

BAB 3: KONSEP ROUTING

Routing & Switching

BAB 3

- 3.0 Konsep Routing
- 3.1 Konfigurasi Router
- 3.2 Penentuan Routing
- 3.3 Pengoperasian Router
- 3.4 Kesimpulan

BAB 3 : TUJUAN

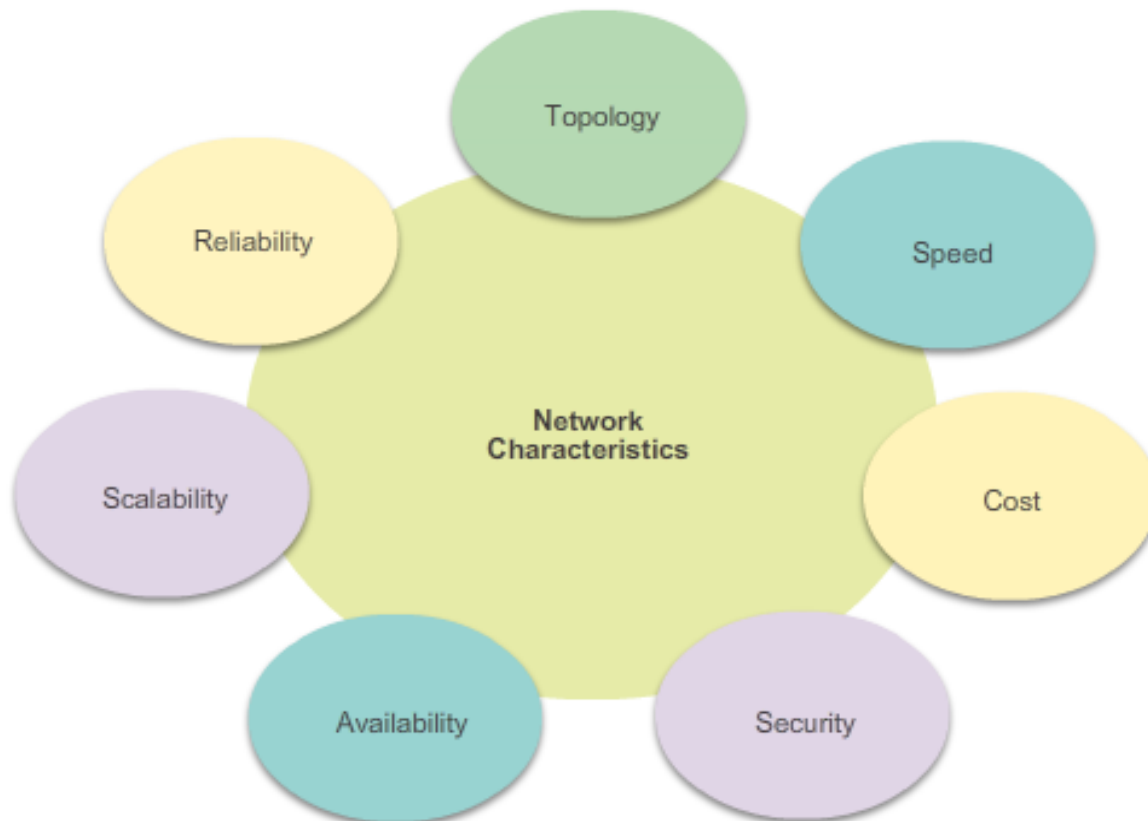
- Configure a router to route between multiple directly connected networks
- Describe the primary functions and features of a router.
- Explain how routers use information in data packets to make forwarding decisions in a small- to medium-sized business network.
- Explain the encapsulation and de-encapsulation process used by routers when switching packets between interfaces.
- Compare ways in which a router builds a routing table when operating in a small- to medium-sized business network.
- Explain routing table entries for directly connected networks.
- Explain how a router builds a routing table of directly connected networks.

BAB 3: TUJUAN (CONT.)

- Explain how a router builds a routing table using static routes.
- Explain how a router builds a routing table using a dynamic routing protocol.

KARAKTERISTIK JARINGAN

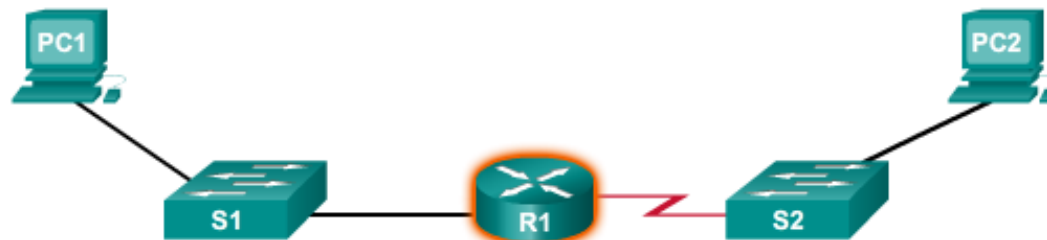
Network Characteristics



KENAPA ROUTING?

Router bertanggung jawab untuk routing trafik antar jaringan.

Routers Route Packets



```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, Serial0/0
```

Cisco IOS command line interface (CLI) can be used to view the route table.

ROUTER ITU ADALAH KOMPUTER

Router adalah komputer khusus yang memiliki komponen yang diperlukan untuk menjalankan tugasnya yaitu routing

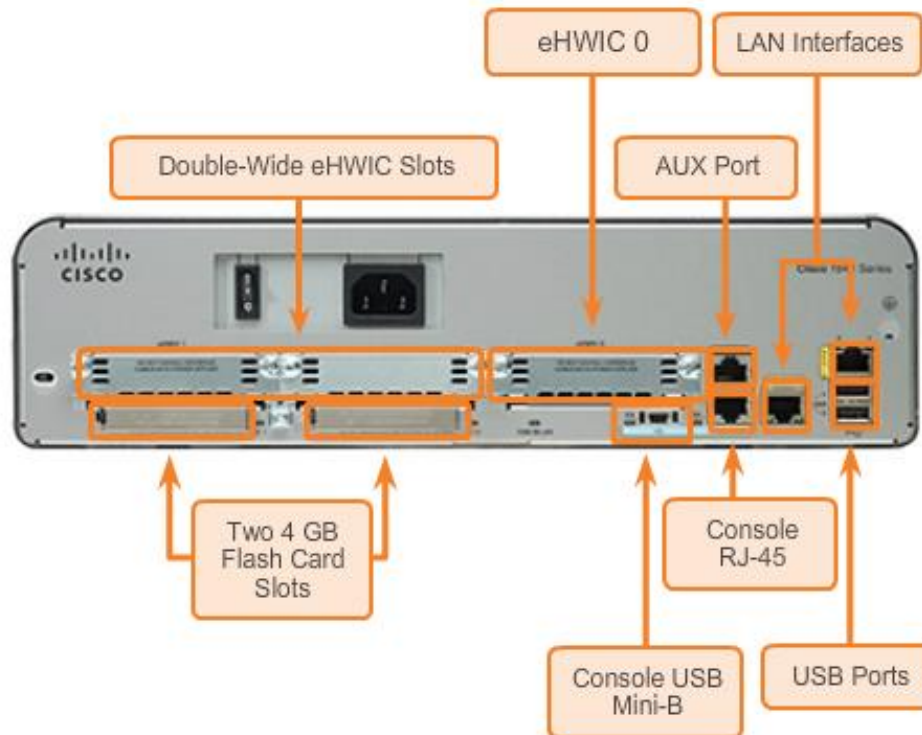
- Central processing unit (CPU)
- Operating system (OS) - Routers use Cisco IOS
- Memory and storage (RAM, ROM, NVRAM, Flash, hard drive)

Memory	Volatile / Non-Volatile	Stores
RAM	Volatile	<ul style="list-style-type: none"> • Running IOS • Running configuration file • IP routing and ARP tables • Packet buffer
ROM	Non-Volatile	<ul style="list-style-type: none"> • Bootup instructions • Basic diagnostic software • Limited IOS
NVRAM	Non-Volatile	<ul style="list-style-type: none"> • Startup configuration file
Flash	Non-Volatile	<ul style="list-style-type: none"> • IOS • Other system files

ROUTER ITU ADALAH KOMPUTER

Router menggunakan port khusus dan network interface cards (NIC) untuk menghubungkan ke jaringan lain.

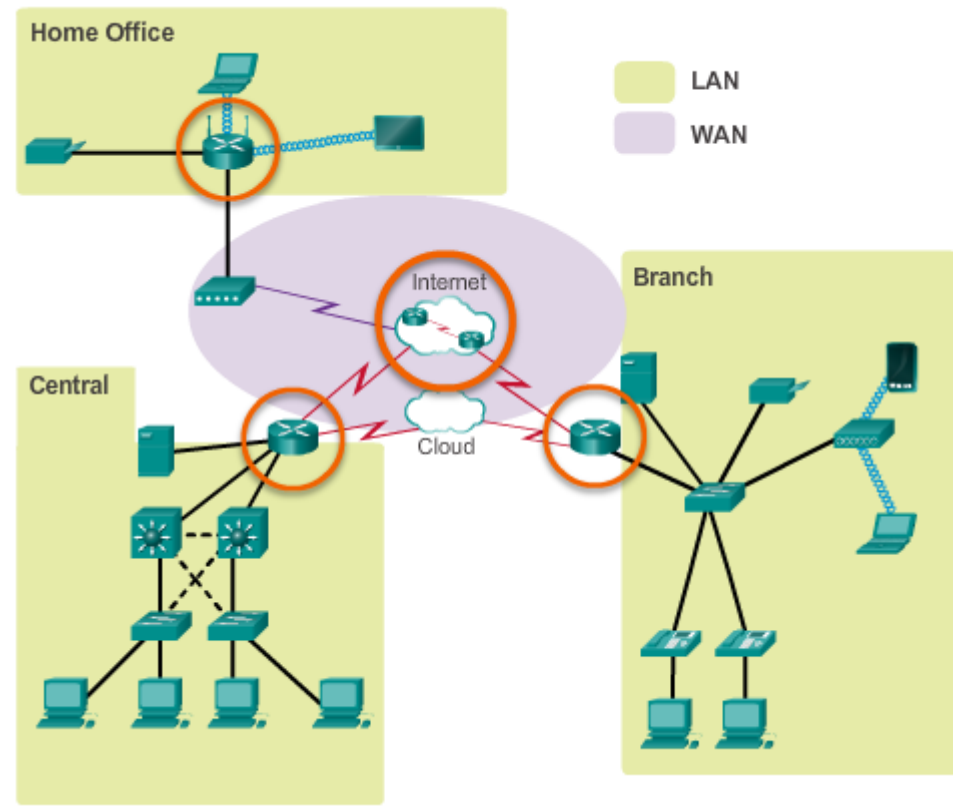
Back Panel of a Router



FUNCTIONS OF A ROUTER

ROUTER PENGHUBUNG JARINGAN

- Router dapat menghubungkan banyak jaringan.
- Router memiliki banyak interface, masing2 interface memiliki IP jaringan yang berbeda.



ROUTER MEMILIH JALUR YANG TERBAIK

- Router menggunakan protokol statik routing dan dinamik routing untuk mempelajari dan membangun tentang routing tabel
- Router menggunakan tabel routing untuk menentukan jalur terbaik untuk mengirim paket
- Router mengenkapsulasi paket dan memforward nya ke interface yang di tuju sesuai dengan tabel routing nya

ROUTER MEMILIH JALUR TERBAIK

How the Router Works



```
R1#show ip route
```

```
Codes:
```

```
C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - OER
P - periodic downloaded static route
```

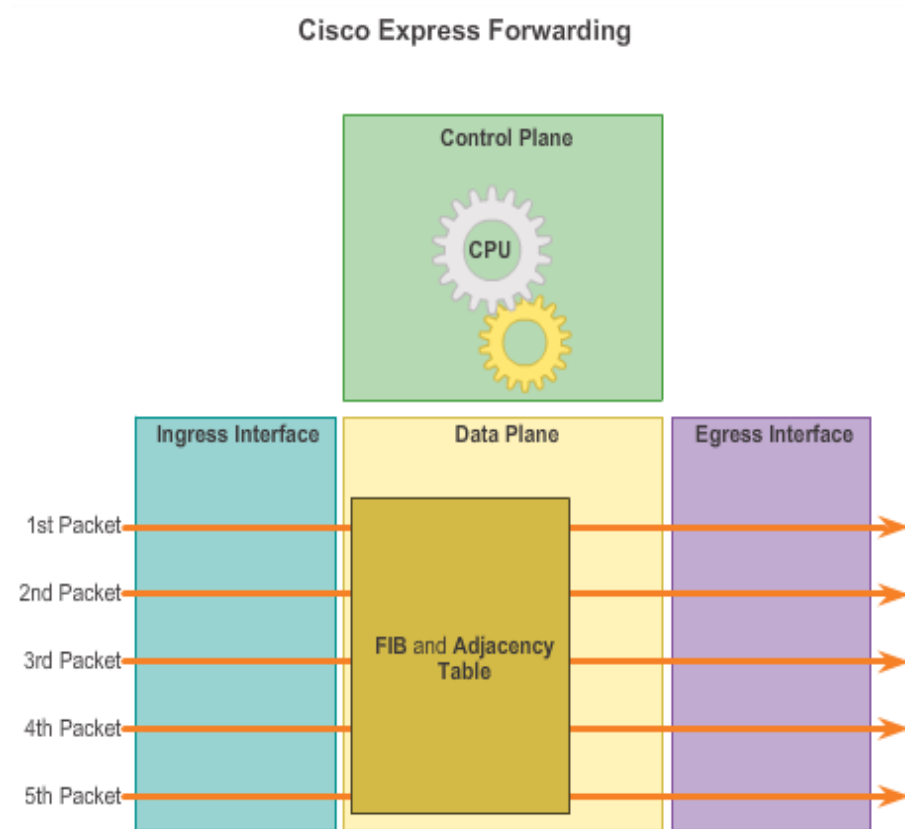
```
Gateway of last resort is not set
```

```
C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.2.0/24 is directly connected, Serial0/0/0
S 192.168.3.0/24 is directly connected, Serial0/0/0
```

Routers use the routing table like a map to discover the best path for a given network.

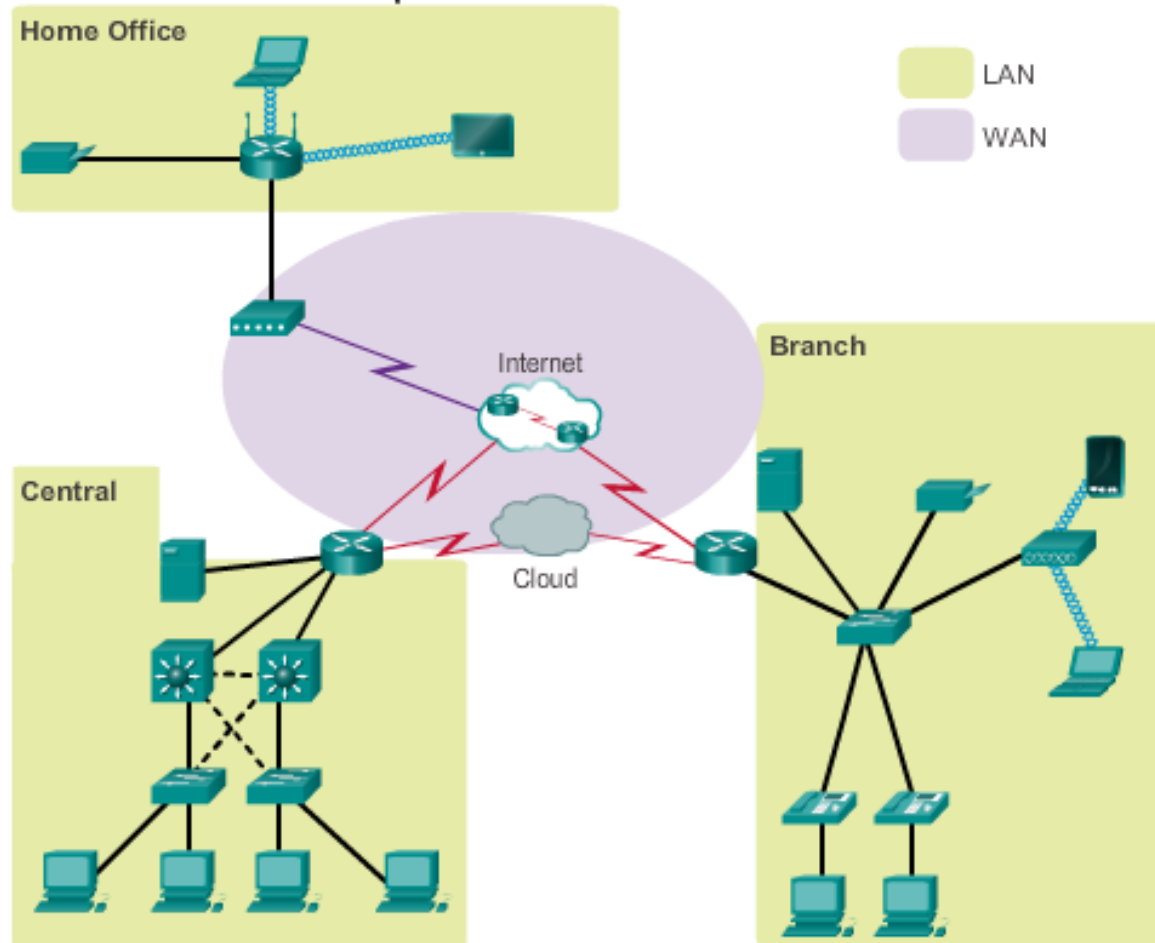
METODE MEMFORWARD PAKET

- **Process switching** –metode memforward paket yang sudah tua tetapi masih tersedia untuk router cisco.
- **Fast switching** – Metode memforward paket yang umum yang menggunakan chace switching untuk menyimpan informasi hop berikutnya.
- **Cisco Express Forwarding (CEF)** – Yang paling baru, lebih cepat, lebih di sukai IOS cisco.



PENGHUBUNG KE JARINGAN

Sample LAN and WAN Connections

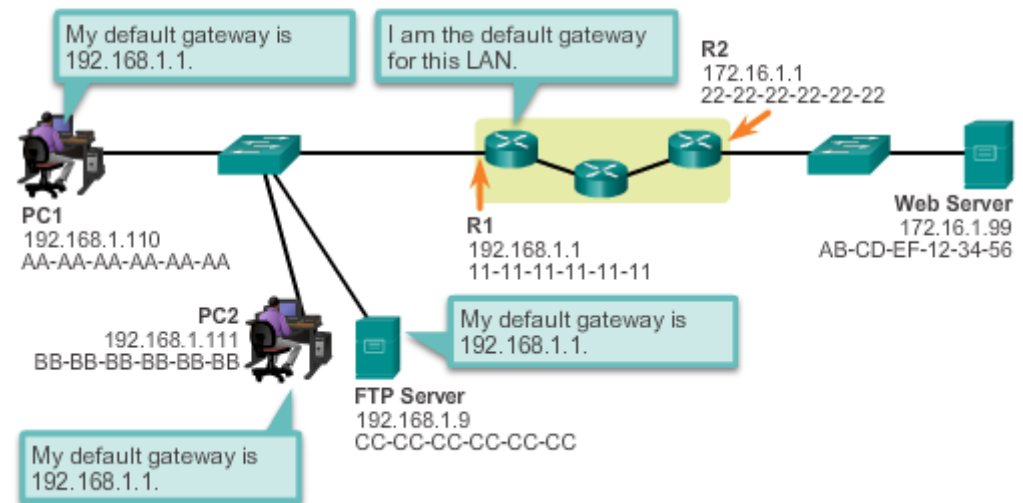


DEFAULT GATEWAYS

Untuk mengaktifkan perangkat akses jaringan hal yang harus dikonfigurasi adalah sebagai berikut:

- **IP address** - Mengidentifikasi alamat host.
- **Subnet mask** - mengidentifikasi alamat jaringan host.
- **Default gateway** - mengidentifikasi router paket ke tujuan yang berbeda jaringan

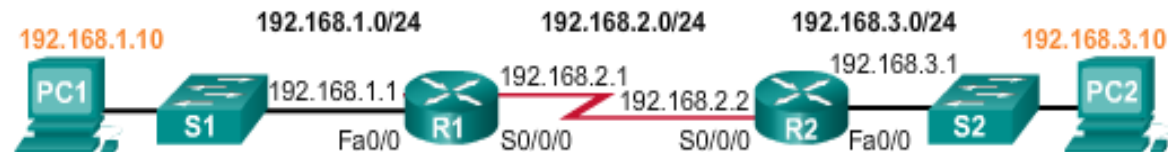
Destination MAC Address	Source MAC Address	Source IP Address	Destination MAC Address	Data
11-11-11-11-11-11	AA-AA-AA-AA-AA-AA	192.168.1.110	172.16.1.99	



DOKUMEN ALAMAT JARINGAN

Dokumentasi jaringan harus mencakup setidaknya ada:

- Nama Interface
- Interfaces
- IP address dan subnet mask
- Default gateways



Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	192.168.2.1	255.255.255.0	N/A
R2	Fa0/0	192.168.3.1	255.255.255.0	N/A
	S0/0/0	192.168.2.2	255.255.255.0	N/A
PC1	N/A	192.168.1.10	255.255.255.0	192.168.1.1
PC2	N/A	192.168.3.10	255.255.255.0	192.168.3.1

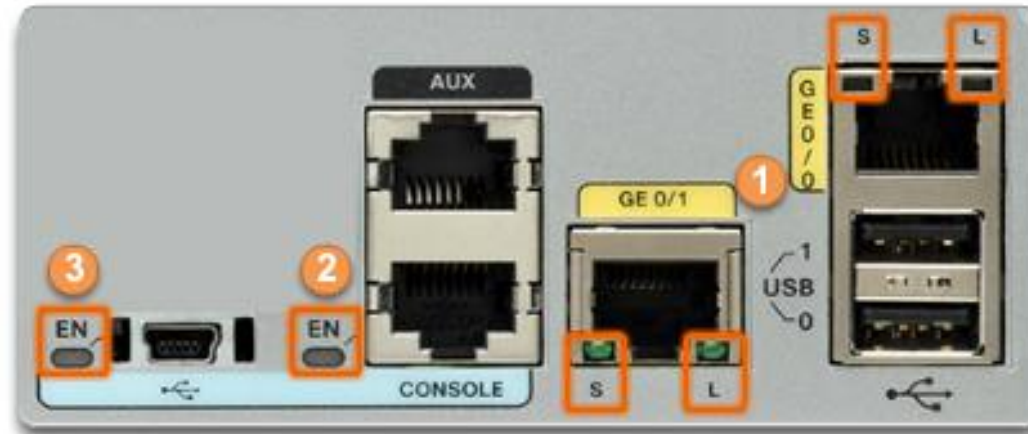
ENABLE IP DI HOST

Alamat IP Statik – Host diberikan IP secara manual, subnet mask dan default gateway. Alamat IP Server DNS dapat juga di masukan secara manual.

Alamat IP dinamis – Informasi Alamat IP diberikan secara dinamik oleh server menggunakan DHCP

DEVICE LEDS

CISCO 1941 LEDs



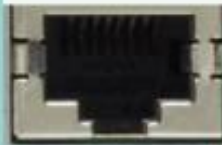










#	Port	LED	Color	Description
1	GE0/0 and GE0/1	S (Speed)	1 blink + pause	Port operating at 10 Mb/s
			2 blink + pause	Port operating at 100 Mb/s
			3 blink + pause	Port operating at 1000 Mb/s
		L (Link)	Green	Link is active
			Off	Link is inactive
2	Console	EN	Green	Port is active
			Off	Port is inactive
3	USB	EN	Green	Port is active
			Off	Port is inactive

AKSES CONSOLE

Akses Console membutuhkan:

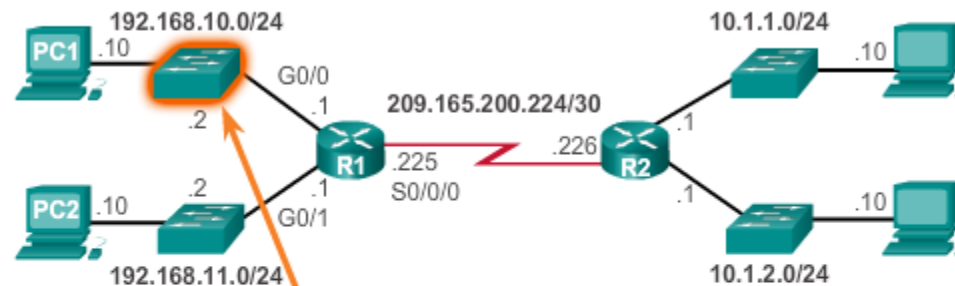
- Console cable – RJ-45-to-DB-9 console cable
- Terminal emulation software – Tera Term, PuTTY, HyperTerminal

Port on Computer	Cable Required	Port on ISR	Terminal Emulation
 Serial Port	 Console Cable	 RJ45 Console Port	 Tera Term
 USB Type-A Port	 USB-to-RS-232 Serial Port Adapter	 RJ45 Console Port	 PuTTY
	 Console Cable	 USB Type-B (Mini-B USB) Console Port	
	 USB Type-A to USB Type-B (Mini-B) Cable		

ENABLE IP DI SWITCH

- Infrastruktur perangkat jaringan membutuhkan IP address untuk memungkinkan remote management.
- Di switch, manajemen IP address di assigned di virtual interface.

Configure the Switch Management Interface



```

S1(config)#interface vlan 1
S1(config-if)#ip address 192.168.10.2 255.255.255.0
S1(config-if)#no shutdown
%LINK-5-CHANGED: Interface Vlan1, changed state to up
S1(config-if)#exit
S1(config)#
S1(config)#ip default-gateway 192.168.10.1
S1(config)#
    
```

SETTING KONFIGURASI DASAR ROUTER

Tugas dasar yang pertama harus di konfigur di Cisco Router dan Cisco Switch:

- **Name the device** – Untuk membedakan dengan router yang lainnya
- **Secure management access** – amankan privileged EXEC, user EXEC, dan Telnet access, dan encrypts passwords

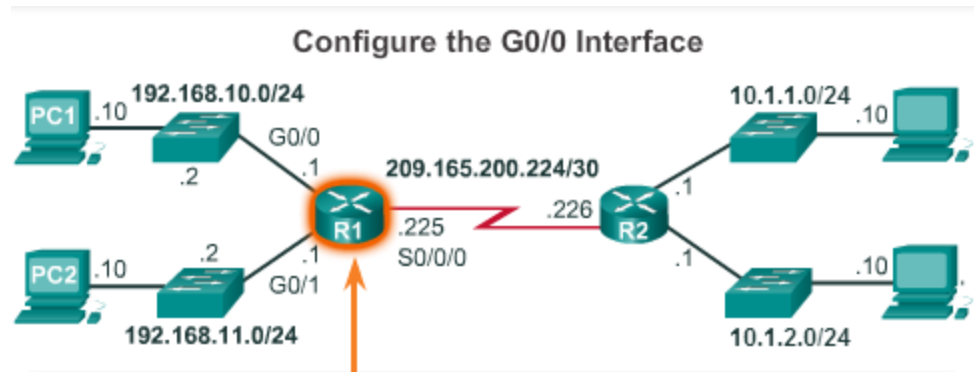
```
R1(config)#enable secret class
R1(config)#
R1(config)#line console 0
R1(config-line)#password cisco
R1(config-line)#login
R1(config-line)#exit
R1(config)#
R1(config)#line vty 0 4
R1(config-line)#password cisco
R1(config-line)#login
R1(config-line)#exit
R1(config)#
R1(config)#service password-encryption
R1(config)#
```

- **Configure a banner** – untuk menginformasikan yang berhak akses
- **Save the Configuration**

KONFIGURASI IPV4 ROUTER INTERFACE

Agar tersedia, sebuah router interface harus :

- Konfigur dengan IP address dan subnet mask .
- Harus di aktifasi dengan perintah no shutdown command. Defaultnya interface LAN dan WAN tidak aktif.
- Kabel Serial dan label DCE harus di konfigur dengan clock rate command.
- Optional description dapat di konfigur juga.



```

R1(config)#interface gigabitethernet 0/0
R1(config-if)#description Link to LAN 1
R1(config-if)#ip address 192.168.10.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#
*Jan 30 22:04:47.551: %LINK-3-UPDOWN: Interface
GigabitEthernet0/0, changed state to down
R1(config)#
*Jan 30 22:04:50.899: %LINK-3-UPDOWN: Interface
GigabitEthernet0/0, changed state to up
*Jan 30 22:04:51.899: %LINEPROTO-5-UPDOWN: Line protocol on
Interface GigabitEthernet0/0, changed state to up
R1(config)#
    
```

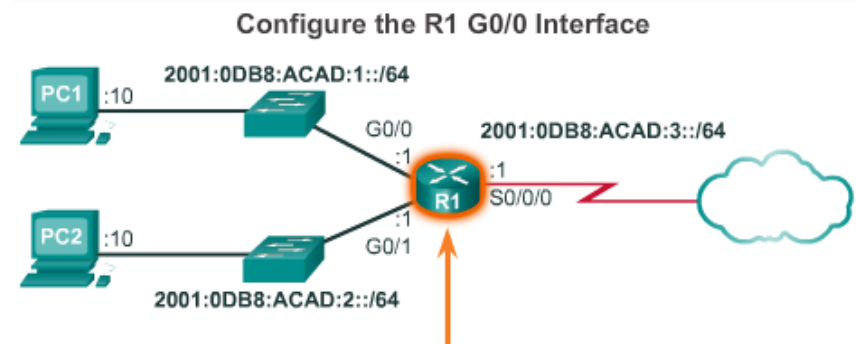
KONFIGURASI IPV6 ROUTER INTERFACE

To configure interface with IPv6 address and subnet mask:

- Use the ipv6 address *ipv6-address/ipv6-length* [link-local | eui-64] interface configuration command.
- Activate using the no shutdown command.

IPv6 interfaces can support more than one address:

- Configure a specified global unicast - *ipv6-address /ipv6-length*
- Configure a global IPv6 address with an interface identifier (ID) in the low-order 64 bits - *ipv6-address /ipv6-length eui-64*
- Configure a link-local address - *ipv6-address /ipv6-length link-local*



```

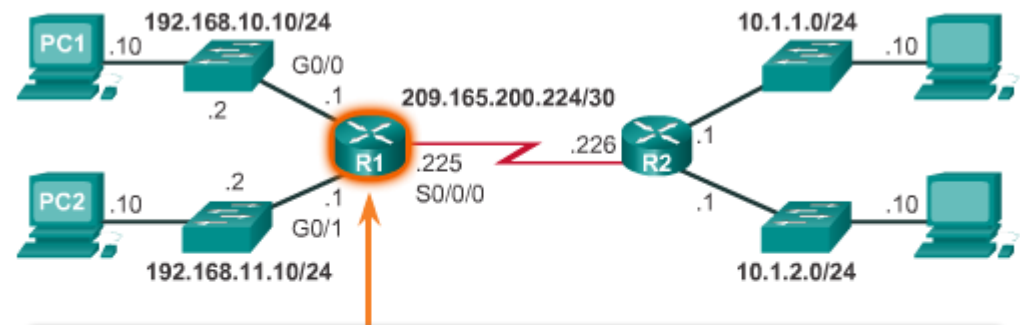
R1 (config)#interface gigabitethernet 0/0
R1 (config-if)#description Link to LAN 1
R1 (config-if)#ipv6 address 2001:db8:acad:1::1/64
R1 (config-if)#no shutdown
R1 (config-if)#exit
R1 (config)#
*Feb 3 21:38:37.279: %LINK-3-UPDOWN: Interface
GigabitEthernet0/0, changed state to down
*Feb 3 21:38:40.967: %LINK-3-UPDOWN: Interface
GigabitEthernet0/0, changed state to up
*Feb 3 21:38:41.967: %LINEPROTO-5-UPDOWN: Line protocol on
Interface GigabitEthernet0/0, changed state to up
R1 (config)#
    
```

KONFIGURASI A LOOPBACK INTERFACE

A loopback interface is a logical interface that is internal to the router:

- It is not assigned to a physical port, it is considered a software interface that is automatically in an UP state.
- A loopback interface is useful for testing.
- It is important in the OSPF routing process.

Configure the Loopback0 Interface



```

R2 (config)#interface loopback 0
R2 (config-if)#ip address 10.0.0.1 255.255.255.0
R2 (config-if)#exit
R1 (config)#
*Jan 30 22:04:50.899: %LINK-3-UPDOWN: Interface loopback0,
changed state to up
*Jan 30 22:04:51.899: %LINEPROTO-5-UPDOWN: Line protocol on
Interface loopback0, changed state to up
    
```


VERIFY CONNECTIVITY OF DIRECTLY CONNECTED NETWORKS

VERIFIKASI PENGATURAN INTERFACE

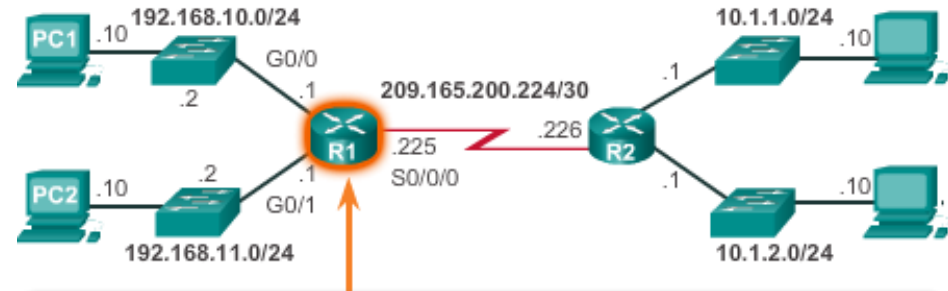
Show commands digunakan untuk memverifikasi operation dan konfigurasi dari interface:

- **show ip interfaces brief**
- **show ip route**
- **show running-config**

Show commands digunakan untuk mengumpulkan informasi interface yang lebih detail:

- **show interfaces**
- **show ip interfaces**

Verify the Routing Table



```

R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - m
<output omitted.

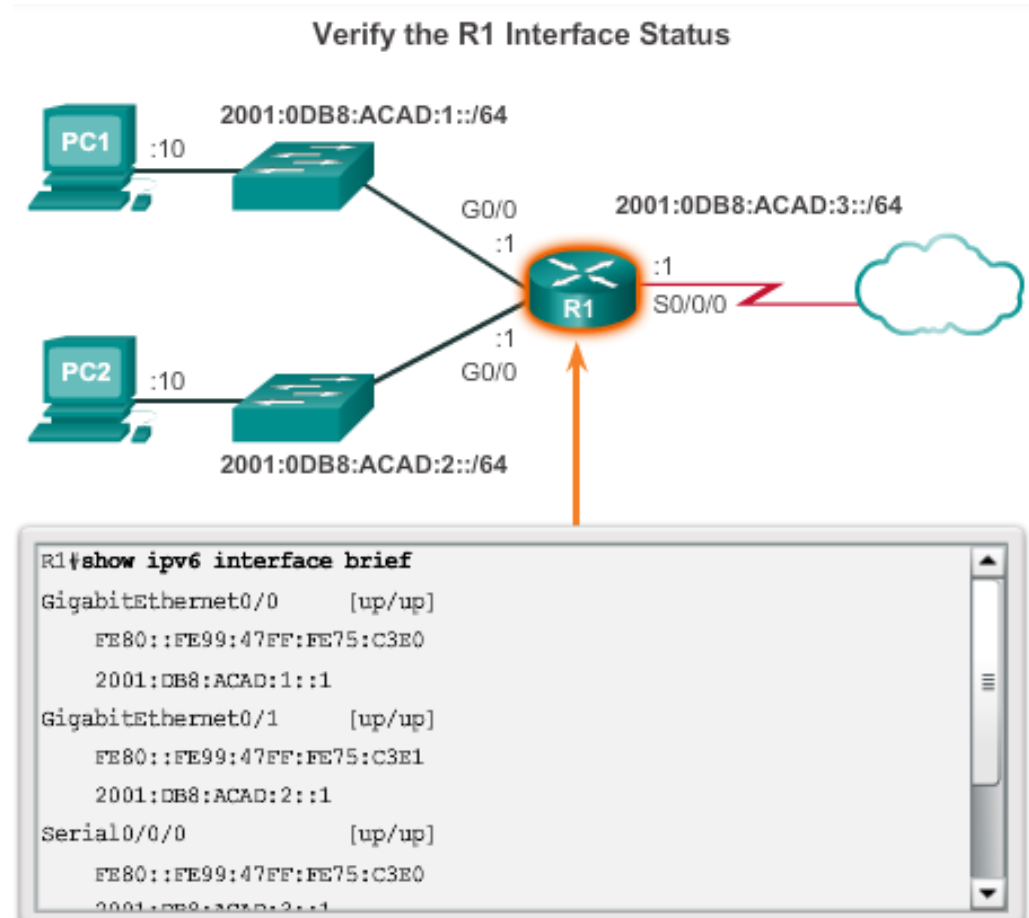
Gateway of last resort is not set

    192.168.10.0/24 is variably subnetted, 2 subnets, 2 ma
C       192.168.10.0/24 is directly connected, GigabitEther
L       192.168.10.1/32 is directly connected, GigabitEther
    192.168.11.0/24 is variably subnetted, 2 subnets, 2 ma
C       192.168.11.0/24 is directly connected, GigabitEther
L       192.168.11.1/32 is directly connected, GigabitEther
    209.165.200.0/24 is variably subnetted, 2 subnets, 2 m
  
```

VERIFIKASI PENGATURAN INTERFACE

Beberapa commands yang umum digunakan untuk memverifikasi konfigurasi interface IPv6

- **show ipv6 interface brief** - displays a summary for each of the interfaces.
- **show ipv6 interface gigabitethernet 0/0** - displays the interface status and all the IPv6 addresses for this interface.
- **show ipv6 route** - verifies that IPv6 networks and specific IPv6 interface addresses have been installed in the IPv6 routing table.



FILTER SHOW COMMAND OUTPUT

Show command output can be managed using the following command and filters:

- Use the **terminal length number** command to specify the number of lines to be displayed. A value of 0 (zero) prevents the router from pausing between screens of output.
- To filter specific output of commands use the **(|)pipe character** after show command. Parameters that can be used after pipe include:
 - **section, include, exclude, begin**

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status
Embedded-Service-Engine0/0 unassigned      YES unset  administr
GigabitEthernet0/0 192.168.10.1    YES manual  up
GigabitEthernet0/1 192.168.11.1    YES manual  up
Serial0/0/0         209.165.200.225 YES manual  up
Serial0/0/1         unassigned      YES unset  administr

R1#show ip interface brief | exclude unassigned
Interface          IP-Address      OK? Method Status
GigabitEthernet0/0 192.168.10.1    YES manual  up
GigabitEthernet0/1 192.168.11.1    YES manual  up
Serial0/0/0         209.165.200.225 YES manual  up
```

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status
Embedded-Service-Engine0/0 unassigned      YES unset  administr
GigabitEthernet0/0 192.168.10.1    YES manual  up
GigabitEthernet0/1 192.168.11.1    YES manual  up
Serial0/0/0         209.165.200.225 YES manual  up
Serial0/0/1         unassigned      YES unset  administr
R1#
R1#show ip interface brief | include up
GigabitEthernet0/0 192.168.10.1    YES manual  up
GigabitEthernet0/1 192.168.11.1    YES manual  up
Serial0/0/0         209.165.200.225 YES manual  up
R1#
```

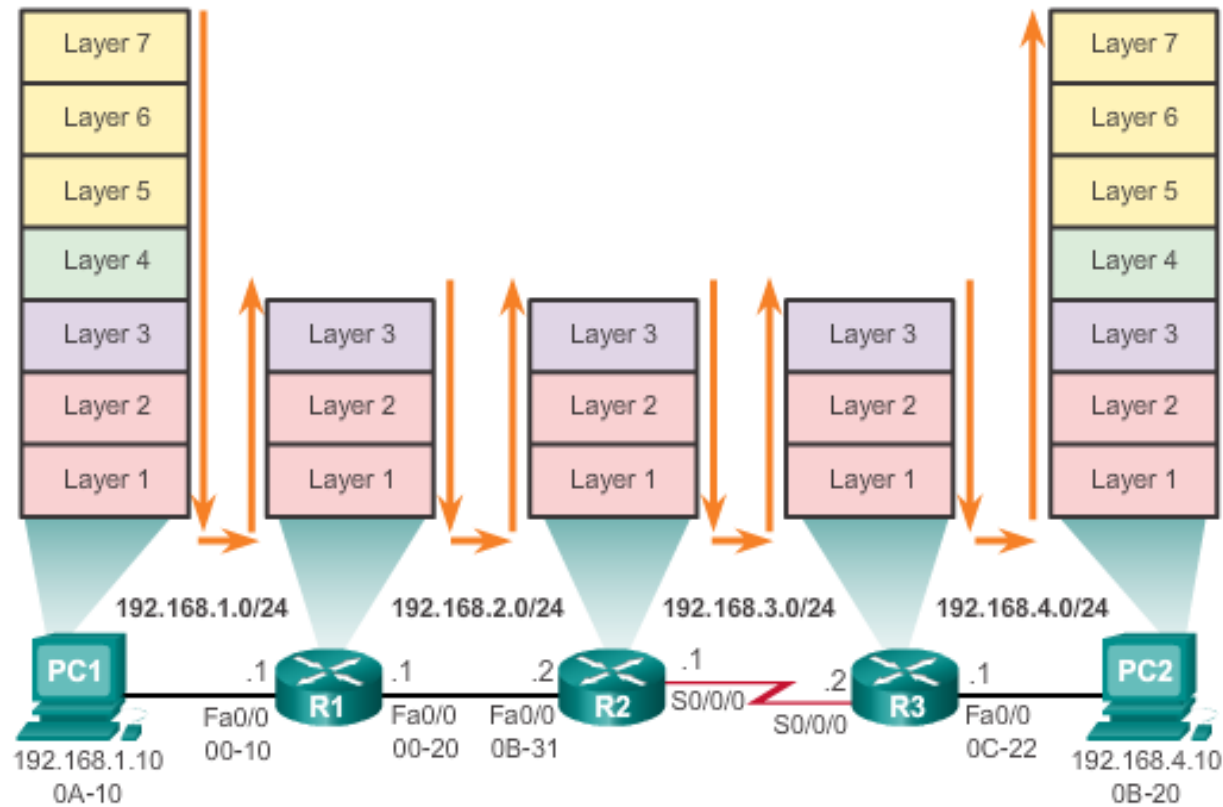
COMMAND HISTORY FEATURE

The command history feature temporarily stores a list of executed commands for access:

- To recall commands press **Ctrl+P** or the **UP Arrow**.
- To return to more recent commands press **Ctrl+N** or the **Down Arrow**.
- By default, command history is enabled and the system captures the last 10 commands in the buffer. Use the **show history** privileged EXEC command to display the buffer contents.
- Use the **terminal history size** user EXEC command to increase or decrease size of the buffer.

FUNGSI ROUTER SWITCHING

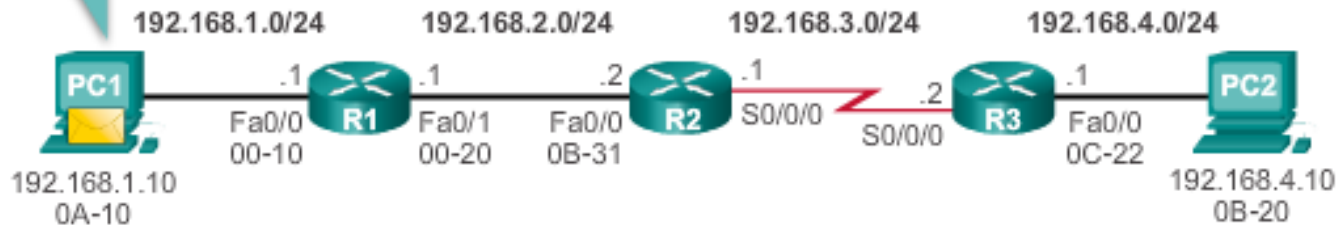
Encapsulating and De-Encapsulating Packets



PENGIRIMAN SEBUAH PAKET

PC1 Sends a Packet to PC2

Because PC2 is on different network, I will encapsulate the packet and send it to the router on MY network. Let me find that MAC address....



Layer 2 Data Link Frame

Packet's Layer 3 data

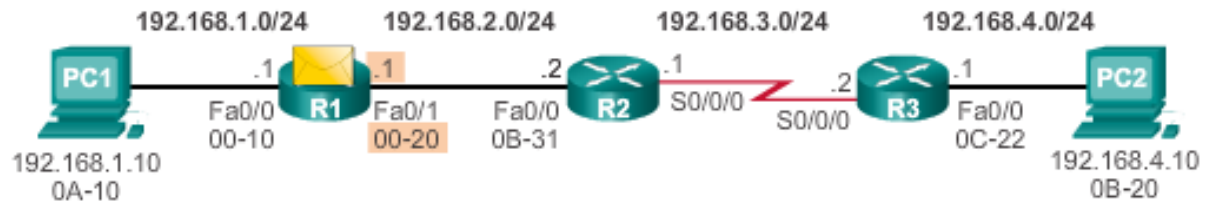
Dest. MAC 00-10	Source MAC 0A-10	Type 800	Source IP 192.168.1.10	Dest. IP 192.168.4.10	IP fields	Data	Trailer
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PC1's ARP Cache for R1

IP Address	MAC Address
192.168.1.1	00-10

FORWARD KE HOP BERIKUTNYA

R3 Forwards the Packet to PC2



Layer 2 Data Link Frame

Packet's Layer 3 data

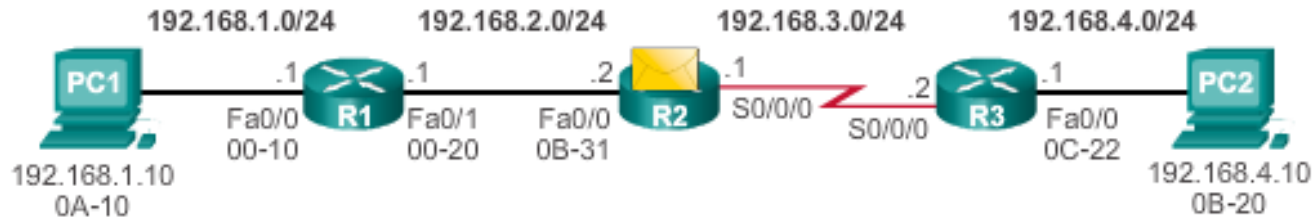
Dest. MAC 0B-31	Source MAC 00-20	Type 800	Source IP 192.168.1.10	Dest. IP 192.168.4.10	IP fields	Data	Trailer
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R1's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	0	Dir. Connect.	Fa0/0
192.168.2.0/24	0	Dir. Connect.	Fa0/1
192.168.3.0/24	1	192.168.2.2	Fa0/1
192.168.4.0/24	2	192.168.2.2	Fa0/1

PAKET ROUTING

R2 Forwards the Packet to R3



Layer 2 Data Link Frame

Packet's Layer 3 data

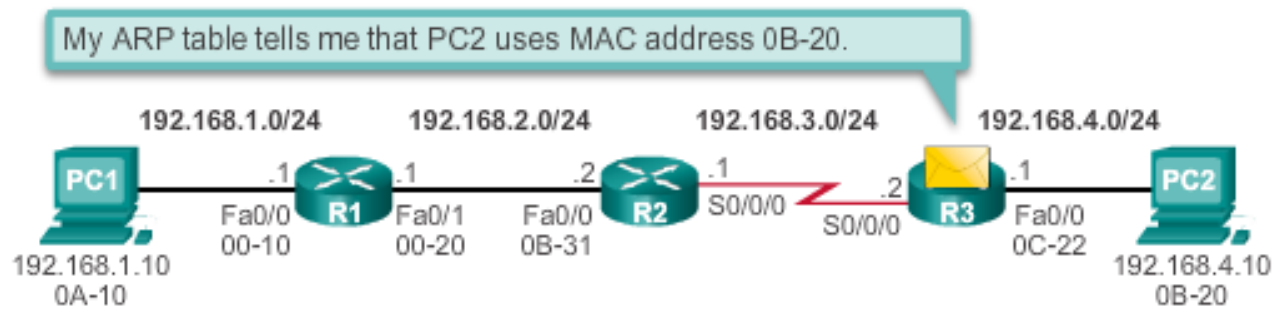
Address 0x8F	Control 0x00	Type 800	Source IP 192.168.1.10	Dest. IP 192.168.4.10	IP fields	Data	Trailer
-----------------	-----------------	----------	---------------------------	--------------------------	-----------	------	---------

R2's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	1	192.168.3.1	Fa0/0
192.168.2.0/24	0	Dir. Connect.	Fa0/0
192.168.3.0/24	0	Dir. Connect.	S0/0/0
192.168.4.0/24	1	192.162.3.2	S0/0/0

MENCARI TUJUAN

R3 Forwards the Packet to PC2



Layer 2 Data Link Frame

Dest. MAC 0B-20	Source MAC 0C-22	Type 800	Source IP 192.168.1.10	Dest. IP 192.168.4.10	IP fields	Data	Trailer
--------------------	---------------------	----------	---------------------------	--------------------------	-----------	------	---------

Packet's Layer 3 data

R3's ARP Cache

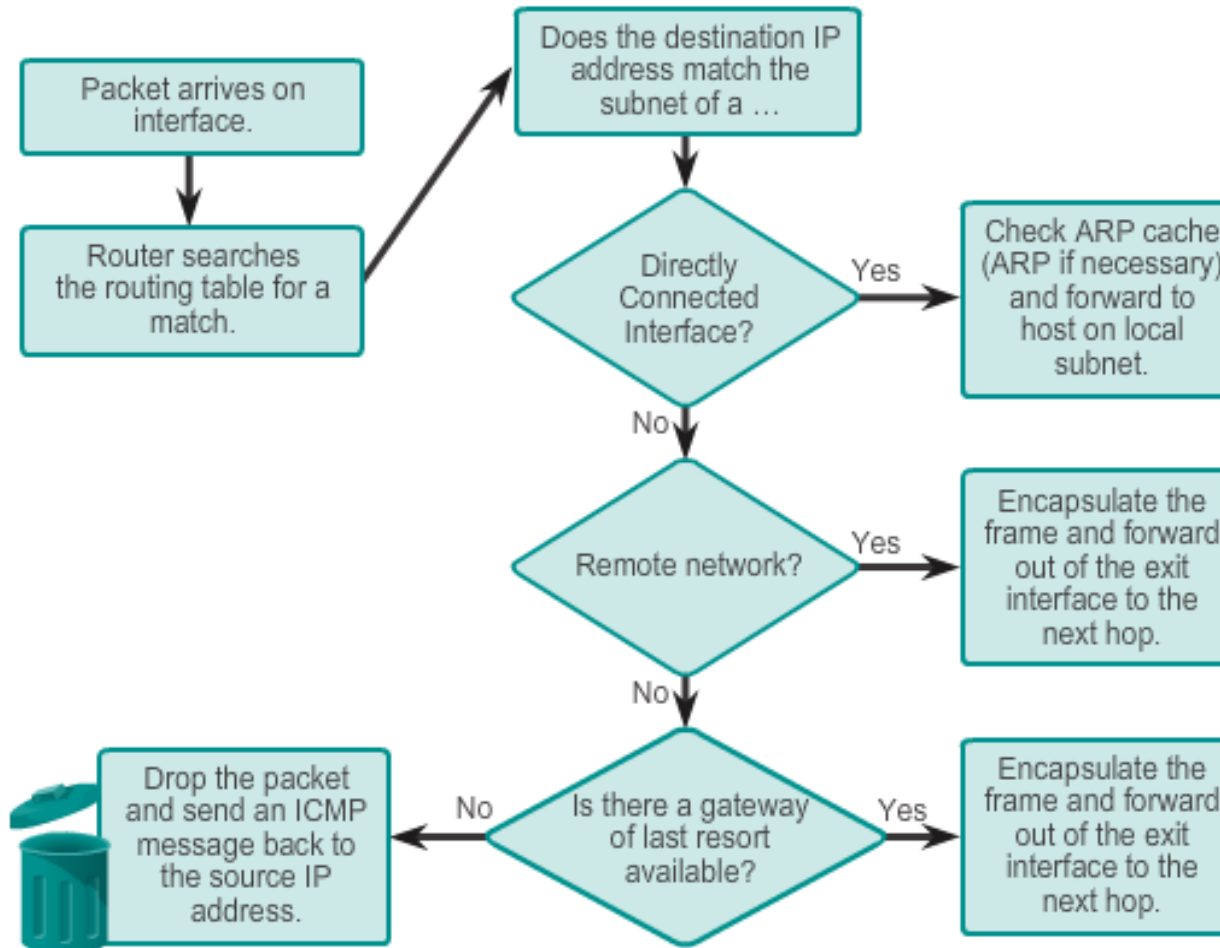
IP Address	MAC Address
192.168.4.10	0B-20

R3's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24v	2	192.168.3.1	S0/0/0
192.168.2.0/24	1	192.162.3.1	S0/0/0
192.168.3.0/24	0	Dir. Connect.	S0/0/0
192.168.4.0/24	0	Dir. Connect.	Fa0/0

KEPUTUSAN ROUTING

Packet Forwarding Decision Process



Best path is selected by a routing protocol based on the value or metric it uses to determine the distance to reach a network:

- A metric is the value used to measure the distance to a given network.
- Best path to a network is the path with the lowest metric.

Dynamic routing protocols use their own rules and metrics to build and update routing tables:

- Routing Information Protocol (RIP) - Hop count
- Open Shortest Path First (OSPF) - Cost based on cumulative bandwidth from source to destination
- Enhanced Interior Gateway Routing Protocol (EIGRP) - Bandwidth, delay, load, reliability

PENYEIMBANG BEBAN

When a router has two or more paths to a destination with equal cost metrics, then the router forwards the packets using both paths equally:

- Equal cost load balancing can improve network performance.
- Equal cost load balancing can be configured to use both dynamic routing protocols and static routes.
- RIP, OSPF and EIGRP support equal cost load balancing.

ADMINISTRATIVE DISTANCE

If multiple paths to a destination are configured on a router, the path installed in the routing table is the one with the lowest Administrative Distance (AD):

- A static route with an AD of 1 is more reliable than an EIGRP-discovered route with an AD of 90.
- A directly connected route with an AD of 0 is more reliable than a static route with an AD of 1.

Default Administrative Distances

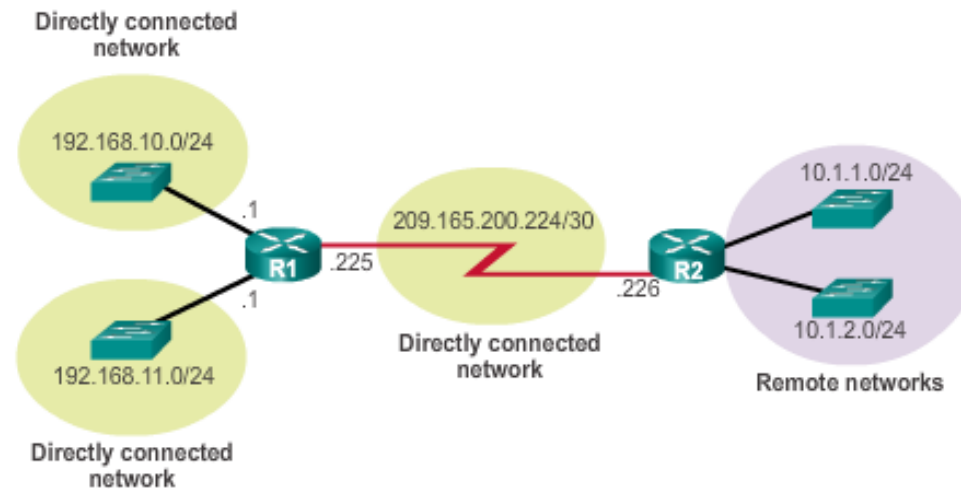
Route Source	Administrative Distance
Connected	0
Static	1
EIGRP summary route	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
IS-IS	115
External EIGRP	170
Internal BGP	200

THE ROUTING TABLE

TABEL ROUTING

Tabel routing adalah file yang disimpan di RAM yang mengandung informasi tentang :

- Directly connected routes
- Remote routes
- Network or next hop associations



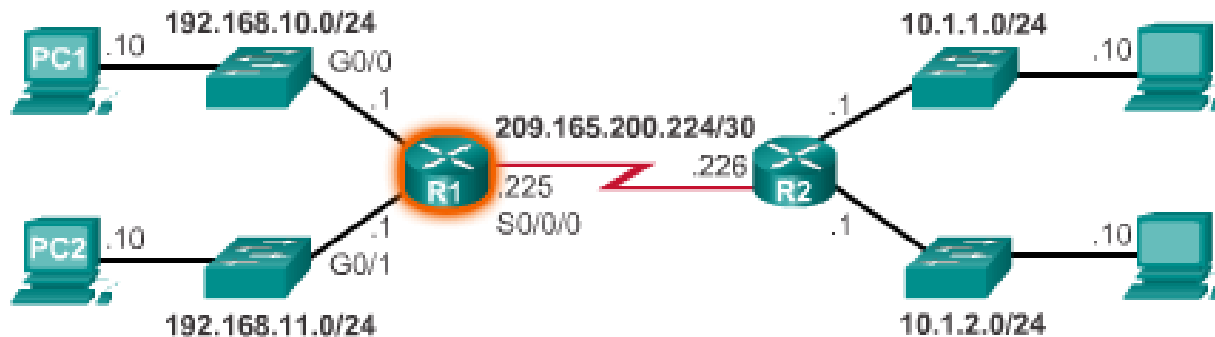
SUMBER TABEL ROUTING

The **show ip route** command is used to display the contents of the routing table:

- **Local route interfaces** - Added to the routing table when an interface is configured. (displayed in IOS 15 or newer)
- **Directly connected interfaces** - Added to the routing table when an interface is configured and active.
- **Static routes** - Added when a route is manually configured and the exit interface is active.
- **Dynamic routing protocol** - Added when EIGRP or OSPF are implemented and networks are identified.

SUMBER TABEL ROUTING

Routing Table of R1



```
R1#show ip route
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia -
       IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```

```
Gateway of last resort is not set
```

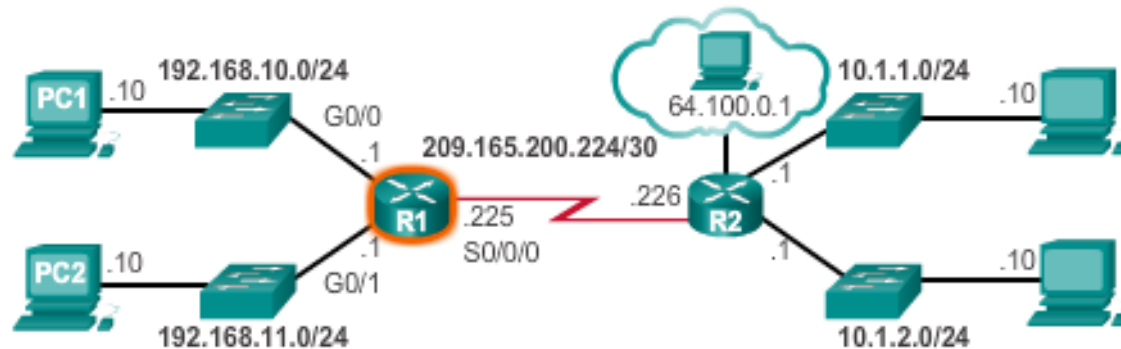
```
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
```

```
D    10.1.1.0/24 [90/2170112] via 209.165.200.226, 00:00:05,
```

REMOTE NETWORK ROUTING ENTRIES

Interpreting the entries in the routing table.

Remote Network Entry Identifiers



D 10.1.1.0/24 [90/2170112] via 209.165.200.226, 00:00:05, Serial0/0/0

Legend

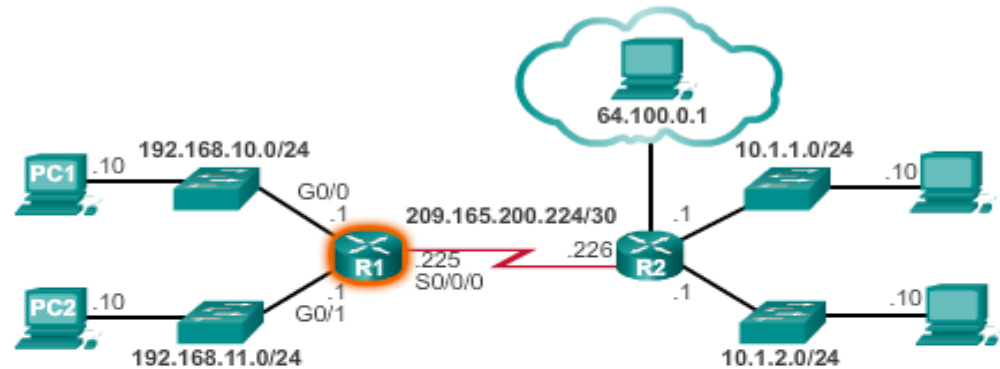
- Identifies how the network was learned by the router.
- Identifies the destination network.
- Identifies the administrative distance (trustworthiness) of the route source.
- Identifies the metric to reach the remote network.
- Identifies the next-hop IP address to reach the remote network.
- Identifies the amount of elapsed time since the network was discovered.
- Identifies the outgoing interface on the router to reach the destination network.

DIRECTLY CONNECTED INTERFACES

A newly deployed router, without any configured interfaces, has an empty routing table. An active, configured, directly connected interface creates two routing table entries:

- Link Local (L)
- Directly Connected (C)

Directly Connected Network Entry Identifiers



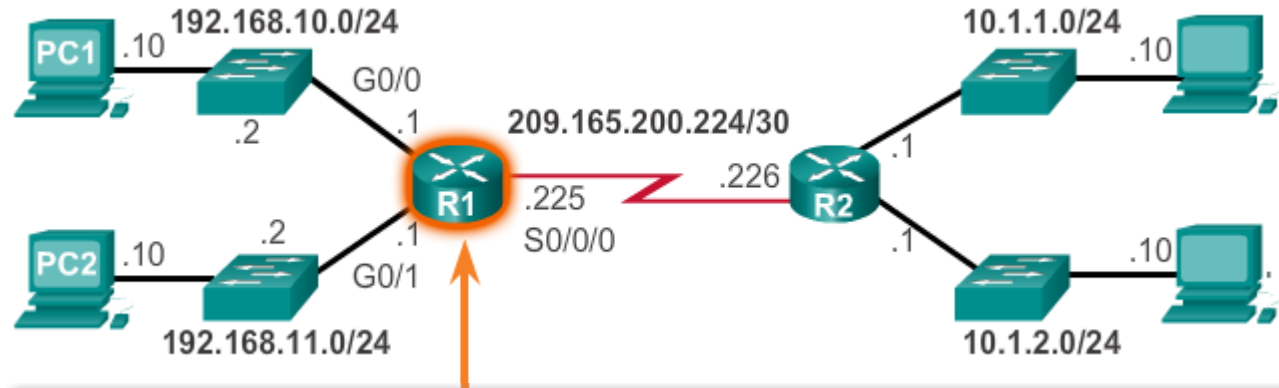
A	B	C
C	192.168.10.0/24 is directly connected,	GigabitEthernet0/0
L	192.168.10.1/32 is directly connected,	GigabitEthernet0/0

Legend

- Identifies how the network was learned by the router.
- Identifies the destination network and how it is connected.
- Identifies the interface on the router connected to the destination network.

DIRECTLY CONNECTED EXAMPLE

A routing table with the directly connected interfaces of R1 configured and activated.

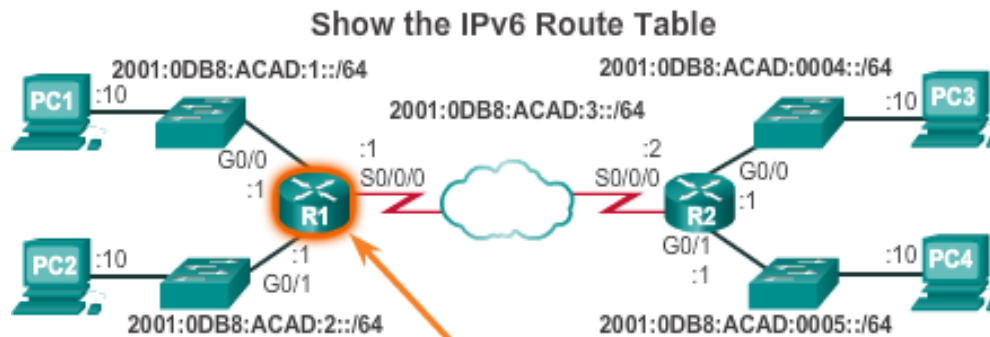


```
R1# show ip route | begin Gateway
Gateway of last resort is not set

      192.168.10.0/24 is variably subnetted, 2 subnets, 2
masks
C       192.168.10.0/24 is directly connected,
GigabitEthernet0/0
L       192.168.10.1/32 is directly connected,
GigabitEthernet0/0
      192.168.11.0/24 is variably subnetted, 2 subnets, 2
masks
C       192.168.11.0/24 is directly connected,
GigabitEthernet0/1
L       192.168.11.1/32 is directly connected,
GigabitEthernet0/1
```


DIRECTLY CONNECTED IPv6 EXAMPLE

The **show ipv6 route** command shows the ipv6 networks and routes installed in the routing table.



```

R1#show ipv6 route
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static,
       U - Per-user Static route, B - BGP, R - RIP
       H - NHRP, I1 - ISIS L1, I2 - ISIS L2
       IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default
       NDp - ND Prefix, DCE - Destination, NDr - Redirect
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1
       ON2 - OSPF NSSA ext 2
C   2001:DB8:ACAD:1::/64 [0/0]
    via GigabitEthernet0/0, directly connected
L   2001:DB8:ACAD:1::1/128 [0/0]
    via GigabitEthernet0/0, receive
    
```

STATICALLY LEARNED ROUTES

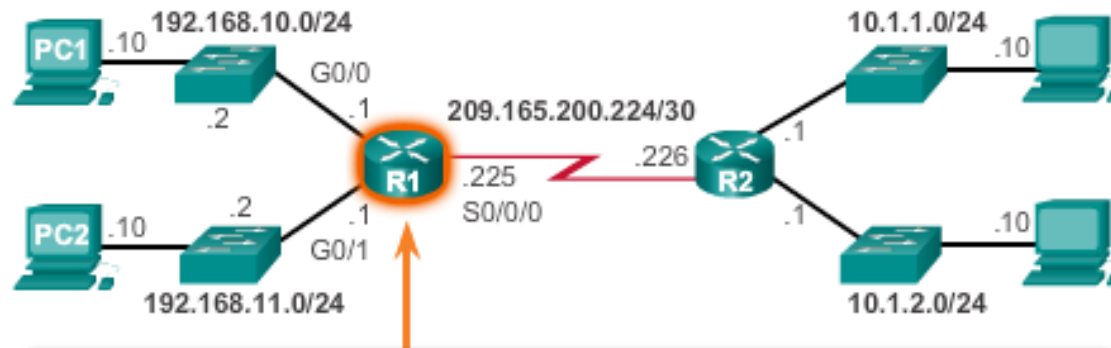
STATIC ROUTES

Static routes and default static routes can be implemented after directly connected interfaces are added to the routing table:

- Static routes are manually configured
- They define an explicit path between two networking devices.
- Static routes must be manually updated if the topology changes.
- Their benefits include improved security and control of resources.
- Configure a static route to a specific network using the **ip route network mask {next-hop-ip | exit-intf}** command.
- A default static route is used when the routing table does not contain a path for a destination network.
- Configure a default static route using the **ip route 0.0.0.0 0.0.0.0 {exit-intf | next-hop-ip}** command.

CONTOH DEFAULT STATIC ROUTES

Entering and Verifying a Static Default Route



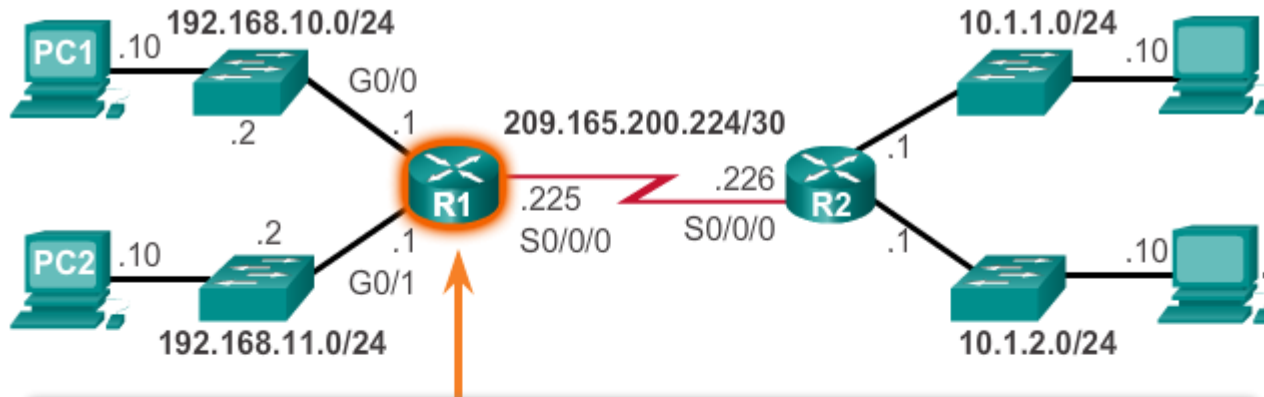
```

R1(config)#ip route 0.0.0.0 0.0.0.0 Serial0/0/0
R1(config)#exit
R1#
^Feb 1 10:19:34.483: %SYS-5-CONFIG_I: Configured from console
by console

R1#show ip route | begin Gateway
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S* 0.0.0.0/0 is directly connected, Serial0/0/0
  192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.10.0/24 is directly connected, GigabitEthernet0/0
L   192.168.10.1/32 is directly connected, GigabitEthernet0/0
  192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.11.0/24 is directly connected, GigabitEthernet0/1
L   192.168.11.1/32 is directly connected, GigabitEthernet0/1
  
```

CONTOH STATIC ROUTES



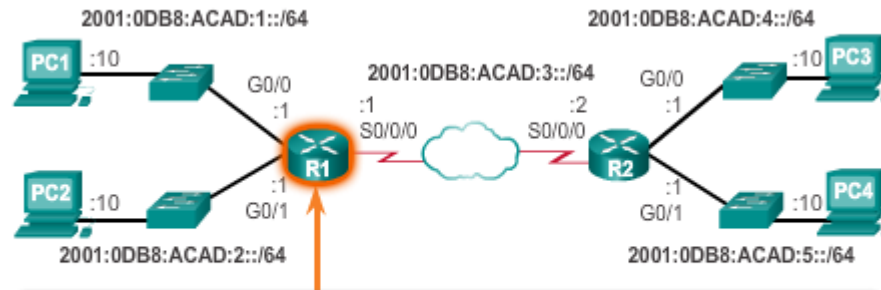
```
R1(config)# ip route 0.0.0.0 0.0.0.0 Serial0/0/0
R1(config)# exit
R1#
*Feb  1 10:19:34.483: %SYS-5-CONFIG_I: Configured from console
by console

R1# show ip route | begin Gateway
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S* 0.0.0.0/0 is directly connected, Serial0/0/0
  192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.10.0/24 is directly connected, GigabitEthernet0/0
L   192.168.10.1/32 is directly connected, GigabitEthernet0/0
  192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.11.0/24 is directly connected, GigabitEthernet0/1
L   192.168.11.1/32 is directly connected, GigabitEthernet0/1
```

CONTOH STATIC IPV6 ROUTES

Entering and Verifying an IPv6 Static Default Route

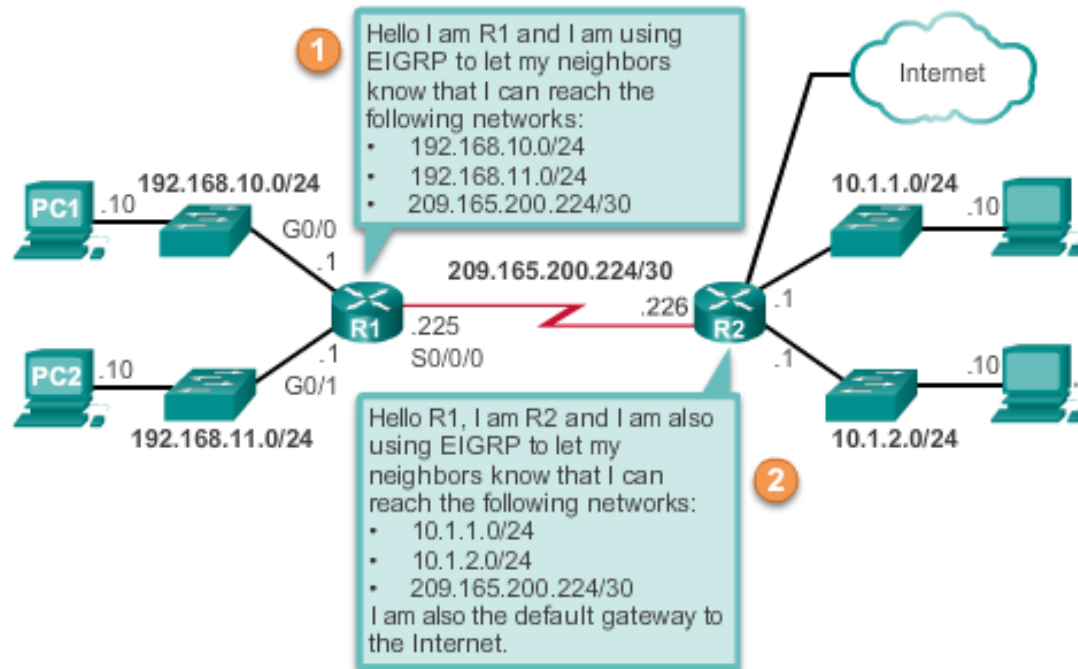


```
R1(config)#ipv6 route ::/0 s0/0/0
R1(config)#exit
R1#
```

```
R1#show ipv6 route
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static,
       U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary,
       D - EIGRP
       EX - EIGRP external, ND - ND Default, NDP - ND Prefix,
       DCE - Destination
       NDR - Redirect, O - OSPF Intra, OI - OSPF Inter,
       OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1,
       ON2 - OSPF NSSA ext 2
S ::/0 [1/0]
   via Serial0/0/0, directly connected
C 2001:DB8:ACAD:1::/64 [0/0]
   via GigabitEthernet0/0, directly connected
```


DYNAMIC ROUTING

Dynamic routing is used by routers to share information about the reachability and status of remote networks. It performs network discovery and maintains routing tables.



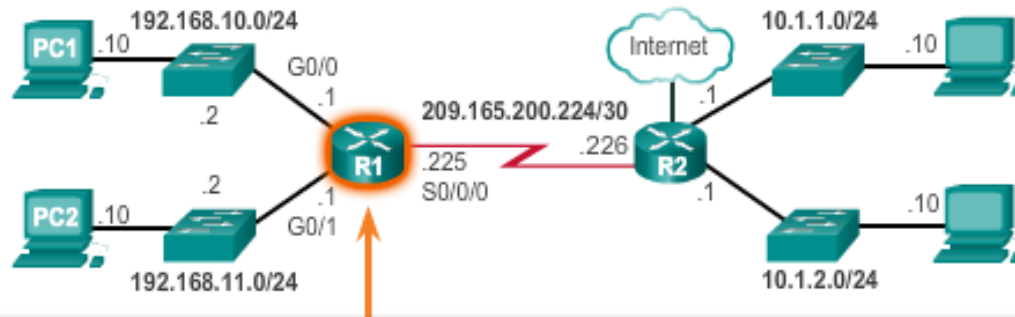
IPV4 ROUTING PROTOCOLS

Cisco ISR router dapat mendukung berbagai jenis routing dinamik protokol dari IPv4 termasuk:

- **EIGRP** – Enhanced Interior Gateway Routing Protocol
- **OSPF** – Open Shortest Path First
- **IS-IS** – Intermediate System-to-Intermediate System
- **RIP** – Routing Information Protocol

IPV4 ROUTING PROTOCOLS

Verify Dynamic Routes



```
R1#show ip route | begin Gateway
Gateway of last resort is 209.165.200.226 to network 0.0.0.0

D*EX 0.0.0.0/0 [170/2297856] via 209.165.200.226, 00:07:29, Serial0/0/0
    10.0.0.0/24 is subnetted, 2 subnets
D    10.1.1.0 [90/2172416] via 209.165.200.226, 00:07:29, Serial0/0/0
D    10.1.2.0 [90/2172416] via 209.165.200.226, 00:07:29, Serial0/0/0
    192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.10.0/24 is directly connected, GigabitEthernet0/0
L    192.168.10.1/32 is directly connected, GigabitEthernet0/0
    192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.11.0/24 is directly connected, GigabitEthernet0/1
L    192.168.11.1/32 is directly connected, GigabitEthernet0/1
    209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C    209.165.200.224/30 is directly connected, Serial0/0/0
L    209.165.200.225/32 is directly connected, Serial0/0/0
R1#
```

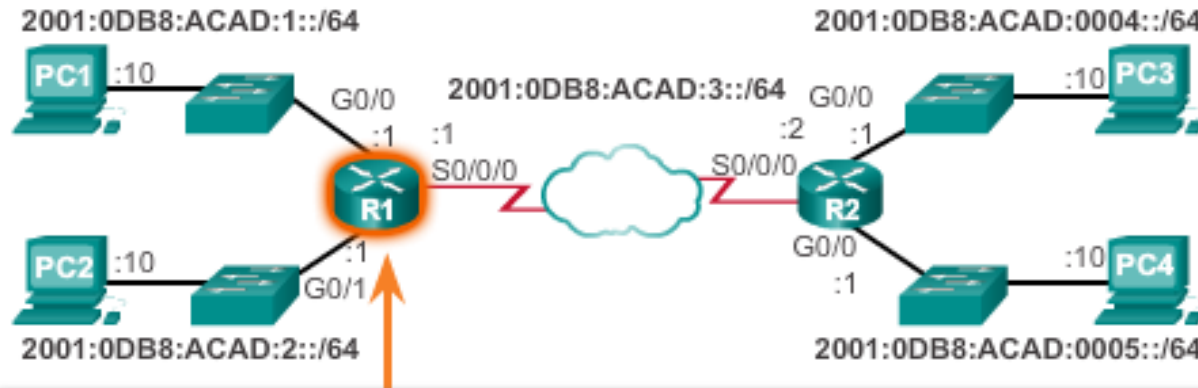
IPV6 ROUTING PROTOCOLS

Cisco ISR router dapat mendukung berbagai routing dinamik protokol dari Pv6 termasuk:

- **RIPng** - RIP next generation
- **OSPFv3**
- **EIGRP** for IPv6
- **MP-BGP4** - Multicast Protocol-Border Gateway Protocol

IPV6 ROUTING PROTOCOLS

Verify Dynamic Routes



```
R1#show ipv6 route
IPv6 Routing Table - default - 9 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE -
Destination
       NDR - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C   2001:DB8:ACAD:1::/64 [0/0]
    via GigabitEthernet0/0, directly connected
L   2001:DB8:ACAD:1::1/128 [0/0]
    via GigabitEthernet0/0, receive
C   2001:DB8:ACAD:2::/64 [0/0]
    via GigabitEthernet0/1, directly connected
L   2001:DB8:ACAD:2::1/128 [0/0]
```


BAB 3: KESIMPULAN

- There are many key structures and performance-related characteristics referred to when discussing networks: topology, speed, cost, security, availability, scalability, and reliability.
- Cisco routers and Cisco switches have many similarities. They support a similar modal operating system, similar command structures, and many of the same commands.
- One distinguishing feature between switches and routers is the type of interfaces supported by each.
- The main purpose of a router is to connect multiple networks and forward packets from one network to the next. This means that a router typically has multiple interfaces. Each interface is a member or host on a different IP network.

BAB 3: KESIMPULAN (LANJ.)

- The routing table is a list of networks known by the router.
- A remote network is a network that can only be reached by forwarding the packet to another router.
- Remote networks are added to the routing table in two ways: either by the network administrator manually configuring static routes or by implementing a dynamic routing protocol.
- Static routes do not have as much overhead as dynamic routing protocols; however, static routes can require more maintenance if the topology is constantly changing or is unstable.
- Dynamic routing protocols automatically adjust to changes without any intervention from the network administrator. Dynamic routing protocols require more CPU processing and also use a certain amount of link capacity for routing updates and messages.

BAB 3: KESIMPULAN (LANJ.)

- Routers make their primary forwarding decision at Layer 3, the Network layer. However, router interfaces participate in Layers 1, 2, and 3. Layer 3 IP packets are encapsulated into a Layer 2 data link frame and encoded into bits at Layer 1.
- Router interfaces participate in Layer 2 processes associated with their encapsulation. For example, an Ethernet interface on a router participates in the ARP process like other hosts on that LAN.
- Components of the IPv6 routing table are very similar to the IPv4 routing table. For instance, it is populated using directly connected interfaces, static routes and dynamically learned routes.

TERIMA KASIH



Thank you very much for your kind attention