SWINBURNE

CENTRE FOR ADVANCED INTERNET ARCHITECTURES

TNE20002/TNE70003

Topic 1: Routing

The Router

Routers

are the

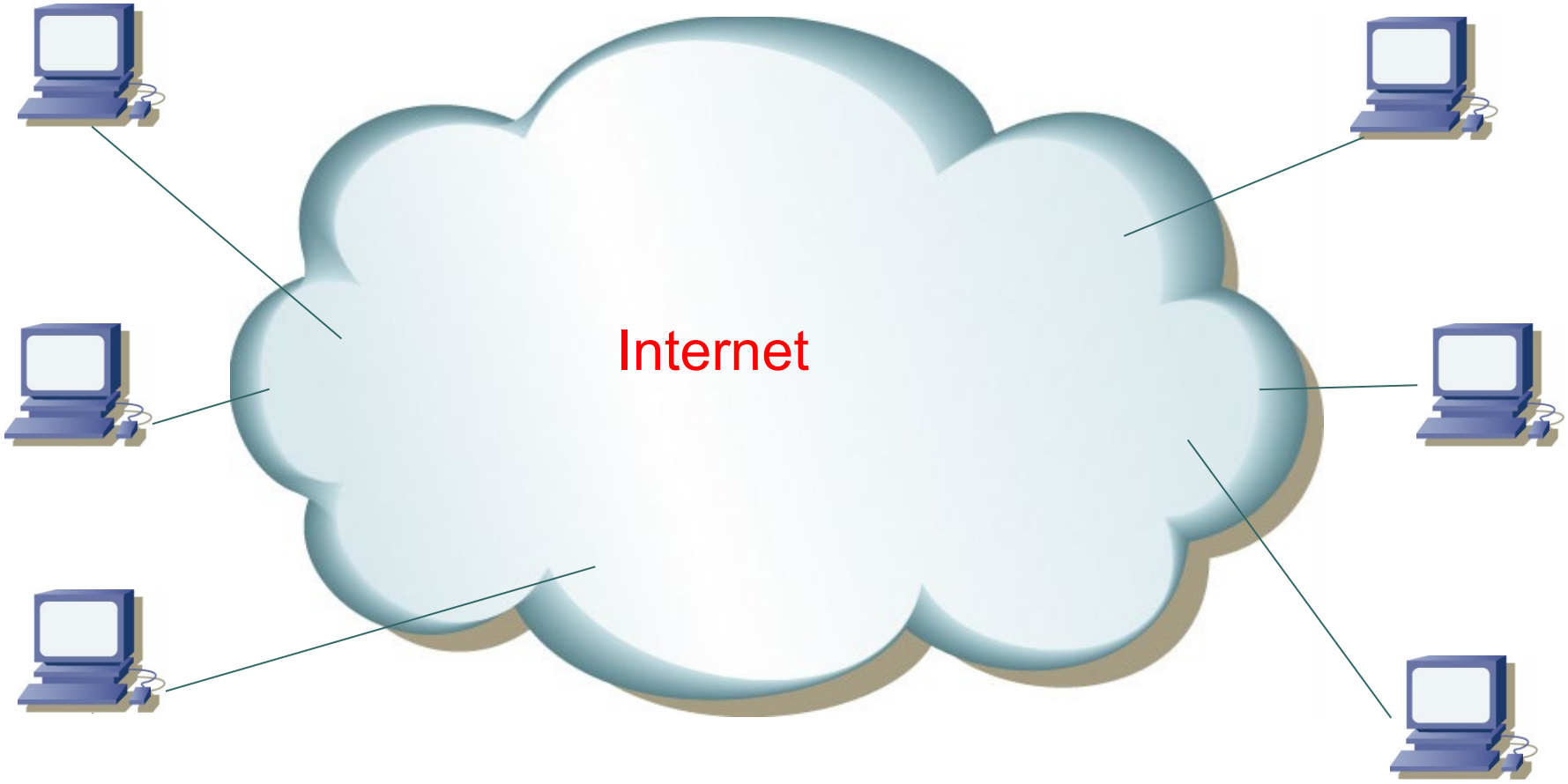
core

of

The Internet

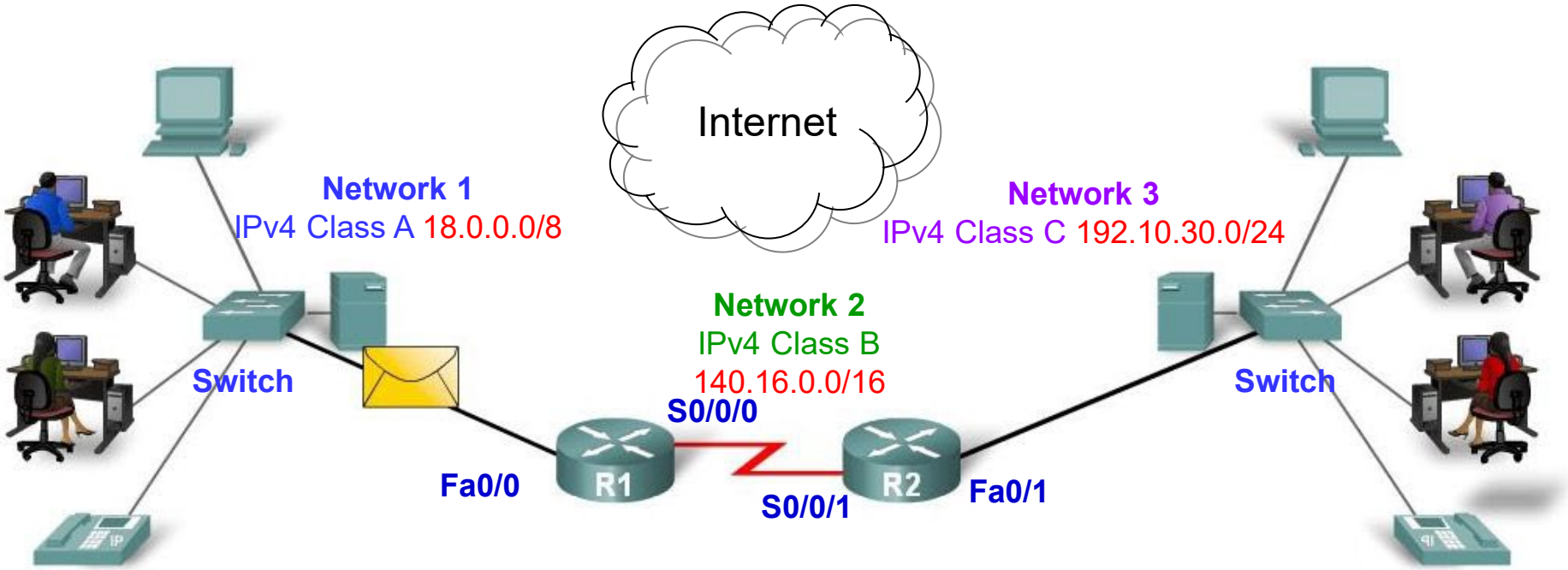
Routing

- The Internet is too large to have all hosts together as one network, it is subdivided



Routers connect Networks

- The Internet is subdivided into many separate networks.
- Each router interface Fa0/0, S0/0/0, etc is a **Gateway** to another a network

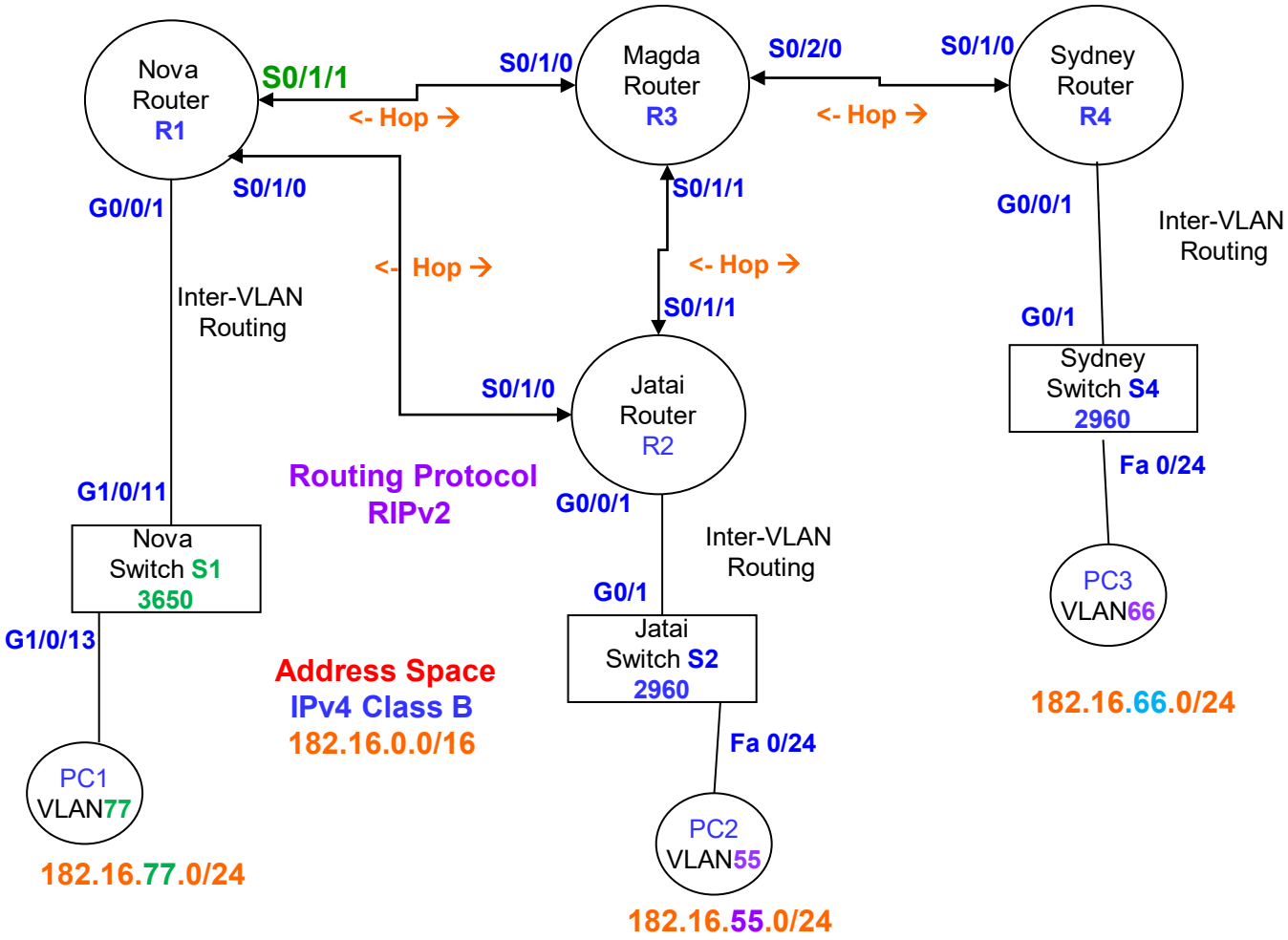


The Router

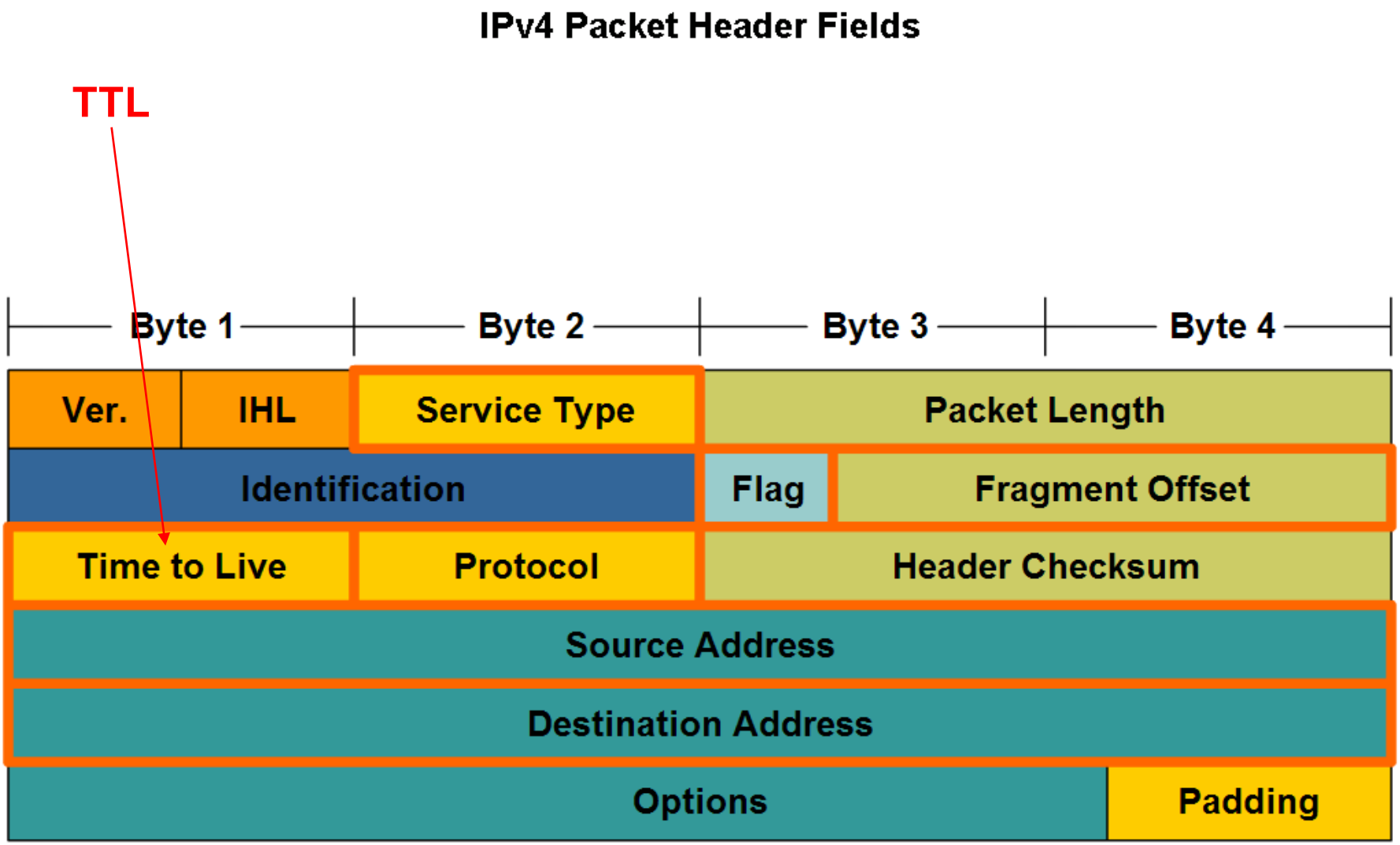
1) The router, routes IP packets to the intended destination

2) The router, drops IP packets to reduce congestion
   - Setting Time to Live (TTL) to 10 hops, means if the packet cannot reach its destination within 10 hops, it will be dropped
   - When a packet enters a router, deduct 1 from TTL
   - IF TTL = 0 the packet will be dropped

Network Topology



IP Header TTL



Routing Decisions

Based on the **Information** in the **Routing Table**, the Router

1. Makes a Best Match Decision

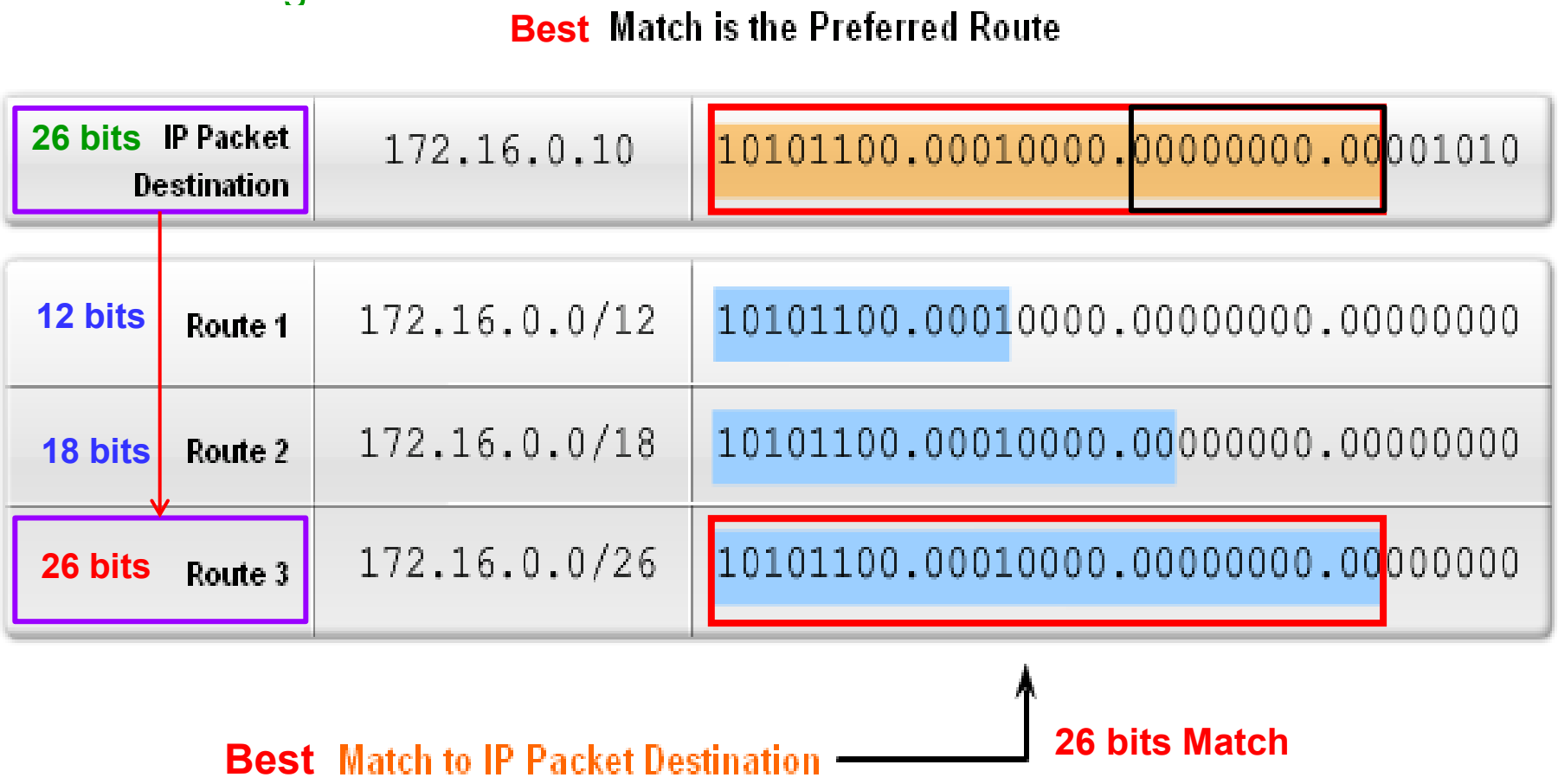
   - It determines the Best Match,
     between the destination network address in the incoming packet and a network address entry in the routing table

2. Makes a Forwarding Decision

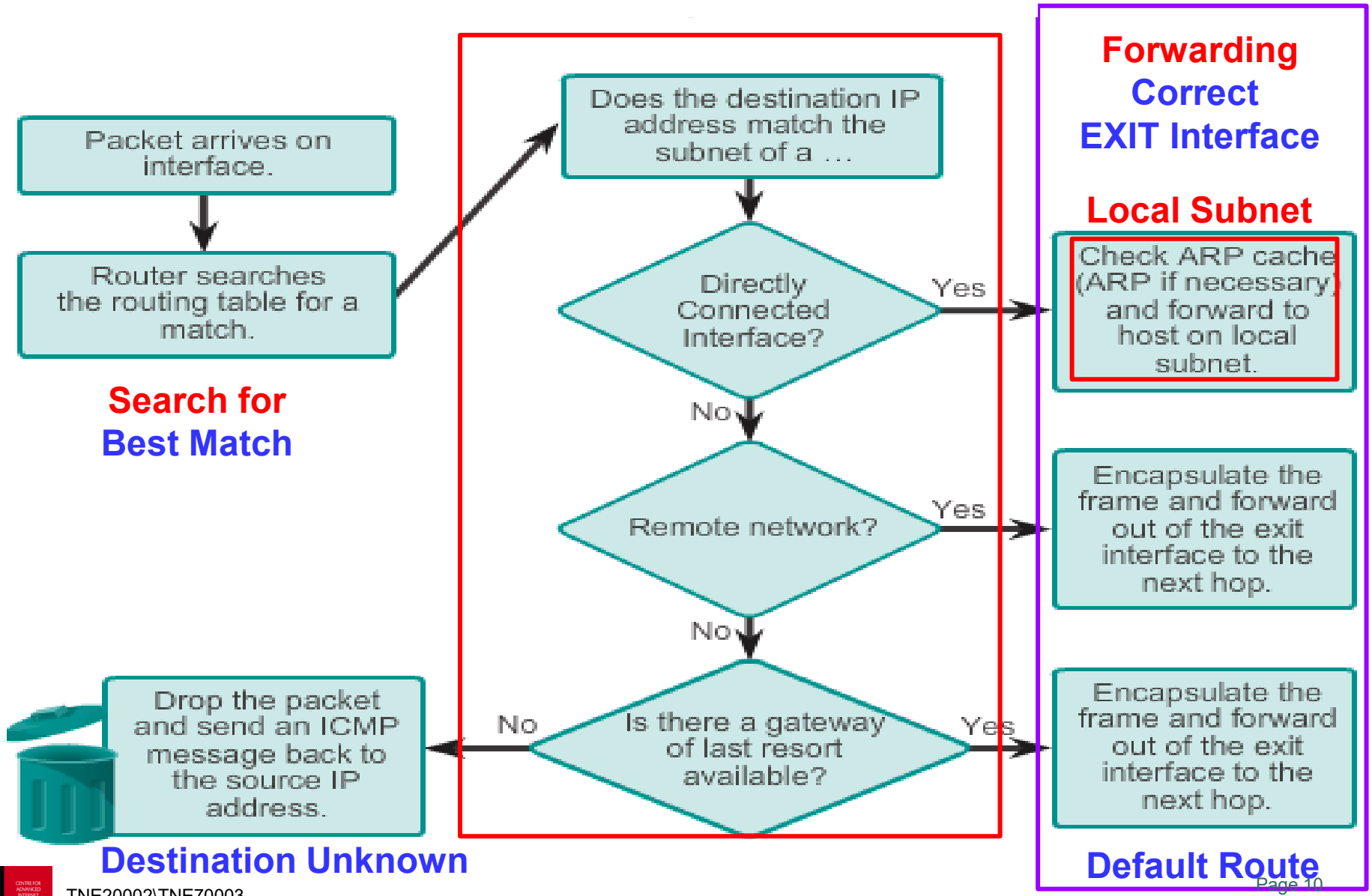
   - It determines the correct exit interface then forwards the packet to that exit interface, towards the destination network.

The Router - Best Match Decision

- The **Best Match** is the one that has the **most** number of bits (left to right) matching between the destination IP network address and a routing entry in the Routing Table.



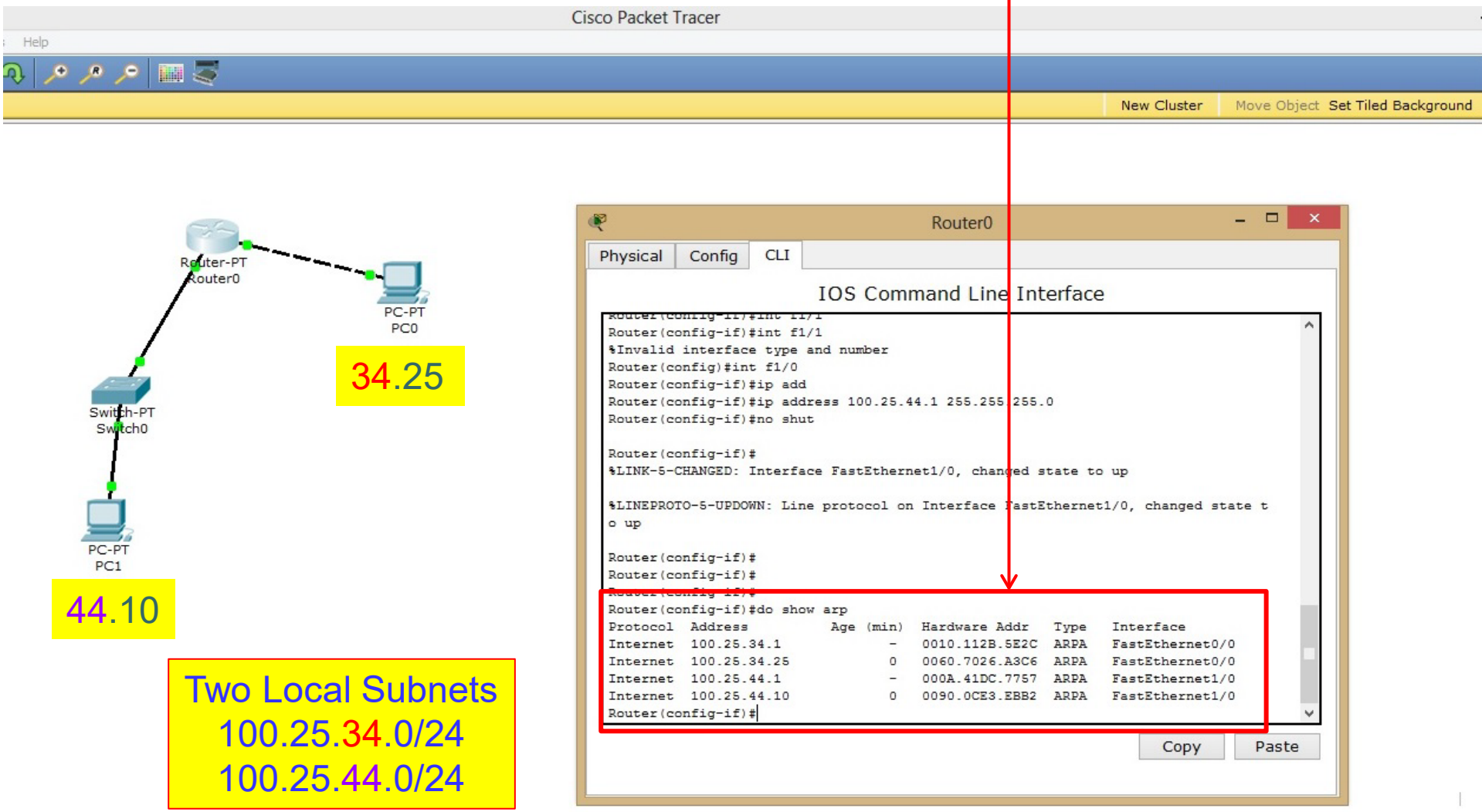
Routing Decisions – Flow Chart



Router ARP Table – Local Subnets

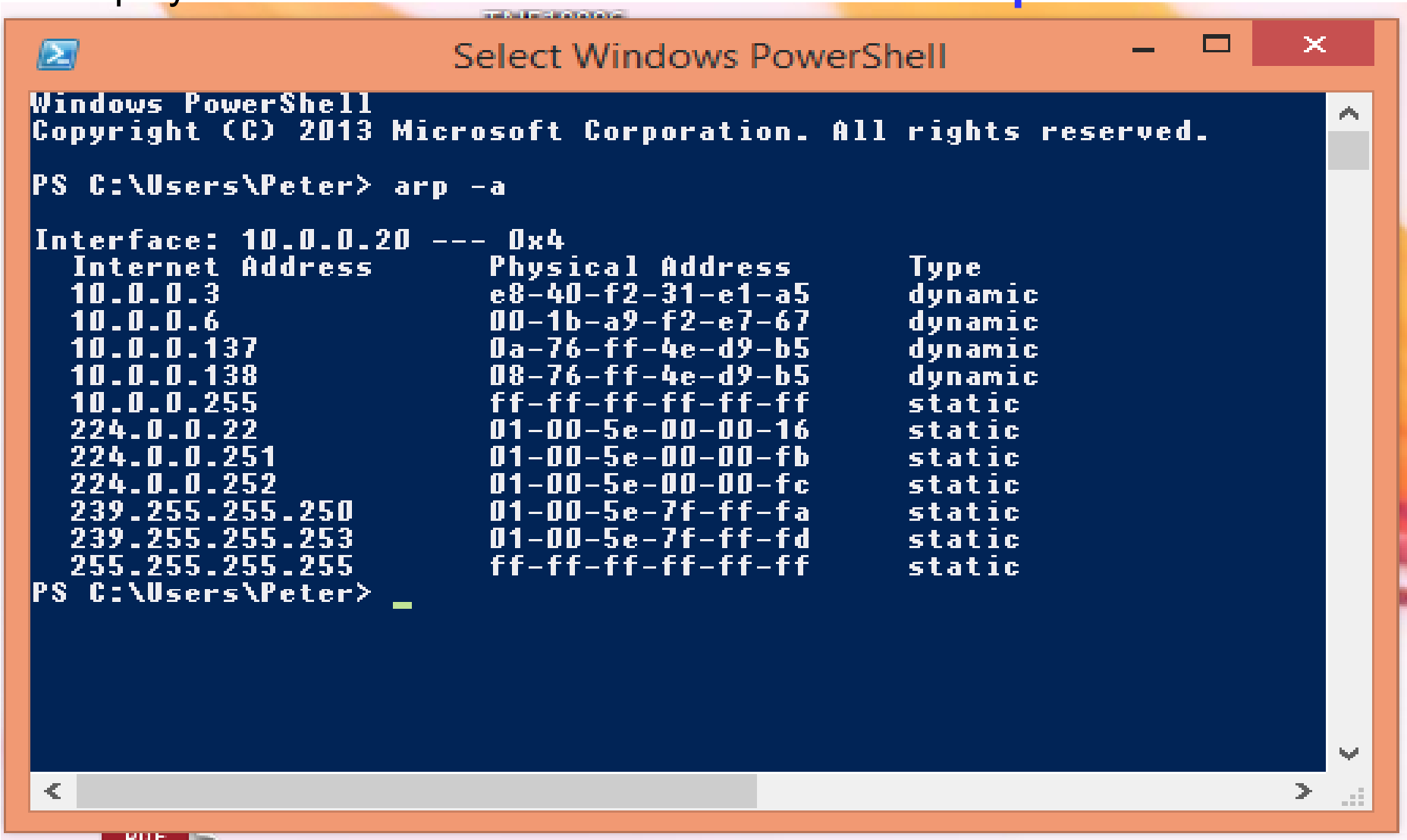
Forwarding a packet through FastEthernet Interfaces

- Display **ARP Table** on Router - **show arp** (Mapping IP to Mac)



PC ARP Table

- Display **ARP Table** on **PC** in Command Window - **arp -a**



The Router

The

Routing

Protocol

Path Determination - Least Cost Path

- The Least Cost Path to a given network is determined by a routing protocol calculating the cost.
- The cost calculation can involve a number of metrics.
- The Least Cost Path to a network is the path with the lowest cost.

Metrics

- Hop Count: counts the number of routers a (IP) packet must traverse
- Bandwidth: Influences path selection by preferring the path with the highest bandwidth
- Load: Considers the traffic utilization of a link
- Signal Delay: Considers the time a packet takes to traverse a path
- Reliability: Assesses the probability of a link failure

Cost

The

COST

is

calculated

based on the

metrics

used by the

Routing

protocol

Routing Information Protocol

RIP

cost

based on metric

Hop count

Dynamic Routing Protocols

Open Shortest Path First

OSPF

cost

based on metric

bandwidth

from source to destination

Enhanced Interior Gateway Routing Protocol

EIGRP

cost

based on metrics

Bandwidth, delay, load, reliability

Routing Table - Least Cost Paths

Only the

Least Cost paths

to given destination networks,

as determined by a routing protocol,

are placed in

the routing table

The Router

The

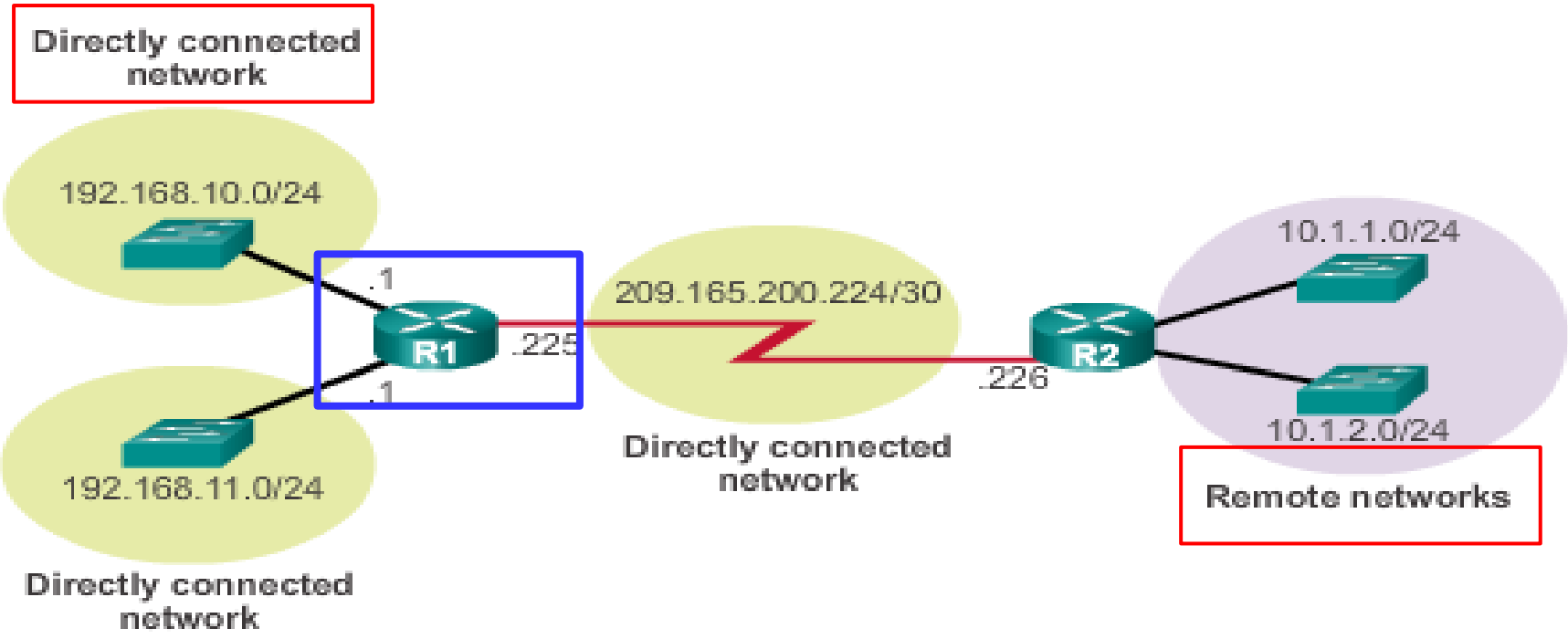
Routing

Table

The Routing Table – R1

A routing table for R1 is a file stored in RAM that contains information about:

- Directly connected routes
- Remote routes (learnt via routing protocol)
- Next hop associations



Routing Table Entries – show ip route

- **Link local route interfaces -** Added to the routing table when an interface is configured. Shows IP address of the Interface.

- **Connected interfaces -** Added to the routing table when an interface is configured and active.

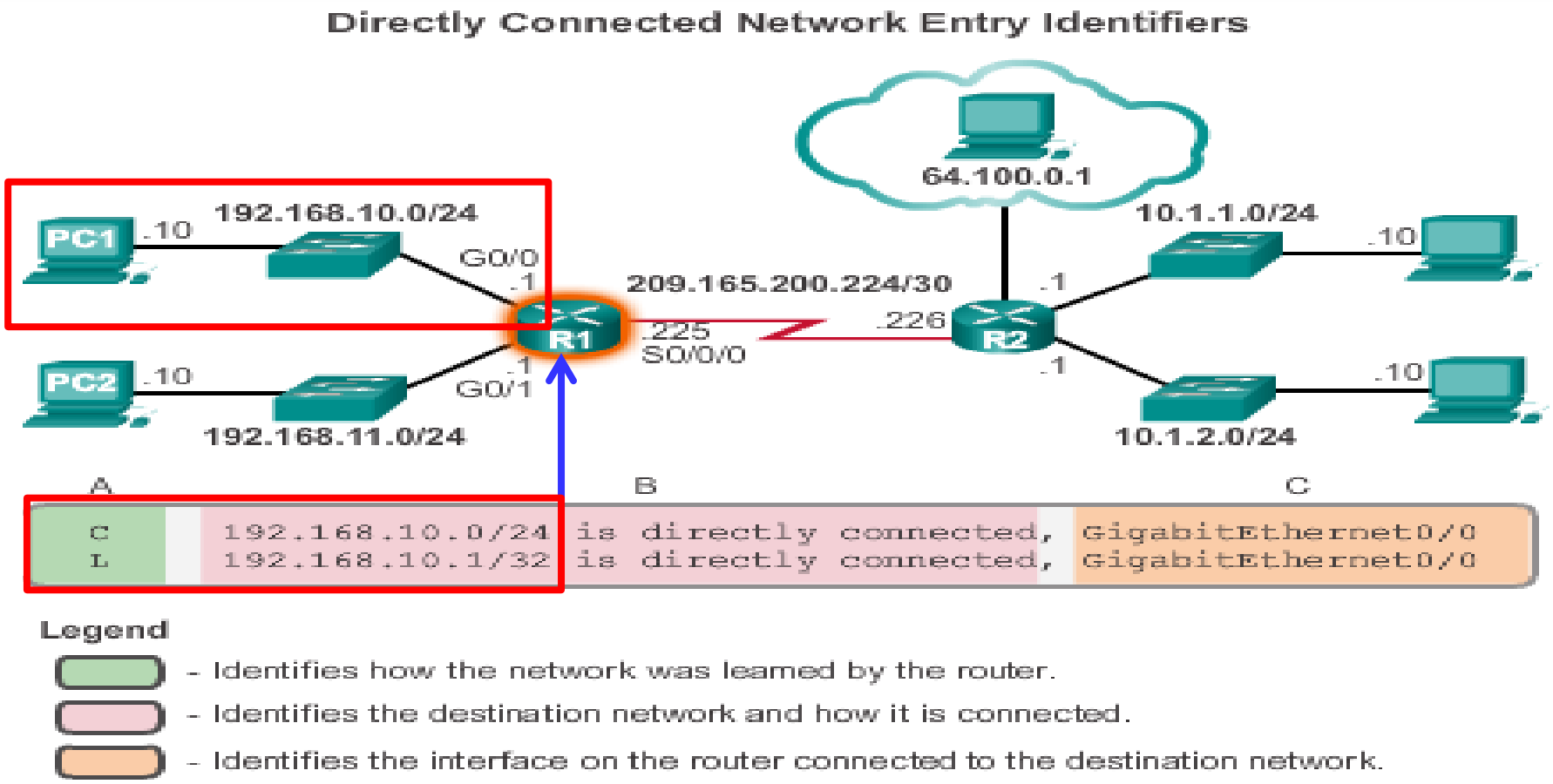
- **Static routes -** Added when a route is manually configured and the exit interface is active.

- **Dynamic routes -** Added when RIP, EIGRP or OSPF are implemented and networks are identified.

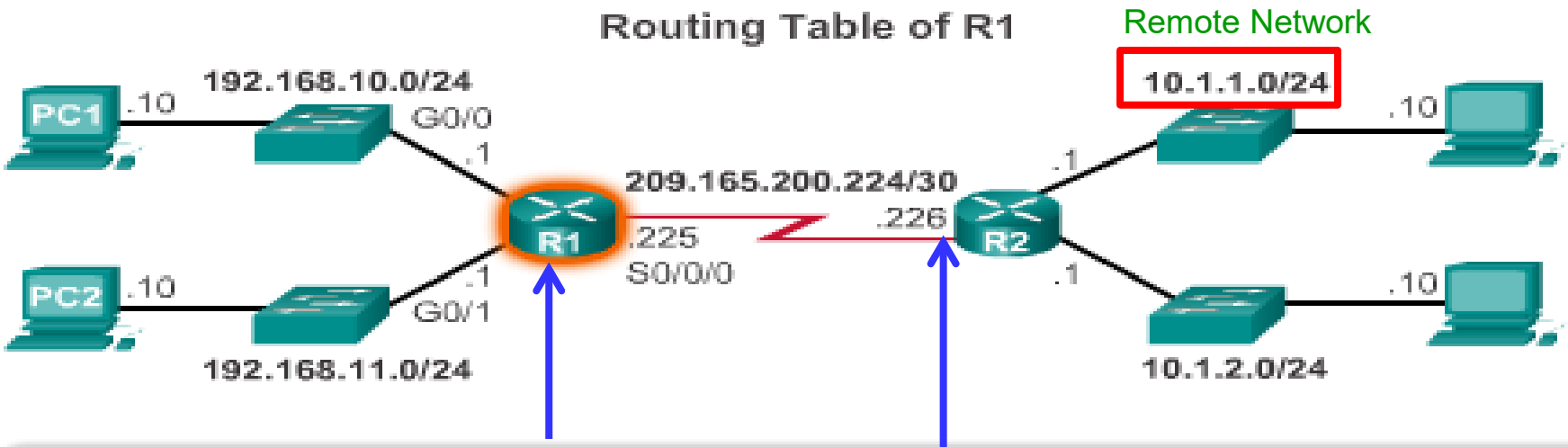
Directly Connected Routes – R1

An active, configured, directly connected interface creates two routing table entries:

- Link Local (L) and Connected (C)



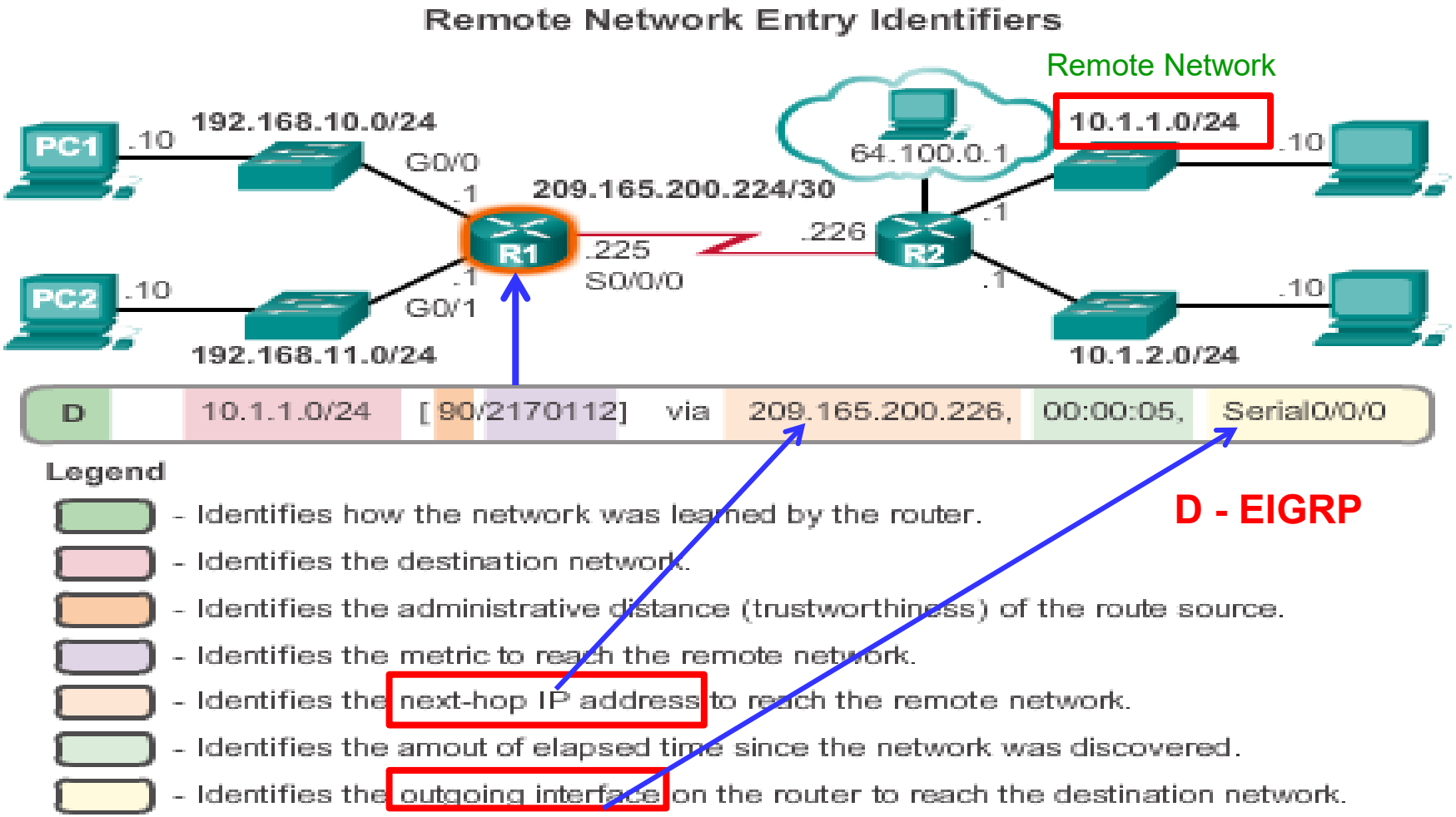
Routing Table Entries – R1: Remote Network




```
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,
```

Routing Table Entries – R1: Remote Network

Interpreting the **entries** in the routing table.



THE END