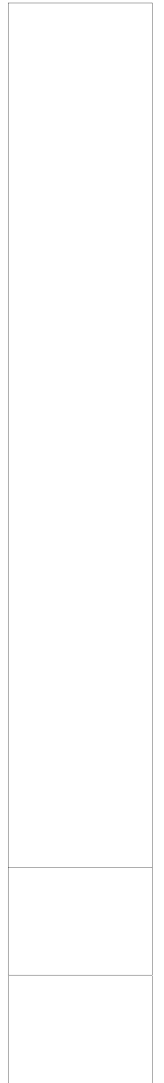


Routing

Foundations of computer networks



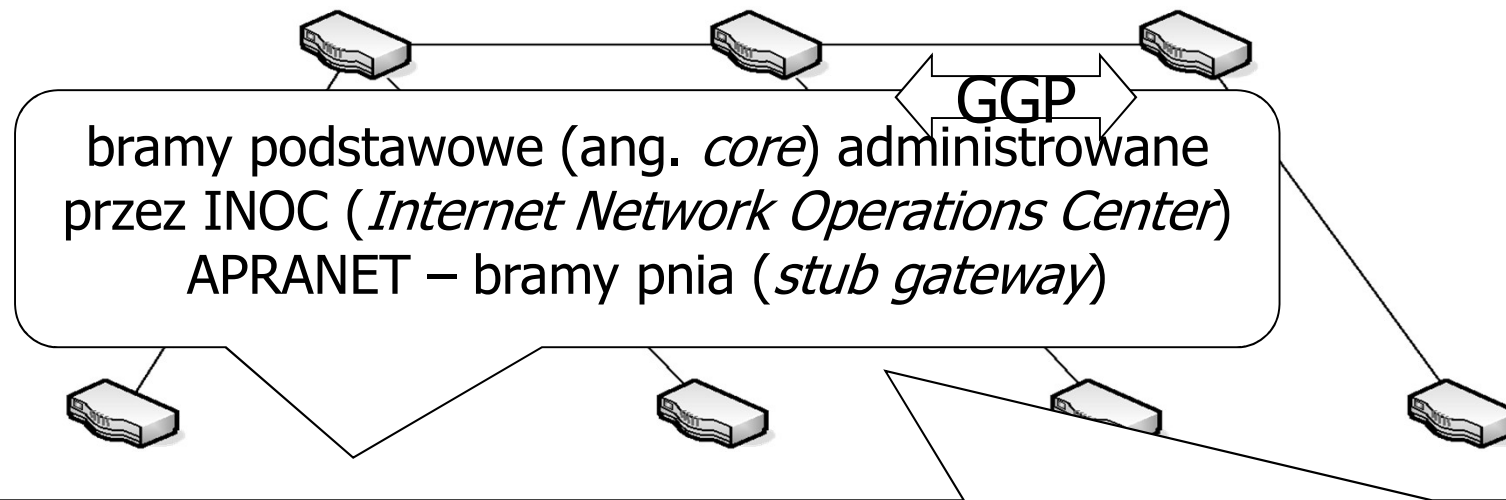
Routing classification

- Static
- Dynamic



- drawbacks
- advantages

Bramy podstawowe

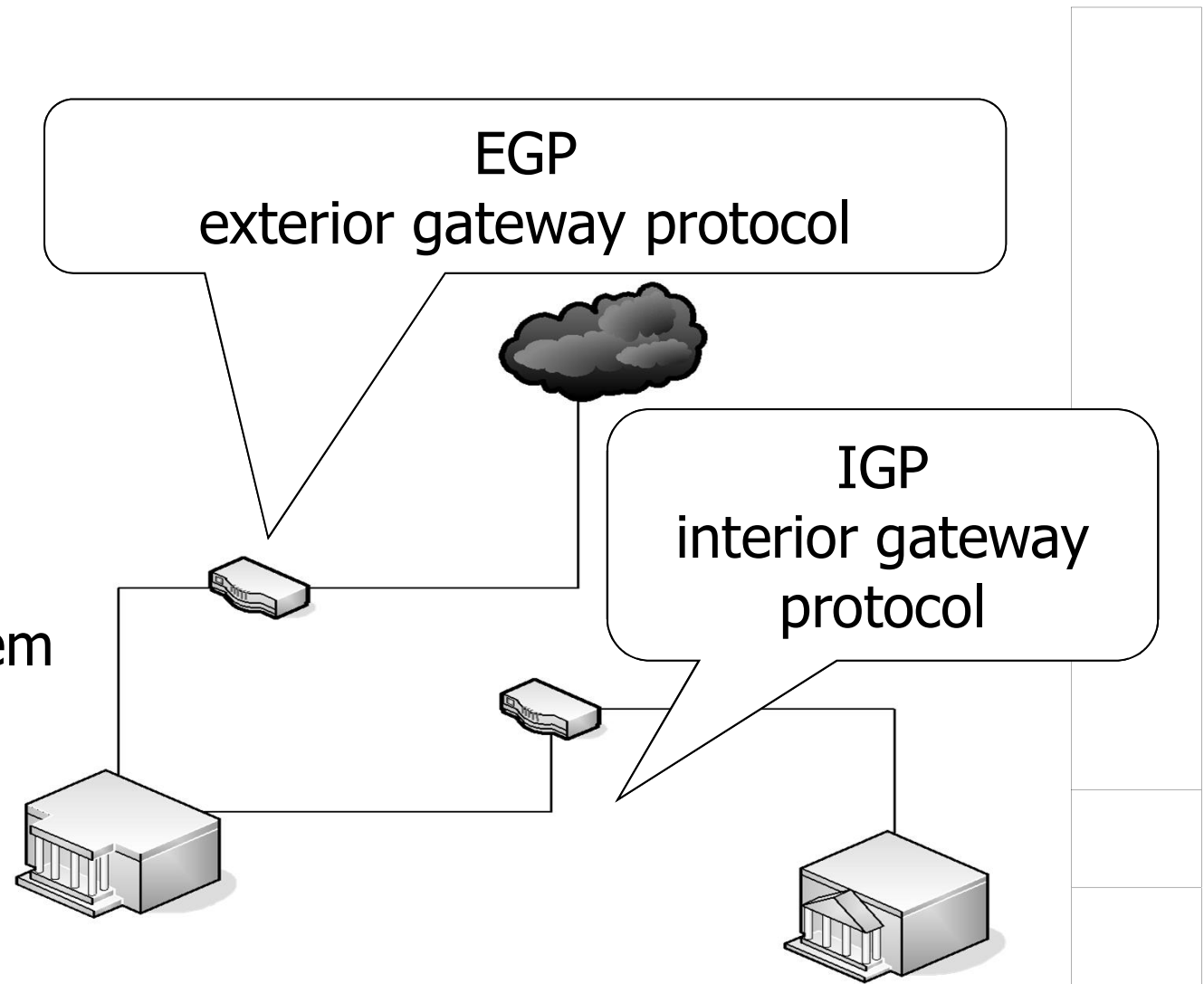


bramy niepodstawowe (ang. *non-core*) administrowane przez inst. edukacyjne, przedsiębiorstwa

Gateways

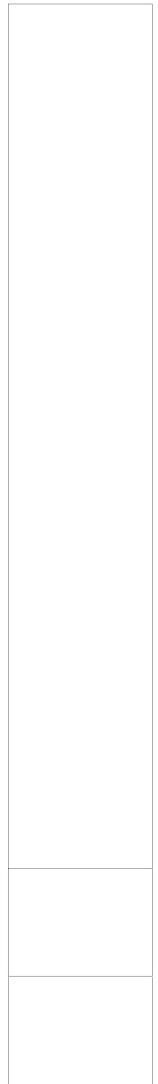
- interior
- exterior

autonomous system



Tasks of routers

- Receive a frame
- destination address analysing
 - term the destination network
- selection of the path (routing)
 - lengtht of the path (physical or hop number)
 - traffic load on the path
 - priorities
 - costs
- Send the frame from selected port



TOS $\rightarrow$ DSCP+ECN

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Version (4 bity)				Lenght of header as in 32 bit words				DSCP						ECN		Total lenght															
Identification																Flags		Fragment Offset													
Time to live (TTL)								Protocol (next)								Header checksum															
Source IP address																															
Destination IP address																															
Options																															
Data																															

Router



Application layer



Analysis of network layer header



Application layer

Presentation layer

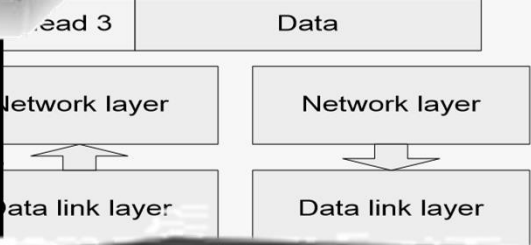
Session layer

Transport layer

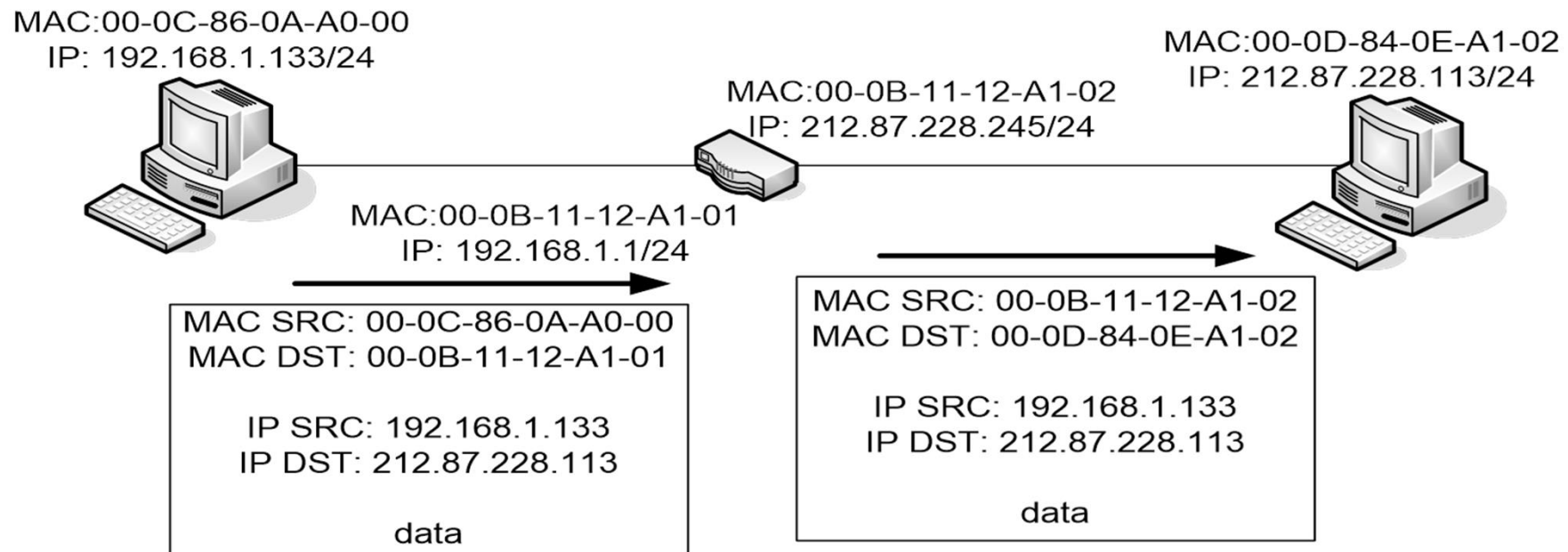
Network layer

Data link layer

network address	Next hop address	Metrics
212.87.228.*	212.87.227.1	2
192.168.1.*	192.168.3.1	
...		...

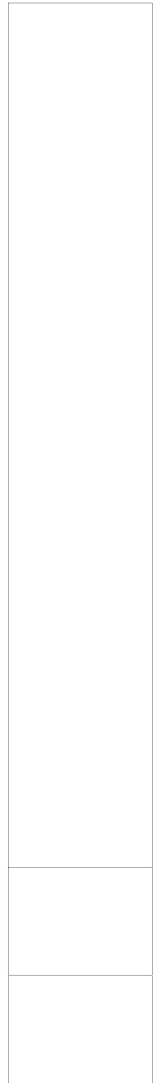


Router in operation



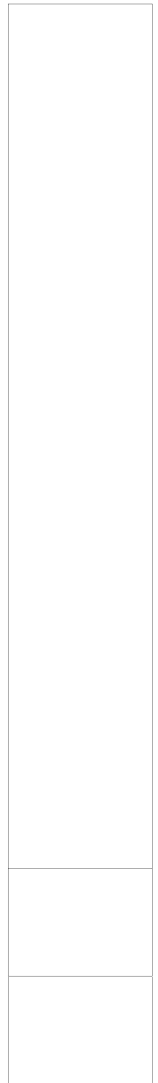
Routing protocol

- GGP, SPREAD
- EGP
 - BGP (BGP 4)
- IGP
 - RIP
 - RIP II
 - HALO
 - OSPF



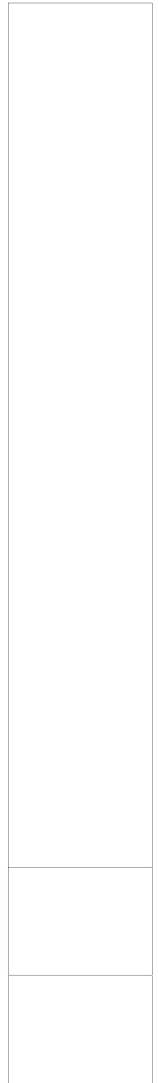
GGP

- Gateway-to-Gateway Protocol (obsolete)
- defined for routing datagrams between Internet gateways.
- komunikaty zawierają
 - wektor
 - odległość
- Internet gateway store routing tables of all Internet gateways!



EGP - Exterior Gateway Protocols

- routing between Exterior Gateways, i.e. autonomous system
- Representatives
 - EGP (obsolete)
 - BGP (Border Gateway Protocol)



IGP – Interior Gateway Protocols

- routing inside the autonomous systems
- the messages contains
 - ID of router/computer
 - distance
 - hops (RIP)
 - time (HALO)
 - optimal path (OSPF)
- distance vector routing protocols
 - **RIP** (Routin Information Protcol)
 - **RIPv2**
 - **RIPng** (supports IPv6)
 - **IGRP** (Interior Gateway Routing Protocol)
- link state routing protocols
 - **OSFP** (Open Shortest Path First)
 - **IS-IS** (Intermediate System to Intermediate System)
- hybrid routing protocols
 - **EIGRP** (Enhanced Interior Gateway Routing Protocol)

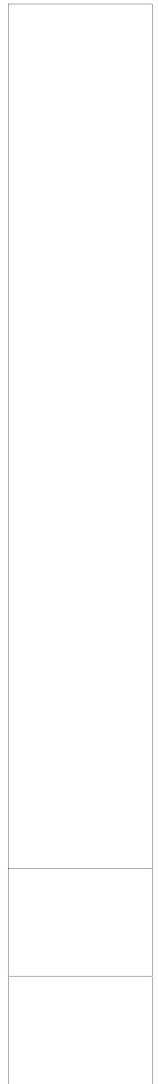
Variable length masks are not supported!

Routing table - RIP

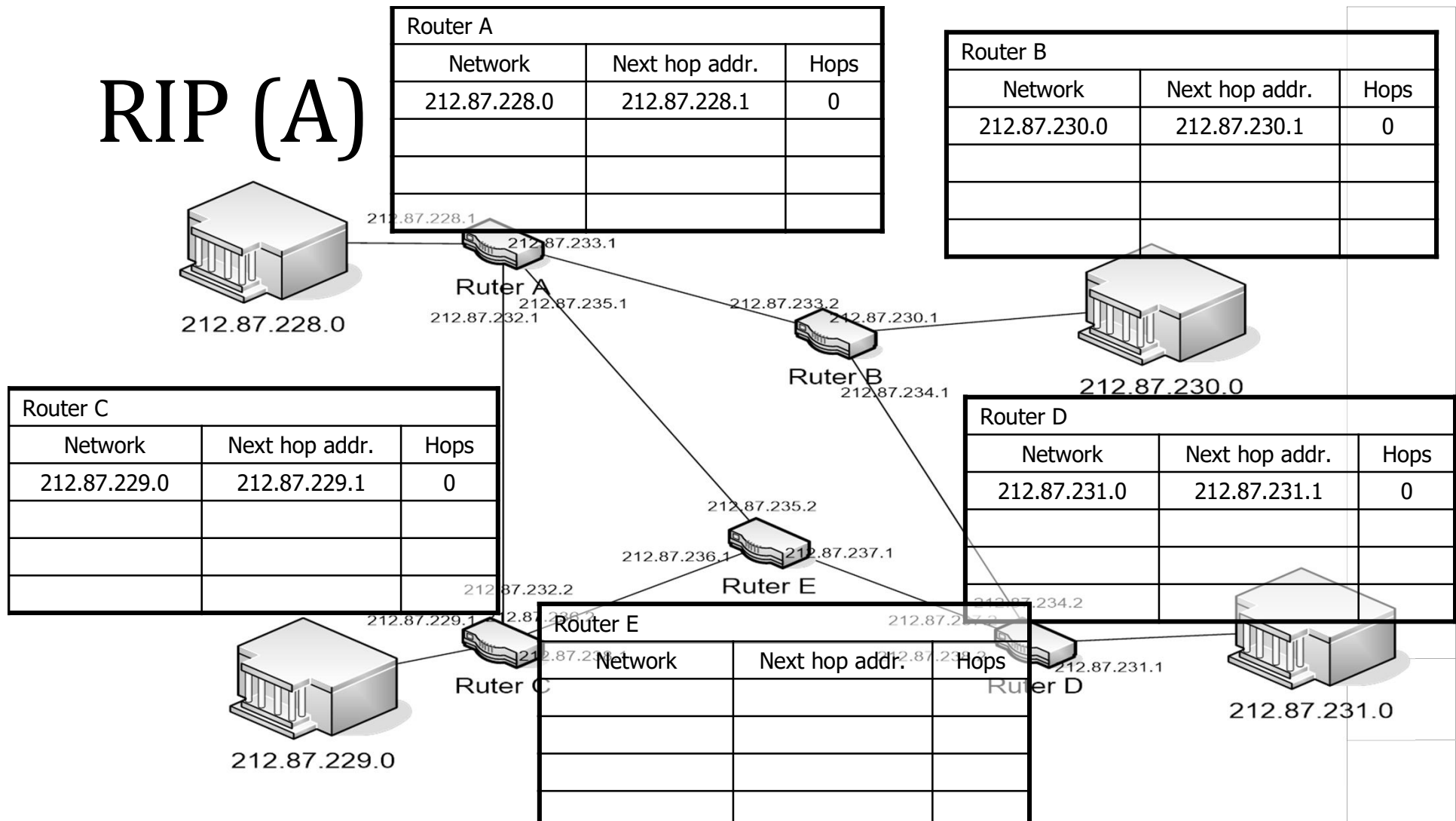
- Destination IP address
- Distance metrics
 - max 15 hops
 - $16 = \infty$
- Next hop IP address
- Change of path flag
- Timers
 - update timer (30s)
 - invalid timer (180s)
 - flush timer (240s=it+60)
 - holddown timer (180s)

RIP in operation

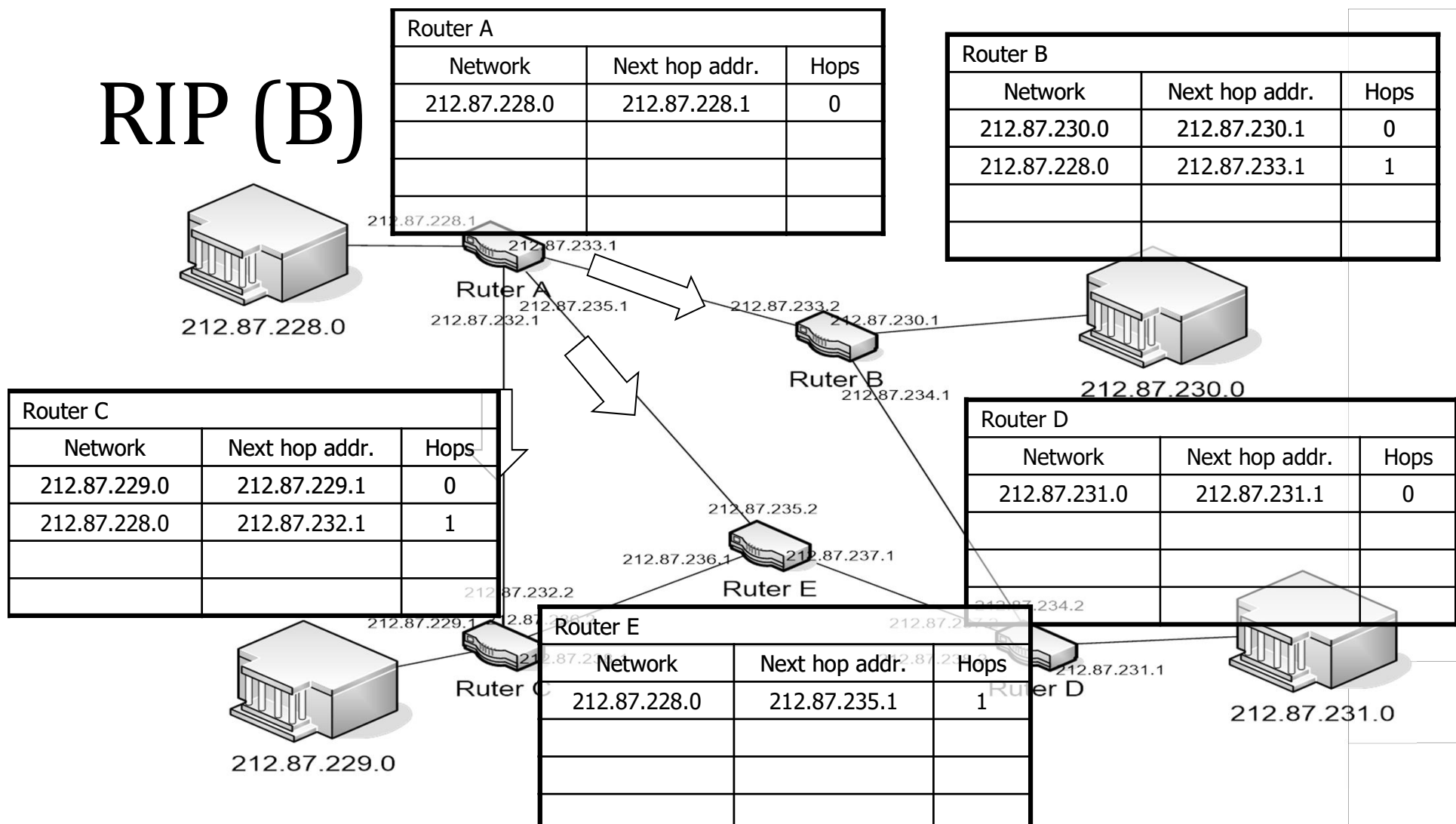
- Broadcast of posesses tables
 - update timer (30s)
- Update the tables based on receiving messages
- Path invalidation
 - invalid timer (180s)
 - set distance metric to 16
 - set flag of path change
- Flush of path
 - flush timer (240s=it+60)



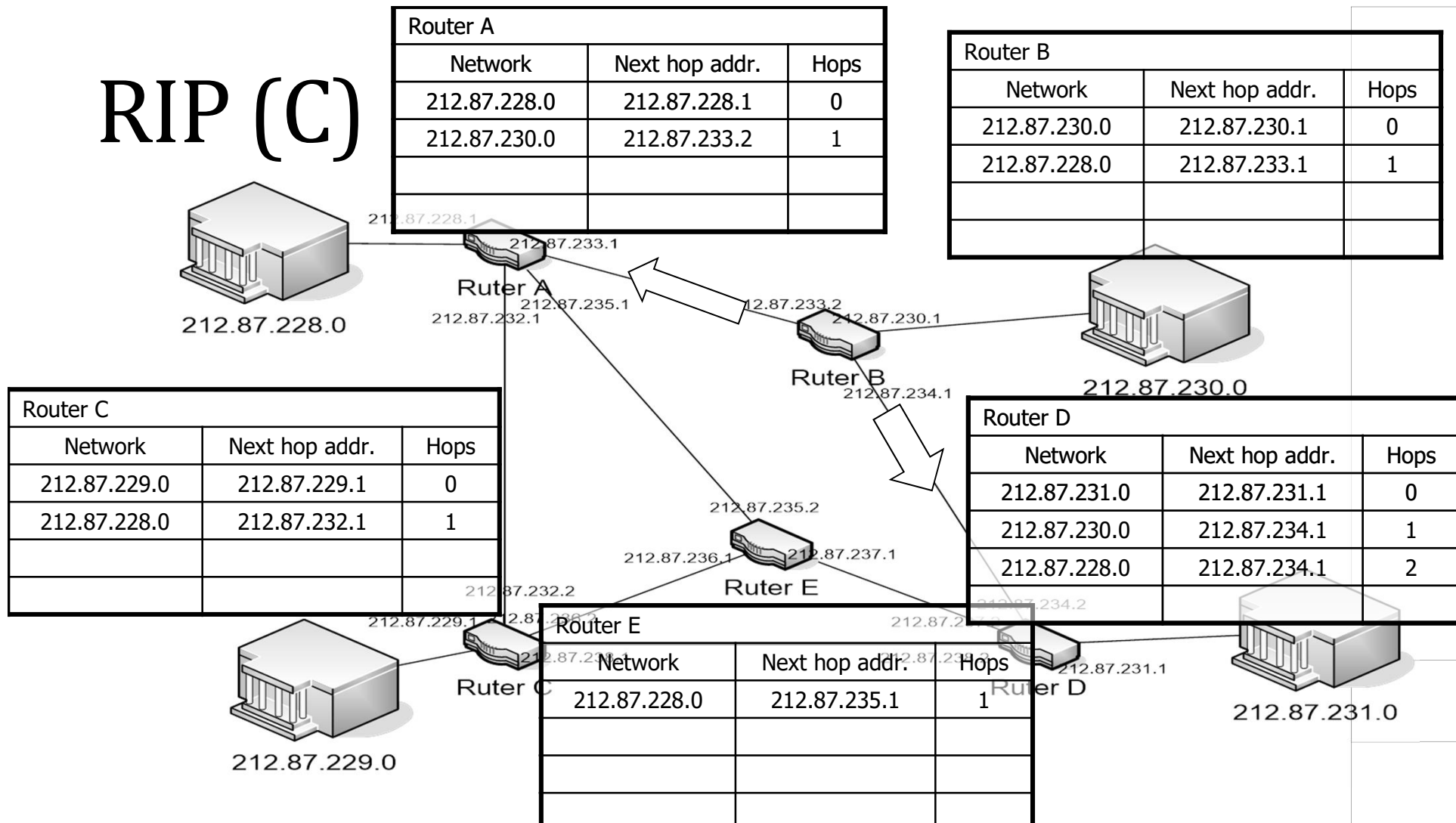
RIP (A)



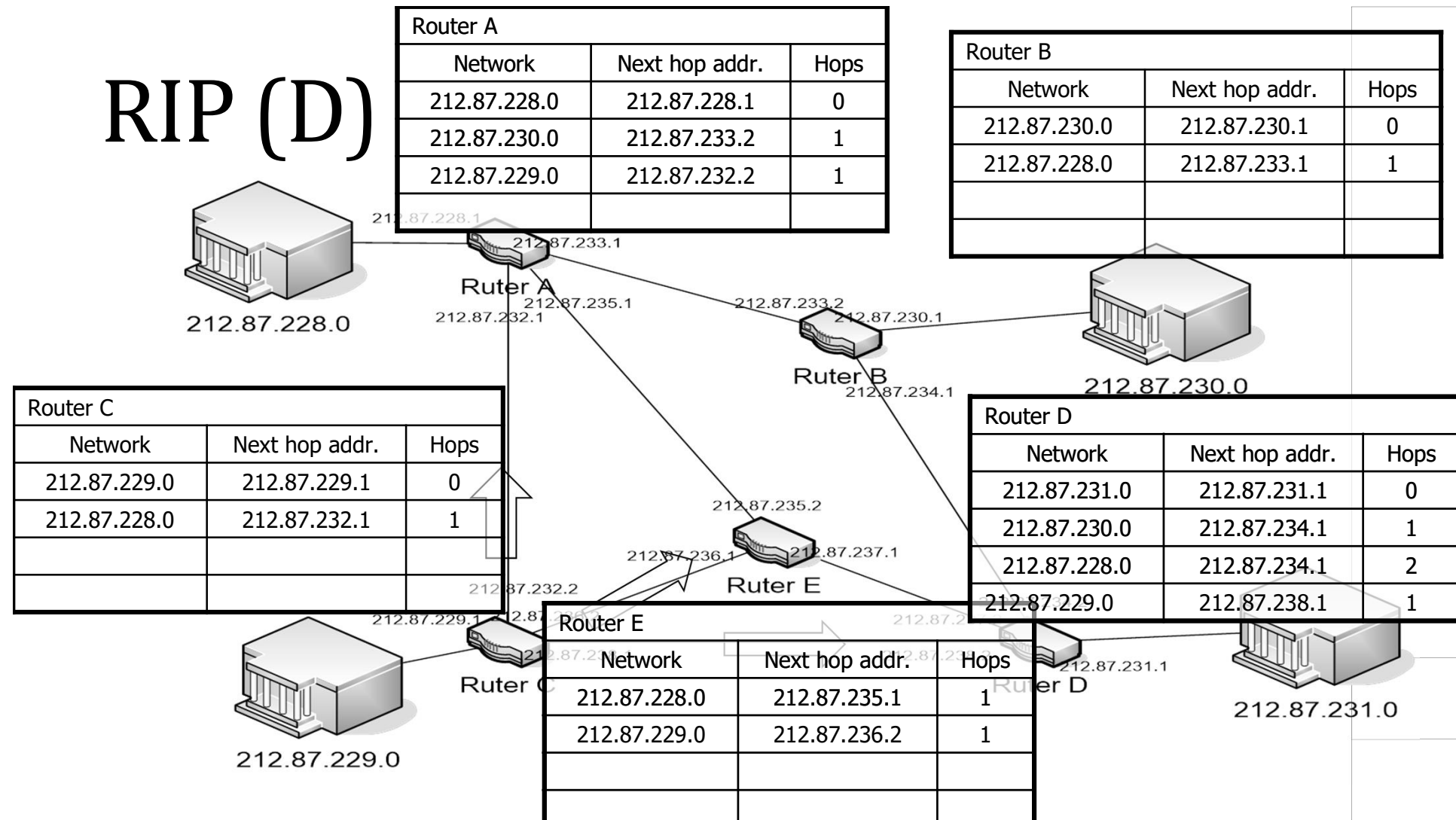
RIP (B)



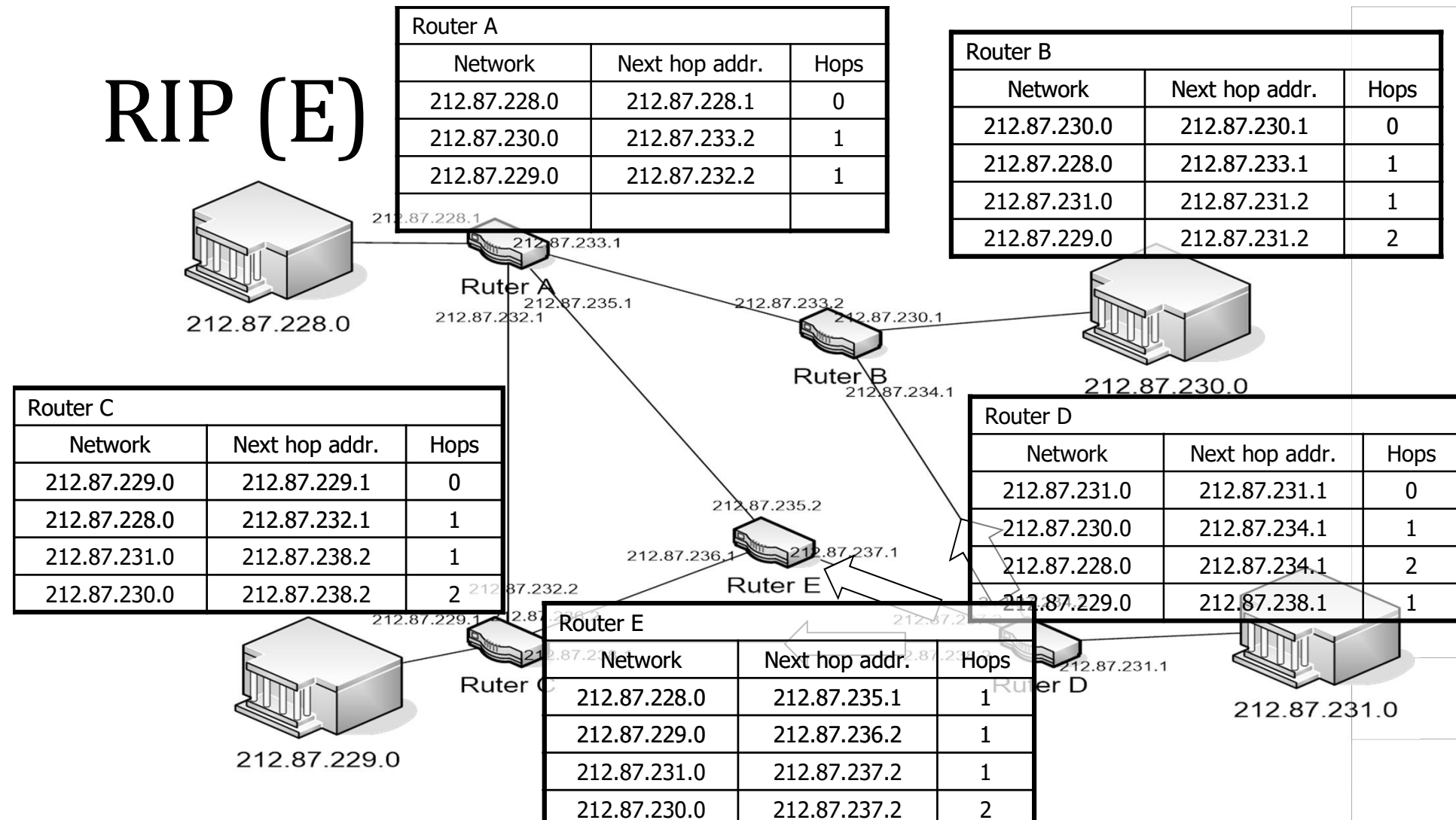
RIP (C)



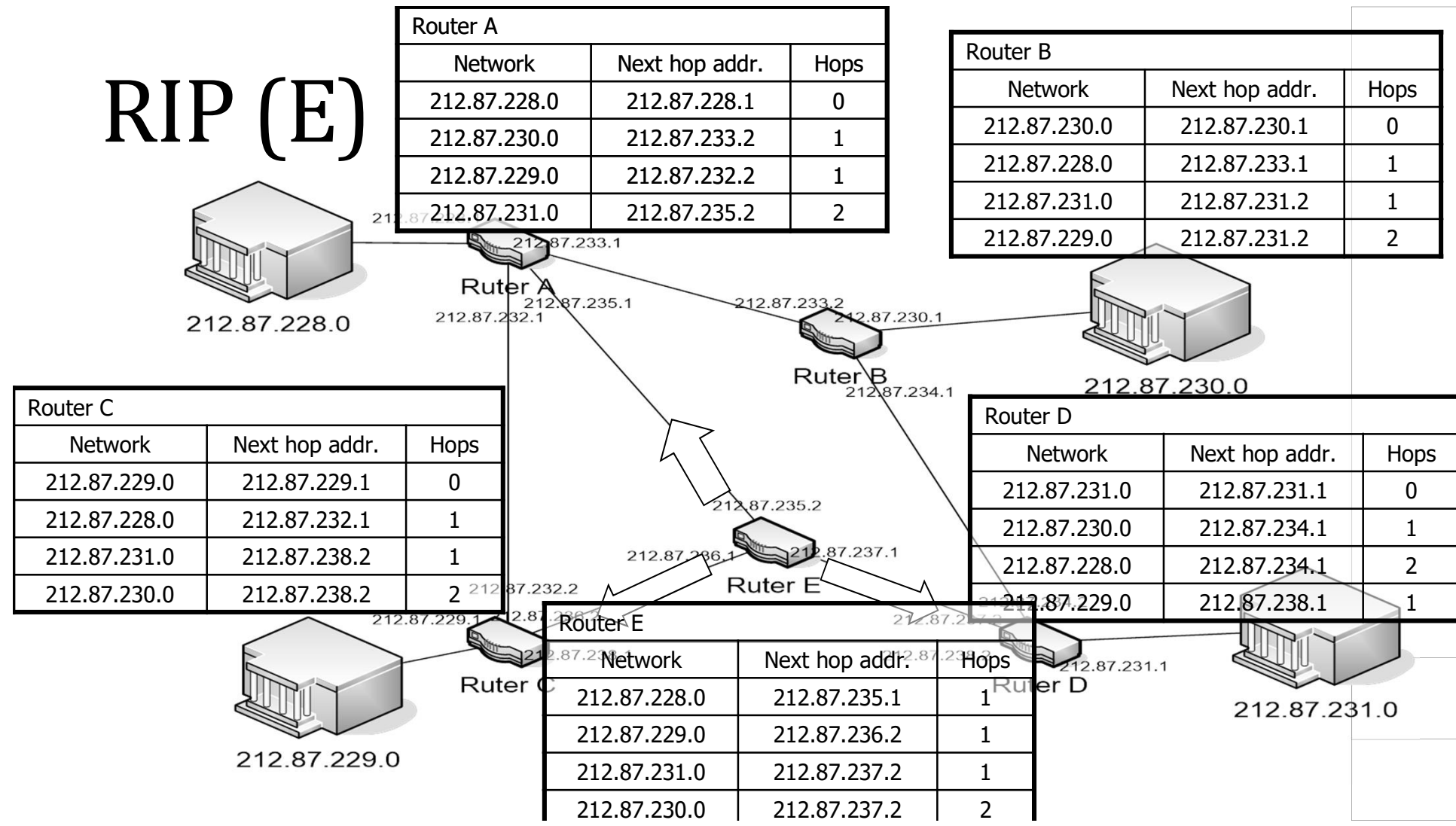
RIP (D)



RIP (E)

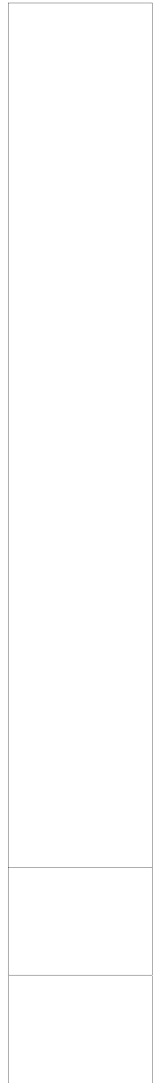


RIP (E)



Drawbacks of RIP

- Limited max length of paths = 15
- Constant metrics of single paths
- Load of links by tables exchange
- Slow convergence
- No load balancing



OSPF

- Aims
 - increasing of network scalability
 - increasing of convergence

- Roles of routers

- internal routers (IR)
- area border routers (ABR)
- backbone routers (BR)
- autonomous system boundary router (ASBR)

- Types of paths

- intra-area
- inter-area
- external (type 1 or 2)

partitioning of autonomous systems into areas

area 0

communication between autonomous systems

route print

```
C:\WINDOWS\System32\cmd.exe
C:\Documents and Settings\malina>route print
=====
Lista interfejsów
0x1 ..... MS TCP Loopback interface
0x2 ...00 30 4f 19 ac cd ..... Karta Realtek RTL8139 Family PCI Fast Ethernet N
IC - Sterownik miniport Harmonogramu pakietów
=====
Aktywne trasy:
Miejsce docelowe w sieci      Maska sieci      Brama      Interfejs      Metryka
0.0.0.0      0.0.0.0      192.168.0.1  192.168.0.10   20
127.0.0.0    255.0.0.0    127.0.0.1   127.0.0.1     1
192.168.0.0  255.255.255.0 192.168.0.10 192.168.0.10  20
192.168.0.10 255.255.255.255 127.0.0.1   127.0.0.1     20
192.168.0.255 255.255.255.255 192.168.0.10 192.168.0.10  20
224.0.0.0    240.0.0.0    192.168.0.10 192.168.0.10  20
255.255.255.255 255.255.255.255 192.168.0.10 192.168.0.10  1
Domyślna brama:      192.168.0.1.
=====
Trasy trwałe:
Brak
C:\Documents and Settings\malina>
```