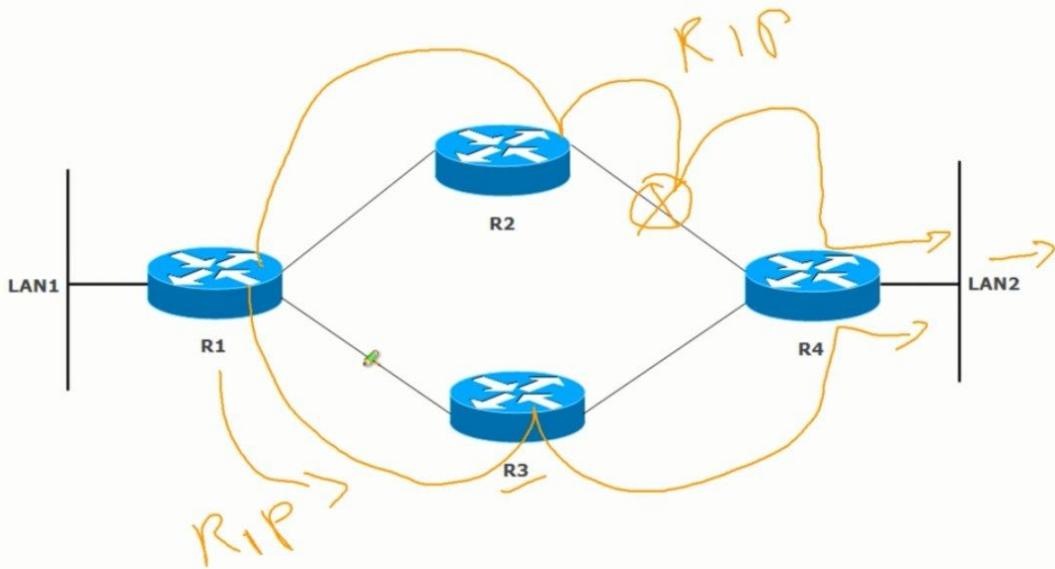
Process switching

Every single packet is analyzed by the router using the CPU.

```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | ? |
10.10.10.7
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#
Router#show run | inc
Router#show run | include cef
no ipv6 cef
ip cef
Router#show star
Router#show startup-config
startup-config is not present
Router#
```

Current selection: 13, 1 to 13, 8 Telnet: 10.10.10.7 17, 8 17 Rows, 104 Cols Xterm CAP NUM

Dynamiczne protokoły routingu

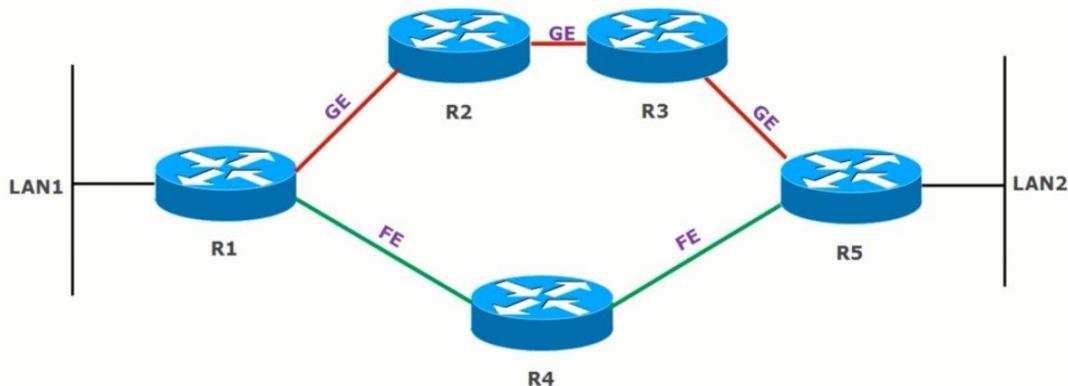


Dynamiczne protokoły routingu

- ✓ Interior Gateway Protocol (IGP) – one Autonomous System
- ✓ Exterior Gateway Protocol (EGP) – between Autonomous Systems

Dynamiczne protokoły routingu

- ✓ Distance Vector Routing Protocols (RIP, EIGRP)
- ✓ Link-state Routing Protocols (OSPF)



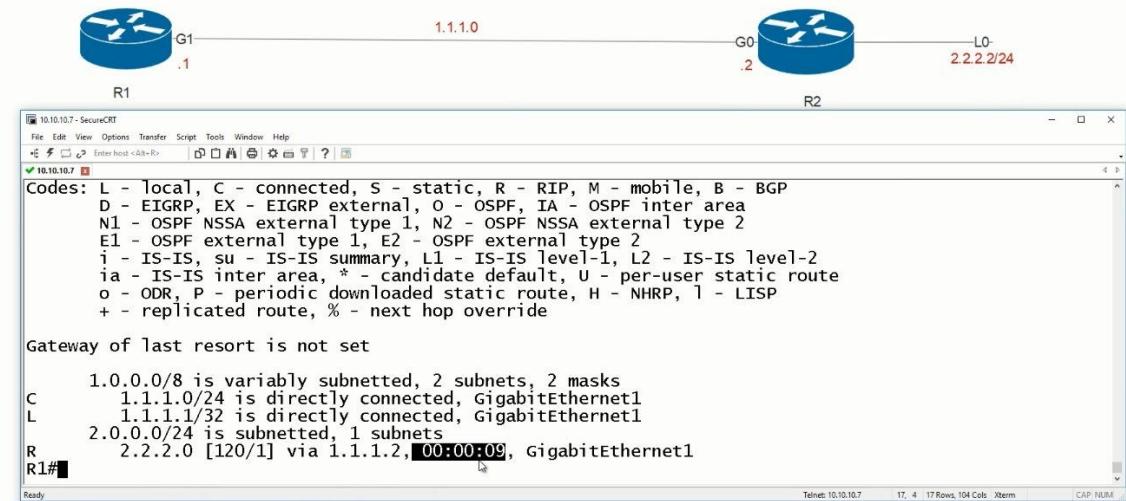
Dynamiczne protokoły routingu

RIP

- ✓ Distance-vector routing protocol
- ✓ Metric – hop count, 16 is unreachable
- ✓ Full routing table advertised every 30 seconds
- ✓ Can perform load balancing maximum of 6 equal cost paths (default = 4)
- ✓ RIPv2 supports VLSM
- ✓ Uses automatic summarization to reduce the size of a routing table (turn off!!!)
- ✓ Version 2 supports authentication
- ✓ Uses 2 message types: request message & response message
- ✓ Rip v1 uses broadcast (255.255.255.255), Rip v2 uses multicast (224.0.0.9)
- ✓ Administrative distance is 120

10.1.2.0/24 →
10.7.3.0/24 →
192.168.1.0/24 →
10.0.0.0/8 →

Routing



Dynamiczne protokoły routingu

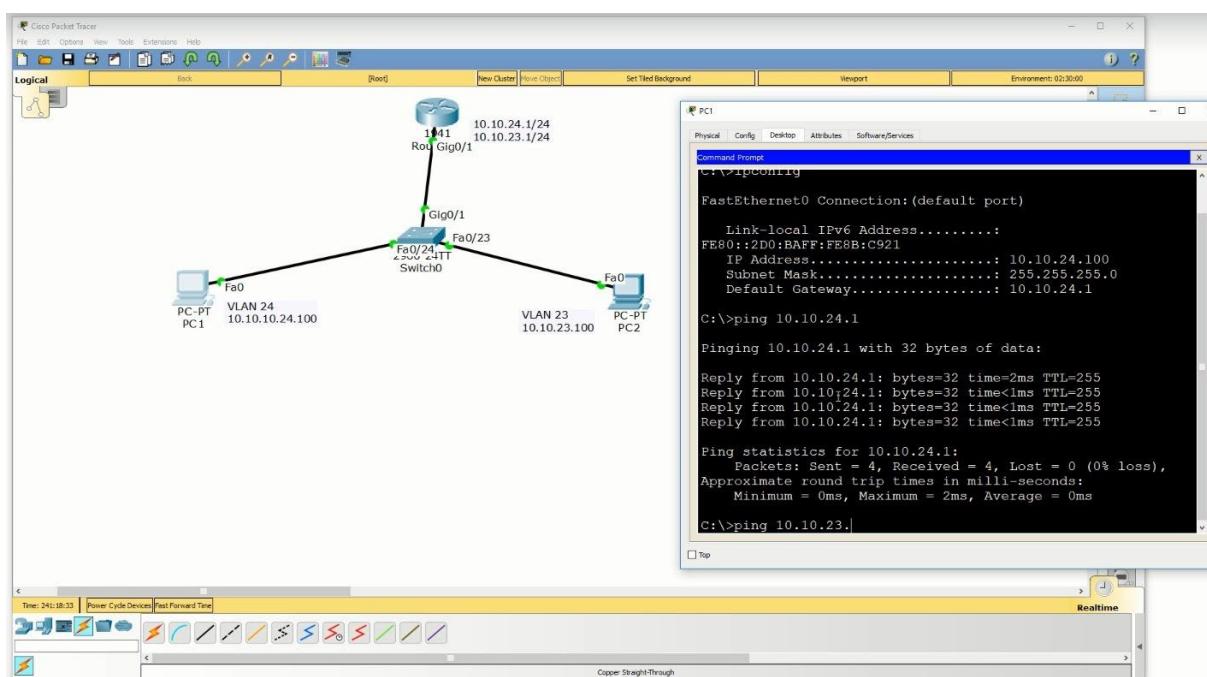
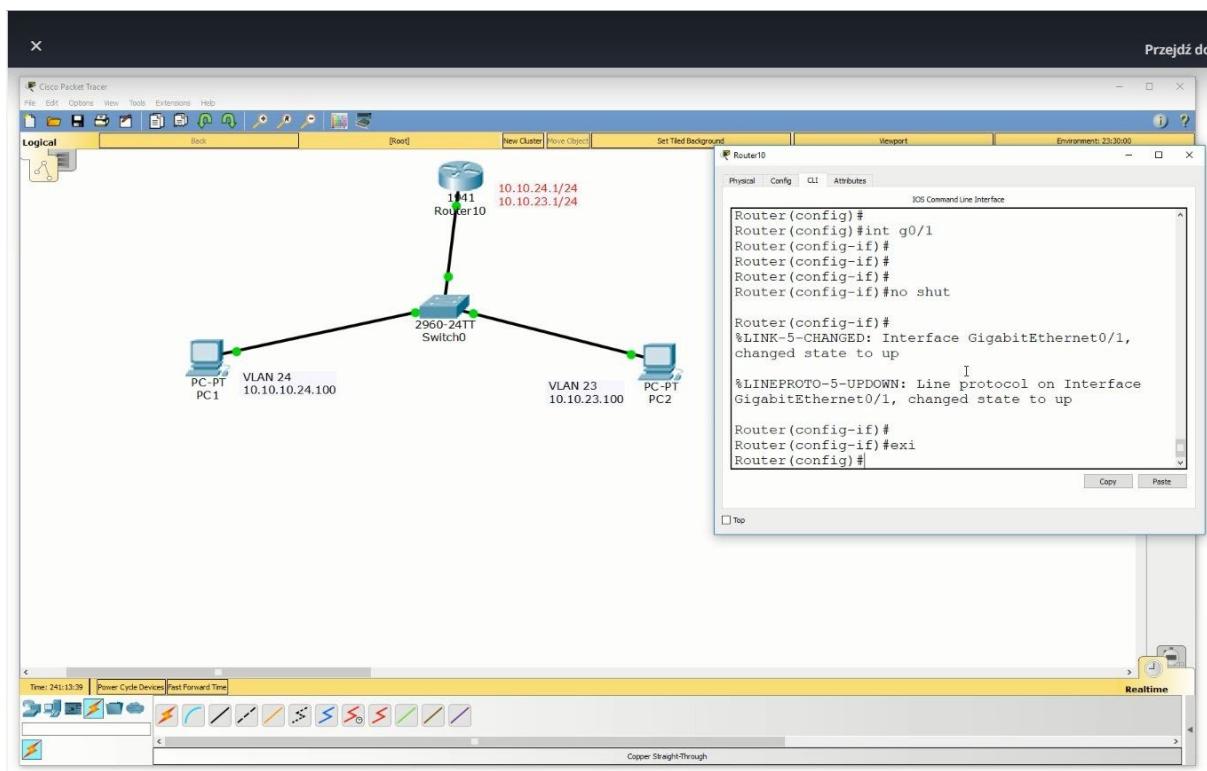
RIP

✓ Distance-vector routing protocol

```
R1#show ip protocols
R1#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 13 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface      Send   Recv   Triggered RIP   Key-chain
    GigabitEthernet1    2      2
  Automatic network summarization is not in eff
```

Telnet: 10.10.10.7 17, 55 17 Rows, 104 Cols Xterm CAP NUM



Loop avoiding (Zapobieganie petli):

- ✓ Split-Horizon
- ✓ Route-Poisoning
- ✓ Hold-Down Timers

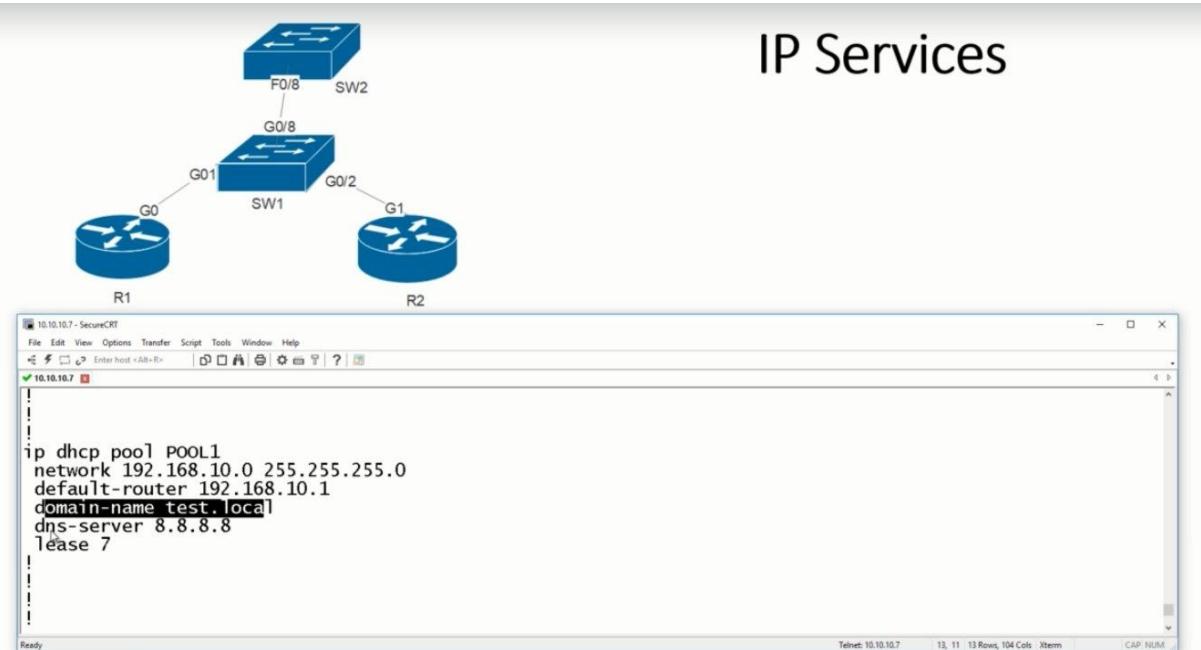
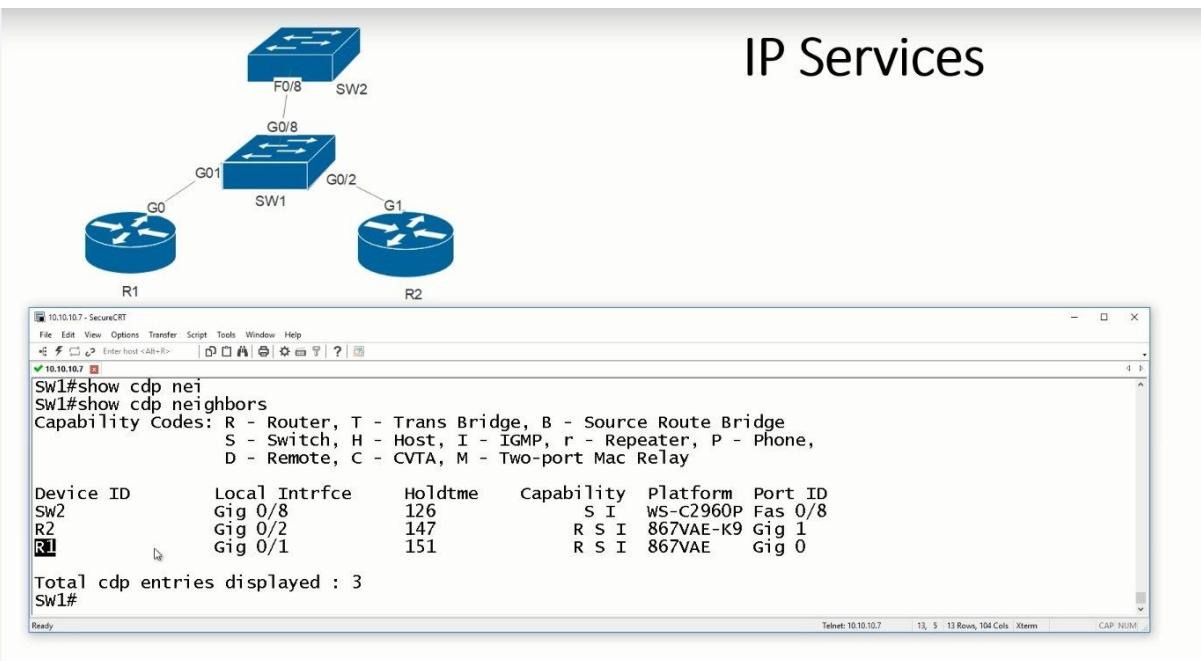
The screenshot shows a dual-pane interface. The top pane is a web browser displaying a Cisco exam topic from learningcontent.cisco.com. The page title is "100-105-icnd1-v3.pdf". The content includes a "Find on page" search bar, a navigation bar with "No results", and a main area with sections like "3.2.b Network mask" and "3.2.d Routing protocol code". The bottom pane is a SecureCRT terminal window titled "10.10.10.7 - SecureCRT". It shows a configuration session for router R1. The user has entered several "ip route" commands:

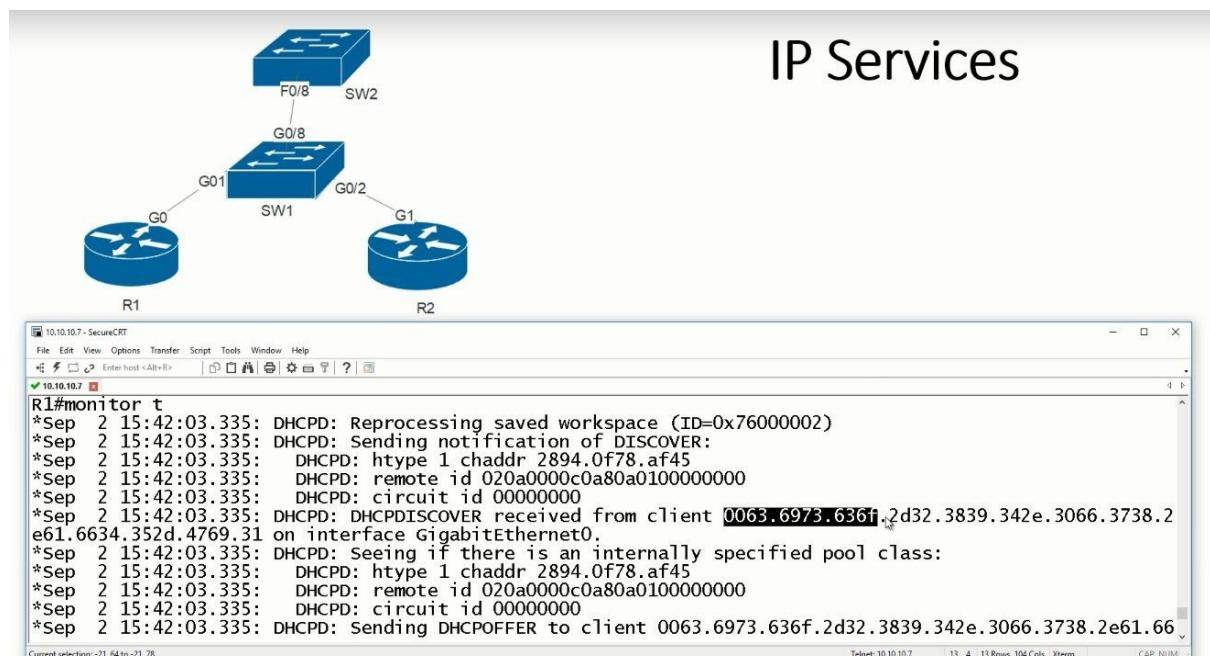
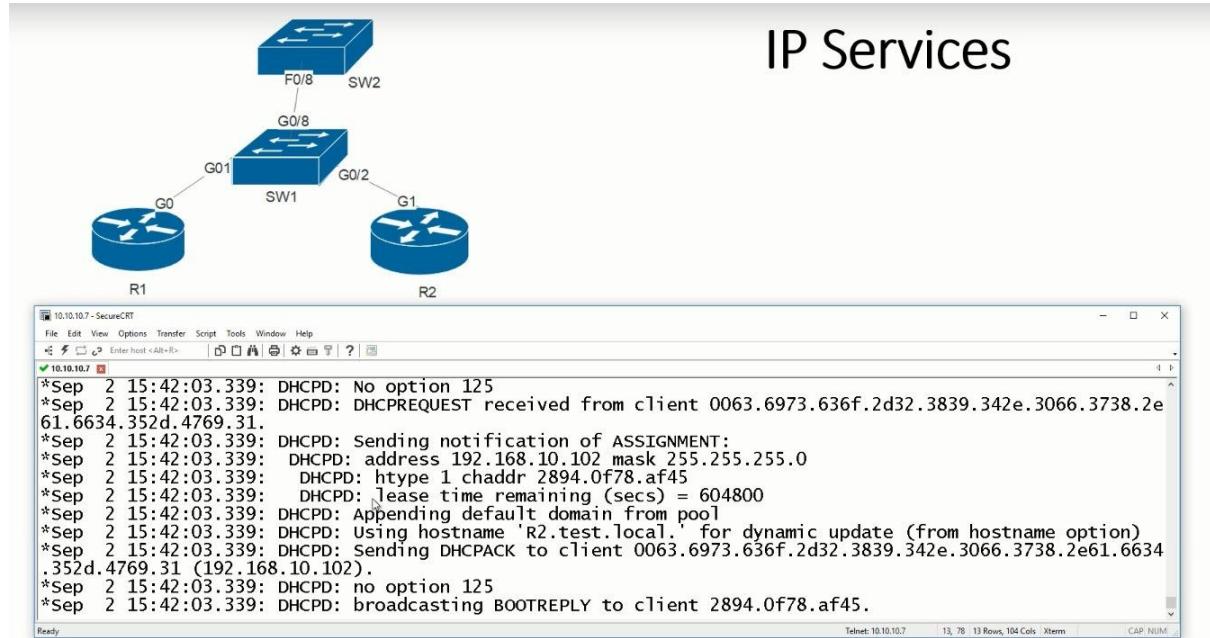
```
R1(config)#ip route 3.3.3.0 255.255.255.0 1.1.1.2 ?
R1(config)#ip route 3.3.3.0 255.255.255.0 1.1.1.2 ?
<1-255> Distance metric for this route
multicast multicast route
name Specify name of the next hop
permanent permanent route
tag Set tag for this route
track Install route depending on tracked item
<cr>
R1(config)#ip route 3.3.3.0 255.255.255.0 1.1.1.2 100
R1(config)#ip route 3.3.3.0 255.255.255.0 1.1.1.2 200
R1(config)#
R1(config)#
R1(config)#ip route 0.0.0.0 0.0.0.0 4.4.4.4
R1(config)#

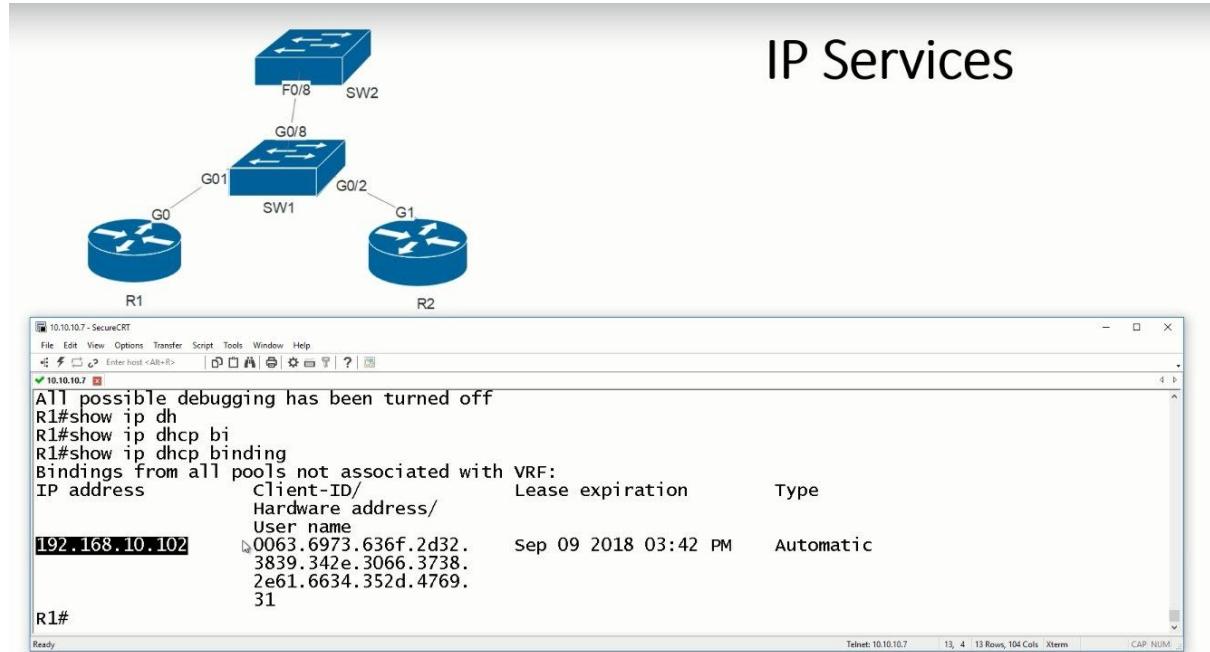
```

The terminal window also displays some help text for the "ip route" command and a status bar at the bottom.

IP Services







IP Services

Network Time Protocol (NTP)

Allows your router to sync time and date. Your router can be an NTP client or server. You can also sync with some public NTP servers.

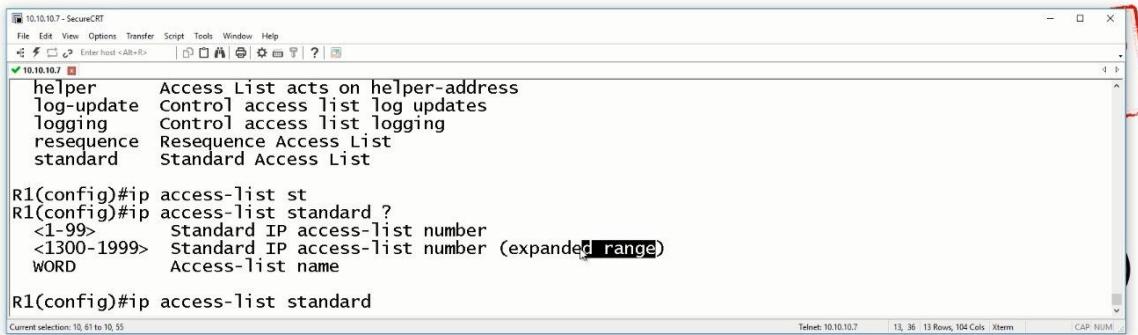
Router(config)# ip nameserver x.x.x.x

Router(config)# ntp server x.x.x.x



Access Control List (ACL)

An ACL can be used to **filter** information for security reasons or to match traffic that you need (e.g. for NAT or QoS).



```
helper Access List acts on helper-address
log-update Control access list log updates
logging Control access list logging
resequence Resequence Access List
standard Standard Access List

R1(config)#ip access-list st
R1(config)#ip access-list standard ?
<1-99> Standard IP access-list number
<1300-1999> Standard IP access-list number (expanded range)
WORD Access-list name

R1(config)#ip access-list standard
```

Access Control List (ACL)

An ACL can be used to **filter** information for security reasons or to match traffic that you need (e.g. for NAT or QoS).

Types:

✓ **Standard (1-99)**

(based on a source address only)

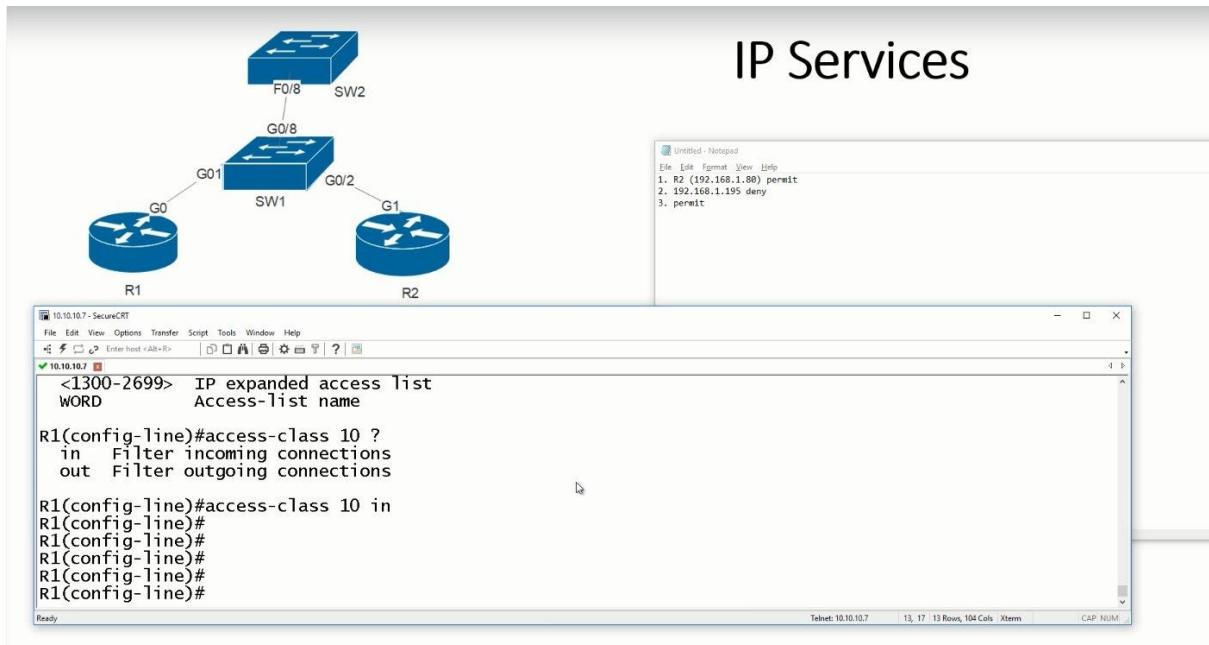
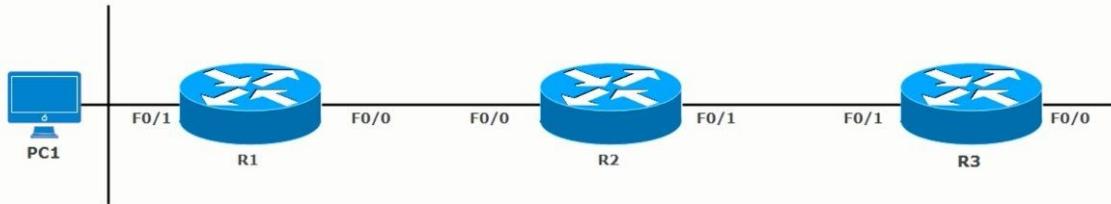
✓ **Extended (100-199)**

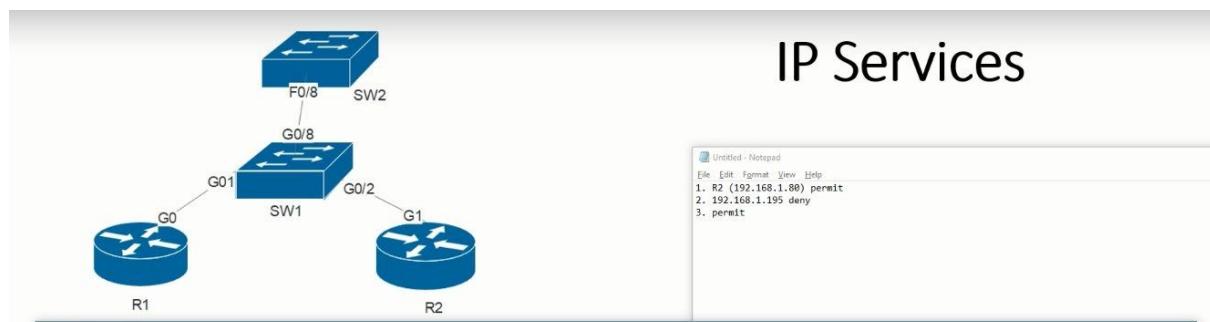
(based on source and destination addresses and protocol)



Access Control List (ACL) - Rules

- ✓ One ACL per interface, per protocol, and direction
- ✓ More specific rules at the top
- ✓ The implicit deny at the end of every ACL
- ✓ Apply a Standard ACL as close to the destination as possible
- ✓ Apply an Extended ACL as close to the source as possible
- ✓ Take advantage of named ACLs and sequence numbers





IP Services

User Access Verification

```

Username: admin
Password:
R1#
R1#
R1#show ip access-list 10
Standard IP access list 10
  10 permit 192.168.1.80 (4 matches)
  20 deny 192.168.1.195 (6 matches)
  30 permit any (2 matches)
R1#

```

Notepad content:

```

Untitled - Notepad
File Edit Format View Help
1. R2 (192.168.1.88) permit
2. 192.168.1.195 deny
3. permit

```

R1#

Notepad content:

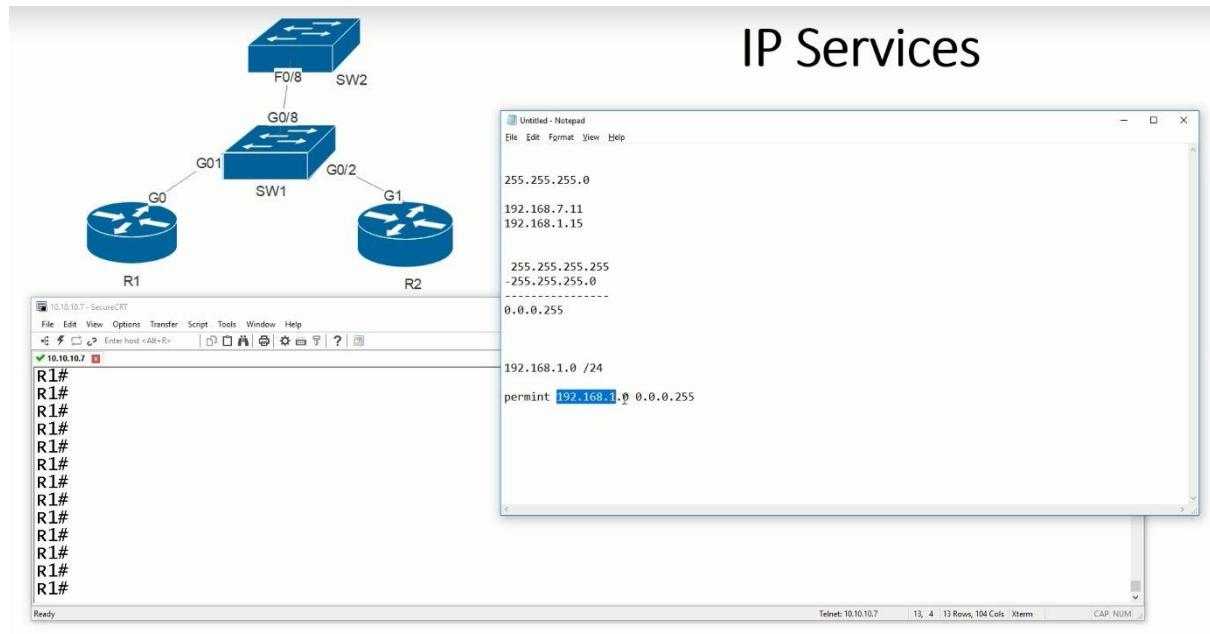
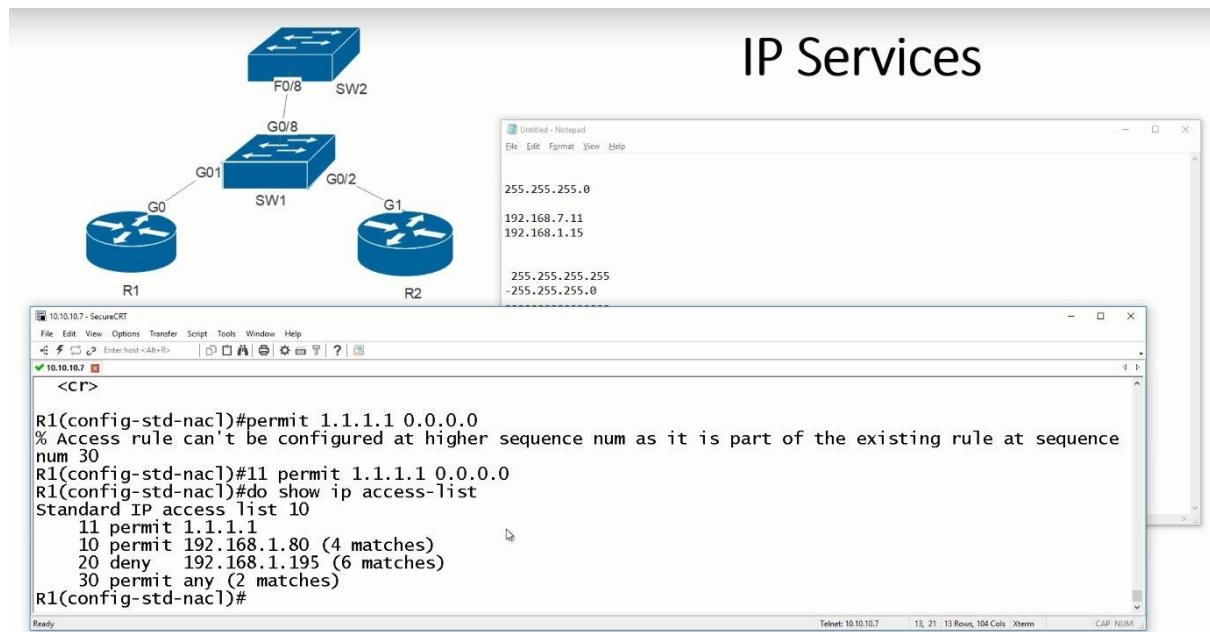
```

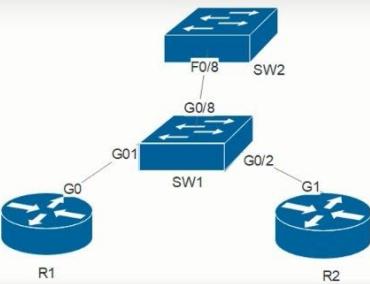
255.255.255.0
192.168.7.11
192.168.1.15

255.255.255.255
-255.255.255.0
-----
0.0.0.255

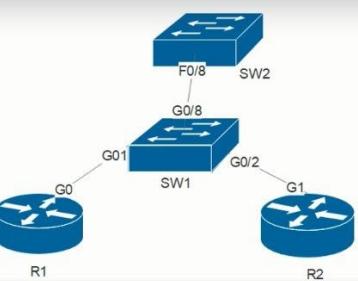
192.168.1.0 /24
0.0.0.0 = host

```





IP Services

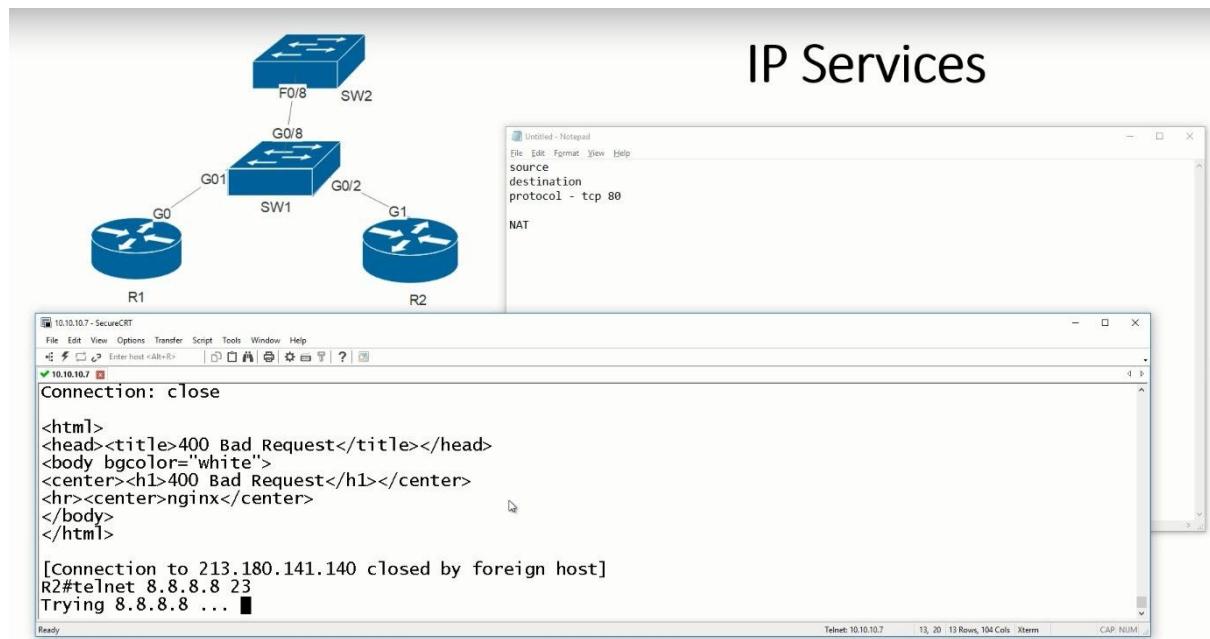


IP Services

```
10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
10.10.10.7

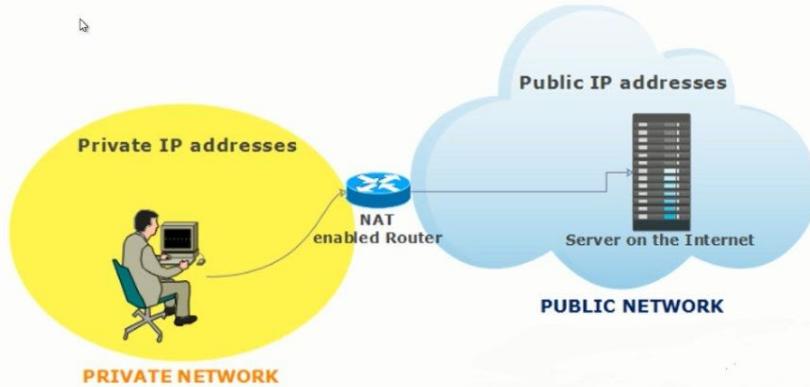
psht Match on the PSH bit
range Match only packets in the range of port numbers
rst Match on the RST bit
syn Match on the SYN bit
time-range Specify a time-range
tos Match packets with given TOS value
ttl Match packets with given TTL value

R1(config-ext-nacl)#deny tcp 192.168.1.89 0.0.0.0 213.180.141.140 0.0.0.0 eq
R1(config-ext-nacl)#$2.168.1.89 0.0.0.0 213.180.141.140 0.0.0.0 eq 80
R1(config-ext-nacl)#
R1(config-ext-nacl)#
R1(config-ext-nacl)#
R1(config-ext-nacl)#
Ready Telnet: 10.10.10.7 13.21 13 Rows, 104 Cols Xterm CAP NUM
```



Network Address Translation (NAT)

Allows a router to “hide” private IP addresses. We cannot use private IP addresses on the Internet and need NAT to be enabled.



Types of NAT

Static NAT (1-to-1)

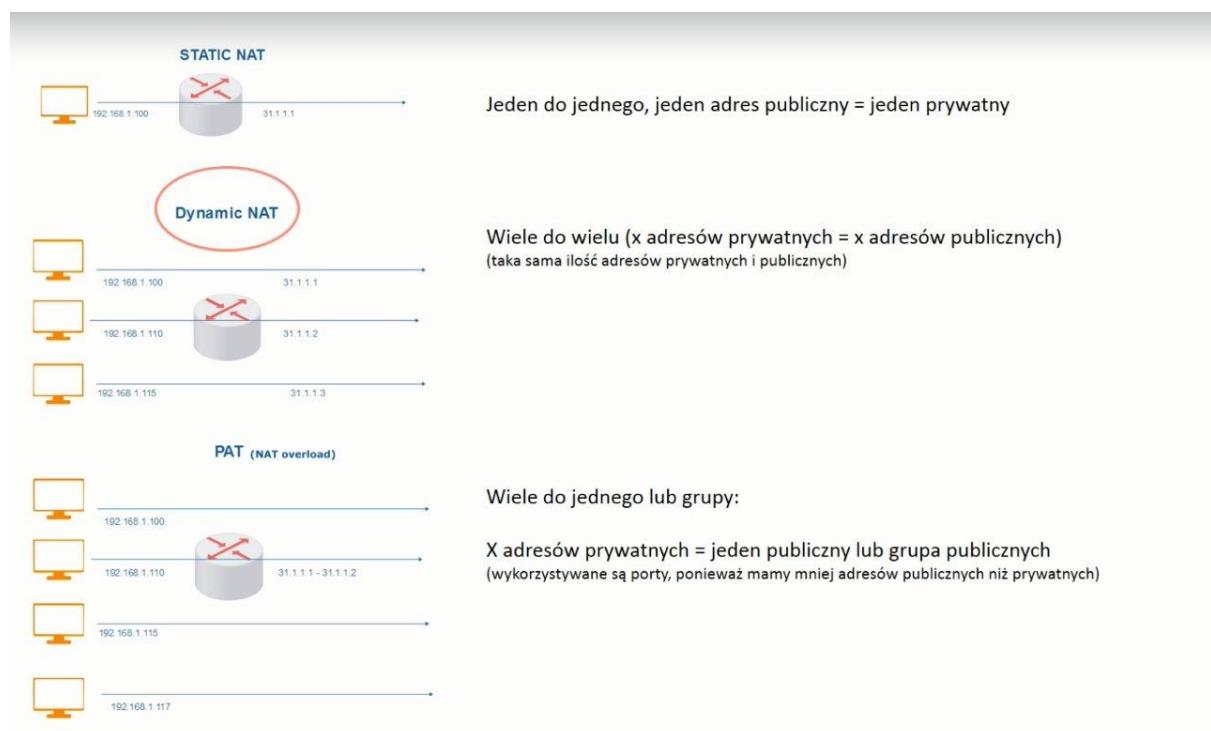
Maps a single private IP address to a single public IP address.

Dynamic NAT

Maps private IP addresses to a pool of public IP addresses.

Port Address Translation (PAT, NAT overload)

Maps private IP addresses using a single public IP.

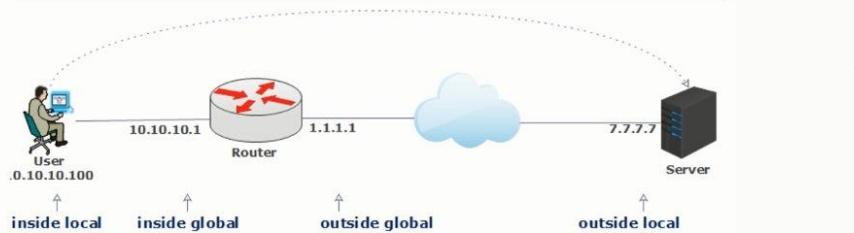


Types of NAT

Inside / Outside / Local / Global

Location of the packet - LOCAL/GLOBAL
Location of the device - INSIDE/OUTSIDE

Inside Local - 10.10.10.100
The LAN private IP address
Outside Local - 7.7.7.7
The destination address before NAT translation
Outside Global - 7.7.7.7
The destination IP address on the Internet
Inside Global - 1.1.1.1
Our public IP address



Read more: <http://packetlife.net/blog/2010/jan/7/understanding-nat-address-types/>

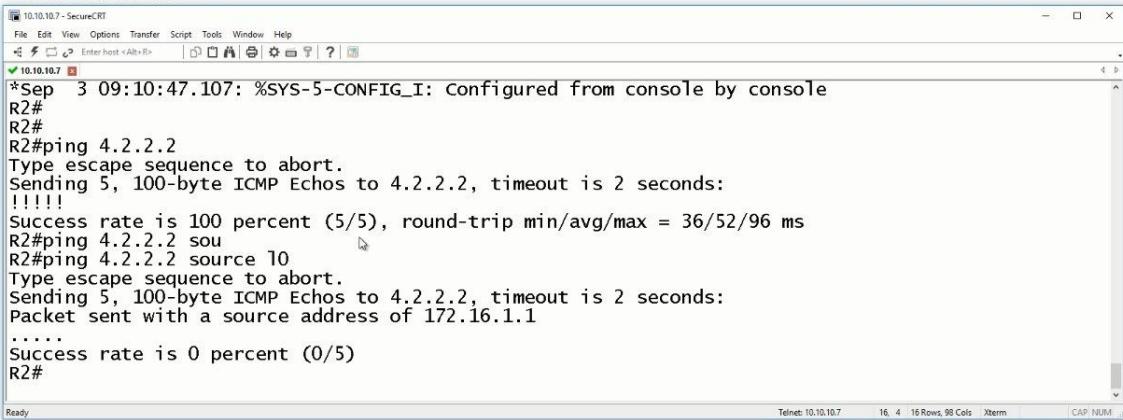
Network Address Translation (NAT)

Allows a router to “hide” private IP addresses. We cannot use private IP addresses on the Internet and need NAT to be enabled.

```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
10.10.10.7
R2(config-if)#
R2(config-if)#
R2(config-if)#ip ad
*Sep 3 09:10:25.275: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to upd
R2(config-if)#ip address 172.16.1.1 255.255.255.0
R2(config-if)#^Z
R2#
R2#
R2#
R2#
R2#
*Sep 3 09:10:47.107: %SYS-5-CONFIG_I: Configured from console by console
R2#
R2#
R2#ping ■
Ready Telnet: 10.10.10.7 16, 9 16 Rows, 99 Cols Xterm CAP NUM
```

Network Address Translation (NAT)

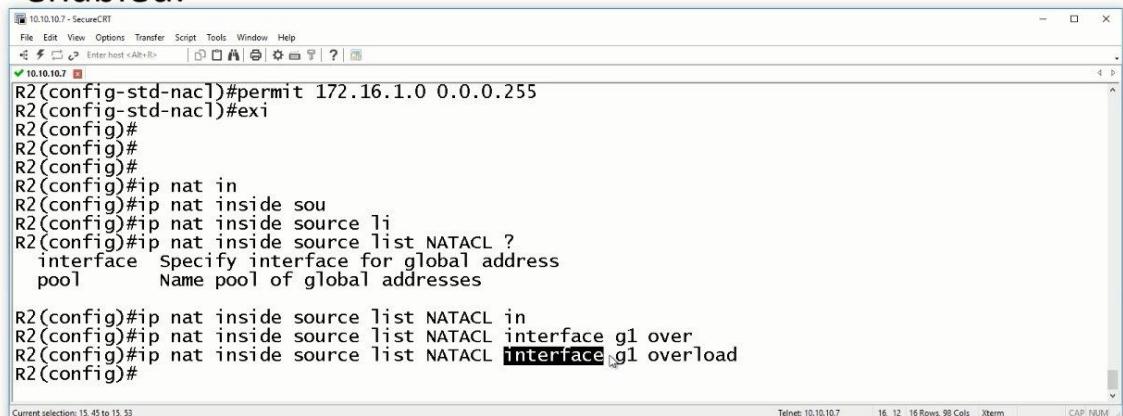
Allows a router to “hide” private IP addresses. We cannot use private IP addresses on the Internet and need NAT to be enabled.



```
*Sep 3 09:10:47.107: %SYS-5-CONFIG_I: Configured from console by console
R2#
R2#ping 4.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.2.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/52/96 ms
R2#ping 4.2.2.2 source 10
R2#ping 4.2.2.2 source 10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 172.16.1.1
.....
Success rate is 0 percent (0/5)
R2#
```

Network Address Translation (NAT)

Allows a router to “hide” private IP addresses. We cannot use private IP addresses on the Internet and need NAT to be enabled.



```
R2(config-std-nacl)#permit 172.16.1.0 0.0.0.255
R2(config-std-nacl)#exit
R2(config)#
R2(config)#
R2(config)#
R2(config)#ip nat inside
R2(config)#ip nat inside source sou
R2(config)#ip nat inside source list 1 i
R2(config)#ip nat inside source list NATACL ?
    interface Specify interface for global address
    pool      Name pool of global addresses
R2(config)#ip nat inside source list NATACL in
R2(config)#ip nat inside source list NATACL interface g1 over
R2(config)#ip nat inside source list NATACL interface g1 overload
R2(config)#
Current selection: 15, 45 to 15, 53
```

1-to-1 NAT:

```
ip nat inside source static 192.168.1.2 209.100.110.55
```

Za kazdym razem komputer adresie 192.168.1.2 bedzie 'ukrywany' za adresem 209.100.110.55

BONUS:

Przekierowanie portu:

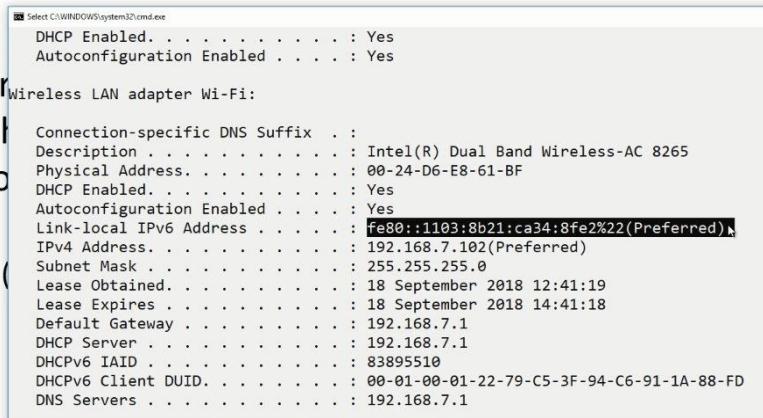
```
ip nat inside source static tcp 192.168.1.252 80 interface G0/1 80
```

192.168.1.252 to adres w sieci LAN "otwieramy" port 80

1-to-1 NAT, czyli jeden-do-jednego:

IPv6

- ✓ 128 bits (a huge address space)
- ✓ Smaller and simpler header
- ✓ No broadcast, all aboutunicast
- ✓ Improved security
- ✓ Link-local addresses (fe80::)



```
Windows PowerShell
Copyright (c) Microsoft Corporation. All rights reserved.

PS C:\> ipconfig /all

Windows IP Configuration

   Adapter: Wireless LAN adapter Wi-Fi

      Connection-specific DNS Suffix . :
      Description . . . . . : Intel(R) Dual Band Wireless-AC 8265
      Physical Address . . . . . : 00-24-D6-E8-61-BF
      DHCP Enabled. . . . . : Yes
      Autoconfiguration Enabled . . . . . : Yes
      IPv4 Address. . . . . : fe80::1103:8b21:ca34:8fe2%22(Preferred)
                               192.168.7.102(Preferred)
      Subnet Mask . . . . . : 255.255.255.0
      Lease Obtained. . . . . : 18 September 2018 12:41:19
      Lease Expires . . . . . : 18 September 2018 14:41:18
      Default Gateway . . . . . : 192.168.7.1
      DHCP Server . . . . . : 192.168.7.1
      DHCPv6 IAID . . . . . : 83895510
      DHCPv6 Client DUID. . . . . : 00-01-00-01-22-79-C5-3F-94-C6-91-1A-88-FD
      DNS Servers . . . . . : 192.168.7.1
```

IPv6

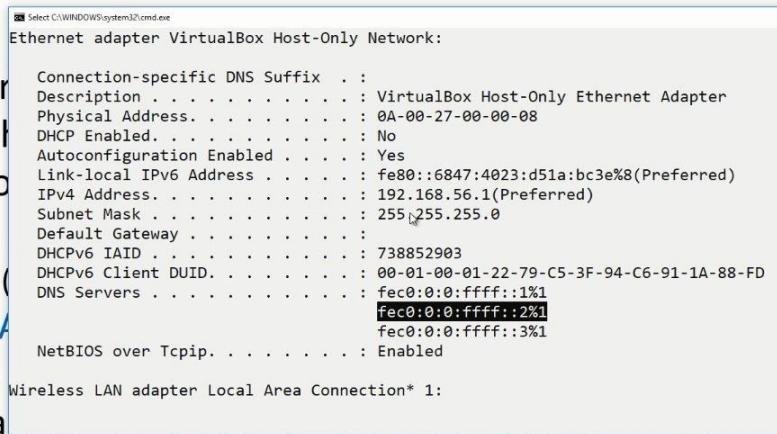
- ✓ 128 bits (a huge address space)
- ✓ Smaller and simpler header
- ✓ No broadcast, all about multicast
- ✓ Improved security
- ✓ Link-local addresses (FE80::/10)
- ✓ New address type – **Anycast** (one to the nearest)
- ✓ Private IPs are called Site-local addresses (FEC0::/10) – deprecated!
- ✓ Public, routable IPs are called **Global Unicast** addresses (2000::/3)

Example of an IPv6 address

2001:AAAA:0000:0000:0000:1234:0001

IPv6

- ✓ 128 bits (a huge address space)
- ✓ Smaller and simpler header
- ✓ No broadcast, all about multicast
- ✓ Improved security
- ✓ Link-local addresses (FE80::/10)
- ✓ New address type – **Anycast** (one to the nearest)
- ✓ Private IPs are called Site-local addresses (FEC0::/10)
- ✓ Public, routable IPs are called **Global Unicast** addresses (2000::/3)



```
Windows PowerShell - VirtualBox Host-Only Network
Select C:\WINDOWS\system32\cmd.exe
Ethernet adapter VirtualBox Host-Only Network:
Connection-specific DNS Suffix . . . . . : 
Description . . . . . : VirtualBox Host-Only Ethernet Adapter
Physical Address . . . . . : 0A-00-27-00-00-08
DHCP Enabled . . . . . : No
Autoconfiguration Enabled . . . . . : Yes
Link-local IPv6 Address . . . . . : fe80::6847:4023:d51a:bc3e%8(PREFERRED)
IPv4 Address . . . . . : 192.168.56.1(PREFERRED)
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 
DHCPv6 IAID . . . . . : 738852903
DHCPv6 Client DUID . . . . . : 00-01-00-01-22-79-C5-3F-94-C6-91-1A-88-FD
DNS Servers . . . . . : fec0:0:0:ffff::1%1
                           fec0:0:0:ffff::2%1
                           fec0:0:0:ffff::3%1
NetBIOS over Tcpip. . . . . : Enabled
Wireless LAN adapter Local Area Connection* 1:
```

Example of an IPv6 address

2001:AAAA:0000:0000:0000:1234:0001

ABY SKRÓCIĆ ADRES IP ZAMIAST ZER NP W ŚRODKU UŻYWA SIĘ PODWÓJNEGO DWUKROPKA.

POWYŻSZY ADRES IP BĘDZIE NASTĘPUJĄCY: **2001:AAAA::1234:0001**

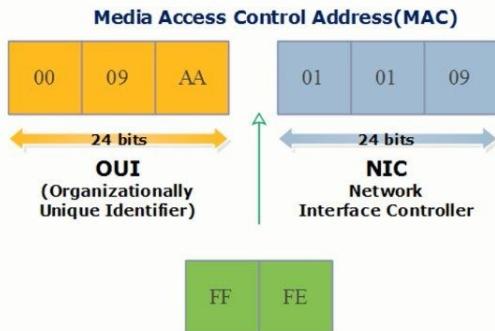
W ADRESIE MOŻNA UŻYC TYLKO RAZ SKRUTU CZYLI TYLKO JEDEN CIĄG ZNAKÓW MOŻNA ZASTAĆ SKRUTEM.

DODATKOWO ZAMIAST:0001 MOŻNA NAPISAĆ:1 - DOMYSLNI SYSTEM WSTAWIA ZERA TYLE ILE TRZEBA.

EUI-64 Bit Address

Hosts can generate their own IPv6 address using this method.

Add FFFE to the MAC address



Then, invert the 7th bit from the left
00000000 -> 00000010

00 = 02

IPv6 on a Cisco Router

To enable IPv6 globally:
ipv6 unicast-routing

IP address:

ipv6 address 2001:::1/64

OSPFv3:

*ipv6 router ospf 1
router-id 1.1.1.1
ipv6 enable
ipv6 ospf 1 area 0*

IPv6 on a Cisco Router

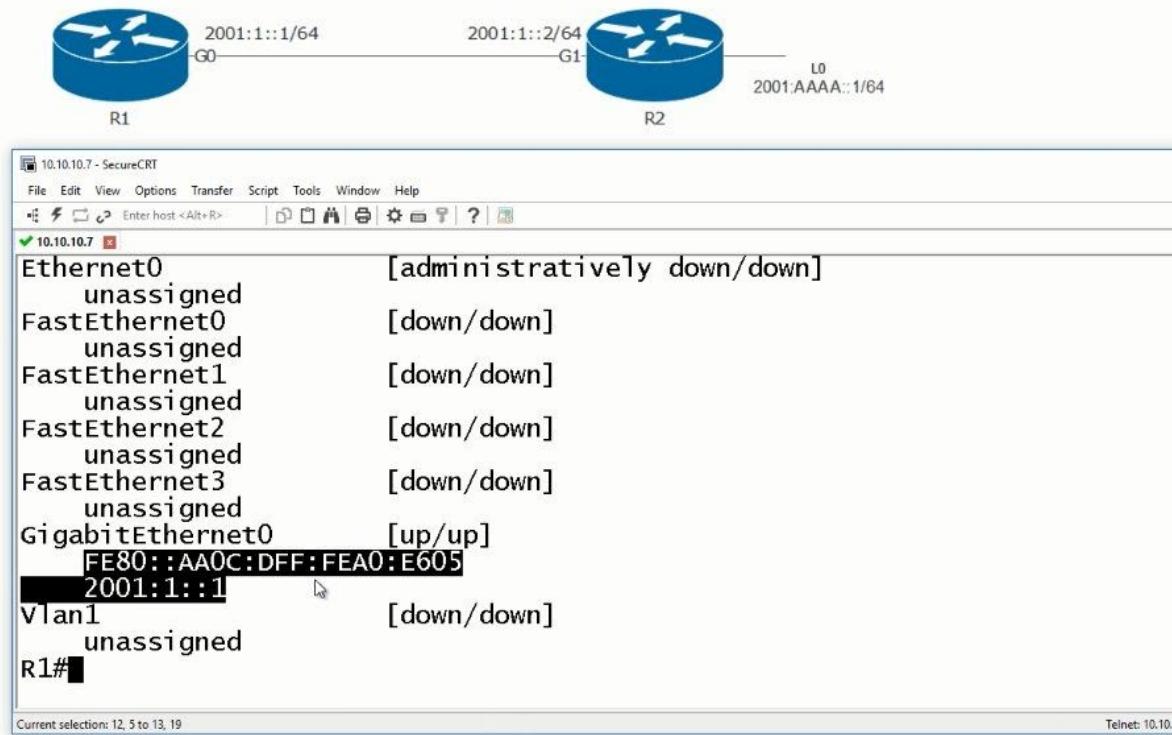


```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | | | | ? | |
10.10.10.7

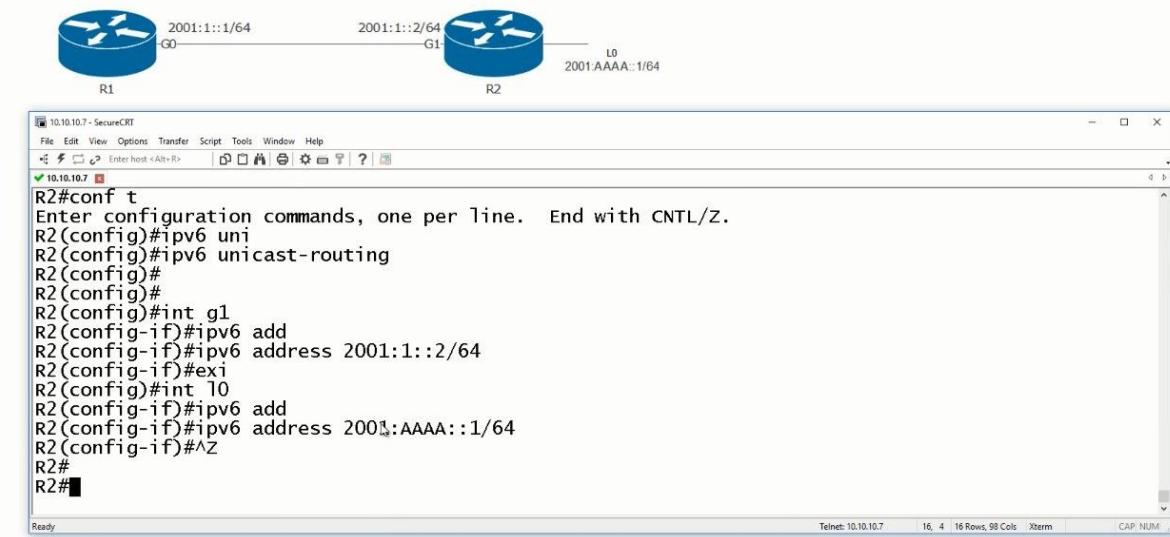
R1#
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ipv6 uni
R1(config)#ipv6 unicast-routing
R1(config)#
R1(config)#int g0
R1(config-if)#ipv6 add
R1(config-if)#ipv6 address ?
WORD          General prefix name
X:X:X:X::X    IPv6 link-local address
X:X:X:X::X/<0-128> IPv6 prefix
autoconfig     Obtain address using autoconfiguration
dhcp          Obtain a ipv6 address using dhcp
R1(config-if)#ipv6 address

Ready           Telnet: 10.10.10.7   16, 28  16 Rows, 98 Cols  Xterm  CAP NUM...
```

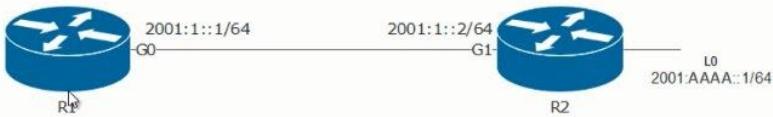
IPv6 on a Cisco Router



IPv6 on a Cisco Router



IPv6 on a Cisco Router



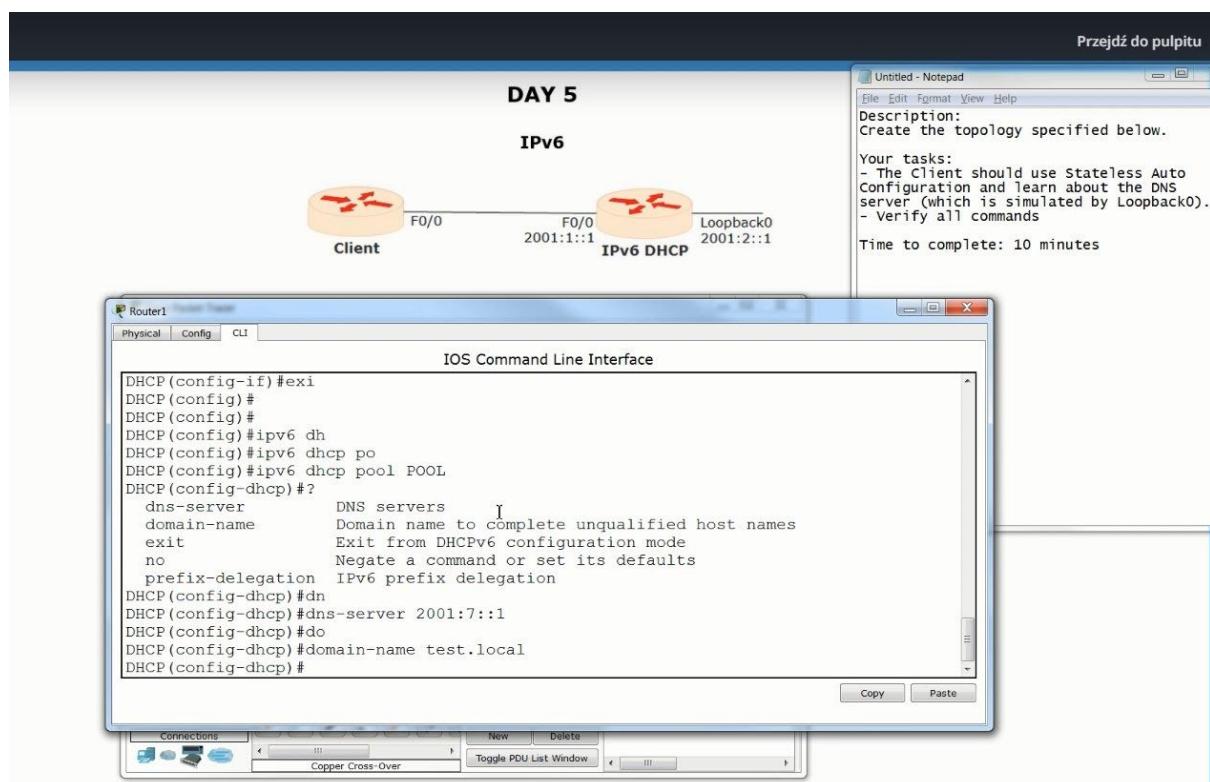
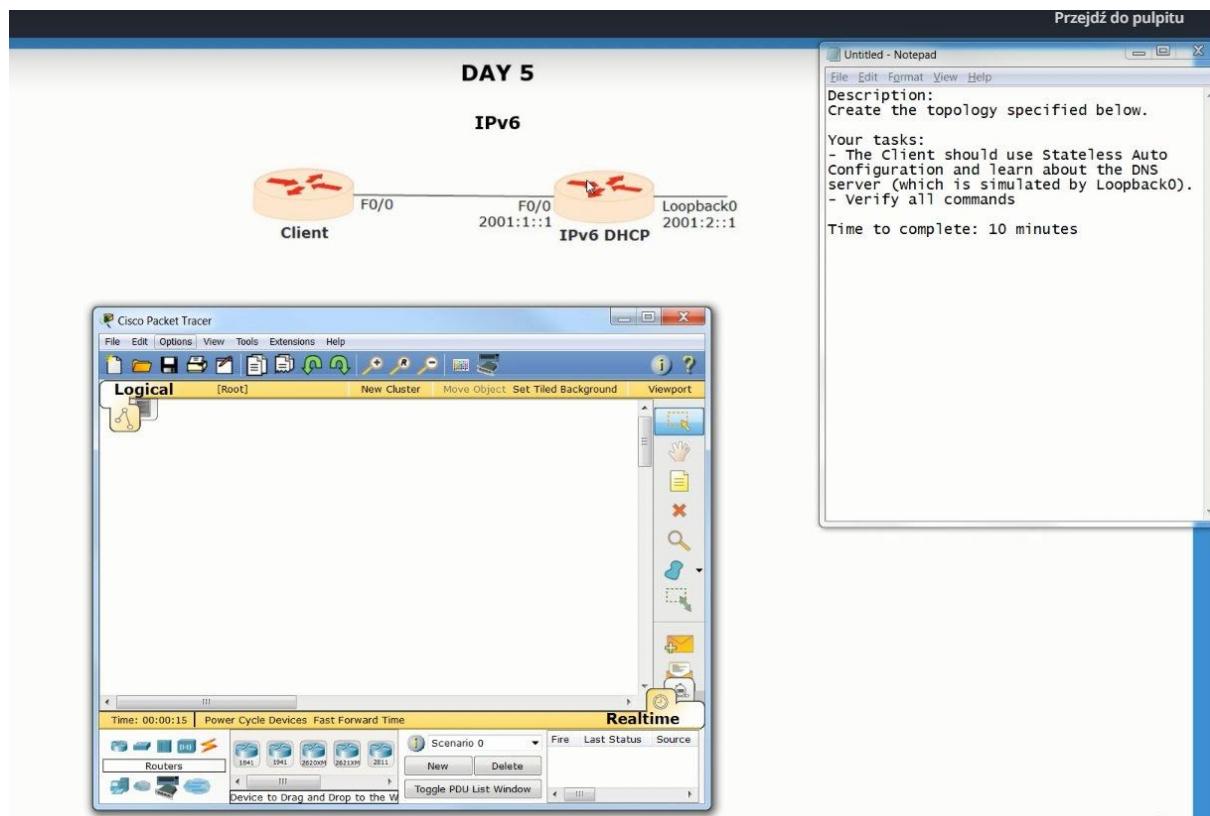
```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | P D A S T ? | 
10.10.10.7 ✘
R1#
R1#
R1#show ipv6 route
IPv6 Routing Table - default - 4 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
        R - RIP, ND - ND Default, NDp - ND Prefix, DCE - Destination
        NDr - Redirect
C  2001:1::/64 [0/0]
    via GigabitEthernet0, directly connected
L  2001:1::1/128 [0/0]
    via GigabitEthernet0, receive
S  2001:AAAA::/64 [1/0]
    via 2001:1::2
L  FF00::/8 [0/0]
    via Null0, receive
R1#ping 2001:AAAA::1█
Ready Telnet: 10.10.10.7 16
```

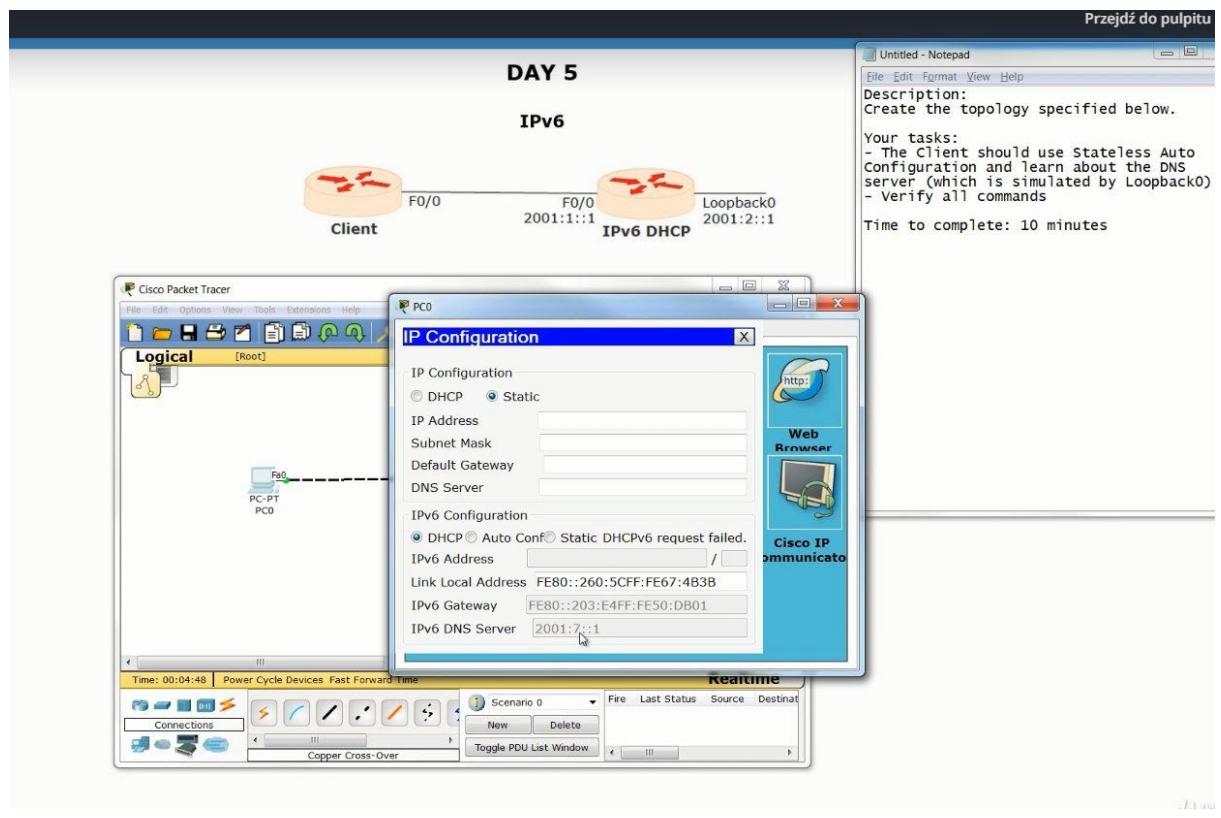
IPv6 on a Cisco Router



```
10.10.10.7 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R> | P D A S T ? | 
10.10.10.7 ✘
R1(config)#ipv6 router rip PROCRIP
R1(config-rtr)#?
default          Set a command to its defaults
distance         Administrative distance
distribute-list  Filter networks in routing updates
exit             Exit from IPv6 routing protocol configuration mode
maximum-paths   Forward packets over multiple paths
no               Negate a command or set its defaults
poison-reverse   Poison reverse updates
port             Port and multicast address
redistribute     Redistribute IPv6 prefixes from another routing protocol
split-horizon    Split horizon updates
timers           Adjust routing timers

R1(config-rtr)#
Ready Telnet: 10.10.10.7 16, 16
```



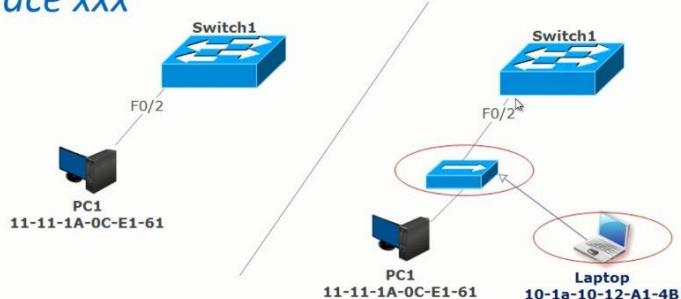


Port Security

Lock down your switch and make sure that nobody can connect a hub, SOHO router or another PC!

*switchport port-security
show port-security interface xxx*

- ✓ MAC address sticky
- ✓ Max number of MAC addresses



Port Security



Violation modes:

- ✓ Shutdown (the default option) *err-ds* X
- ✓ Protect }
 - ✓ Restrict }

Port security Violation Modes

Shutdown - port w trybie err-disabled

Protect - blokuje ramki z innych MAC adresow

Restrict - jak Protect a dodatkowo generuje informacje SYSLOG