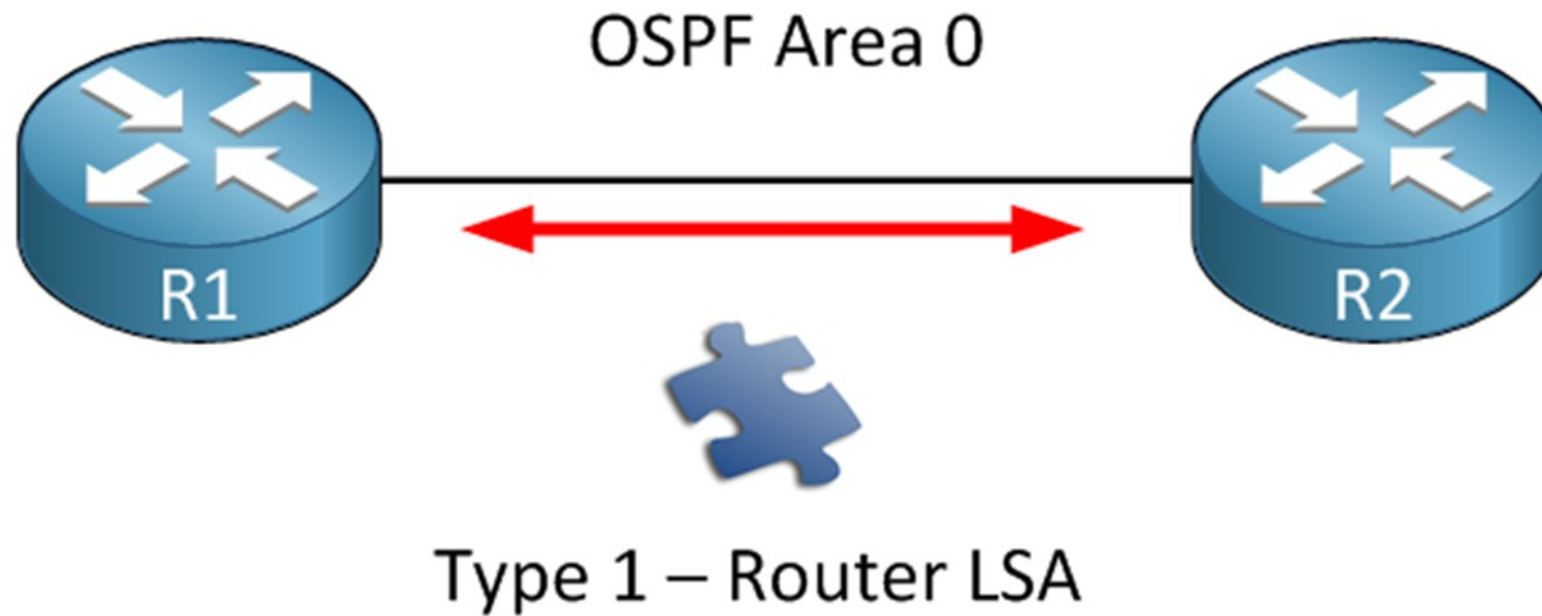


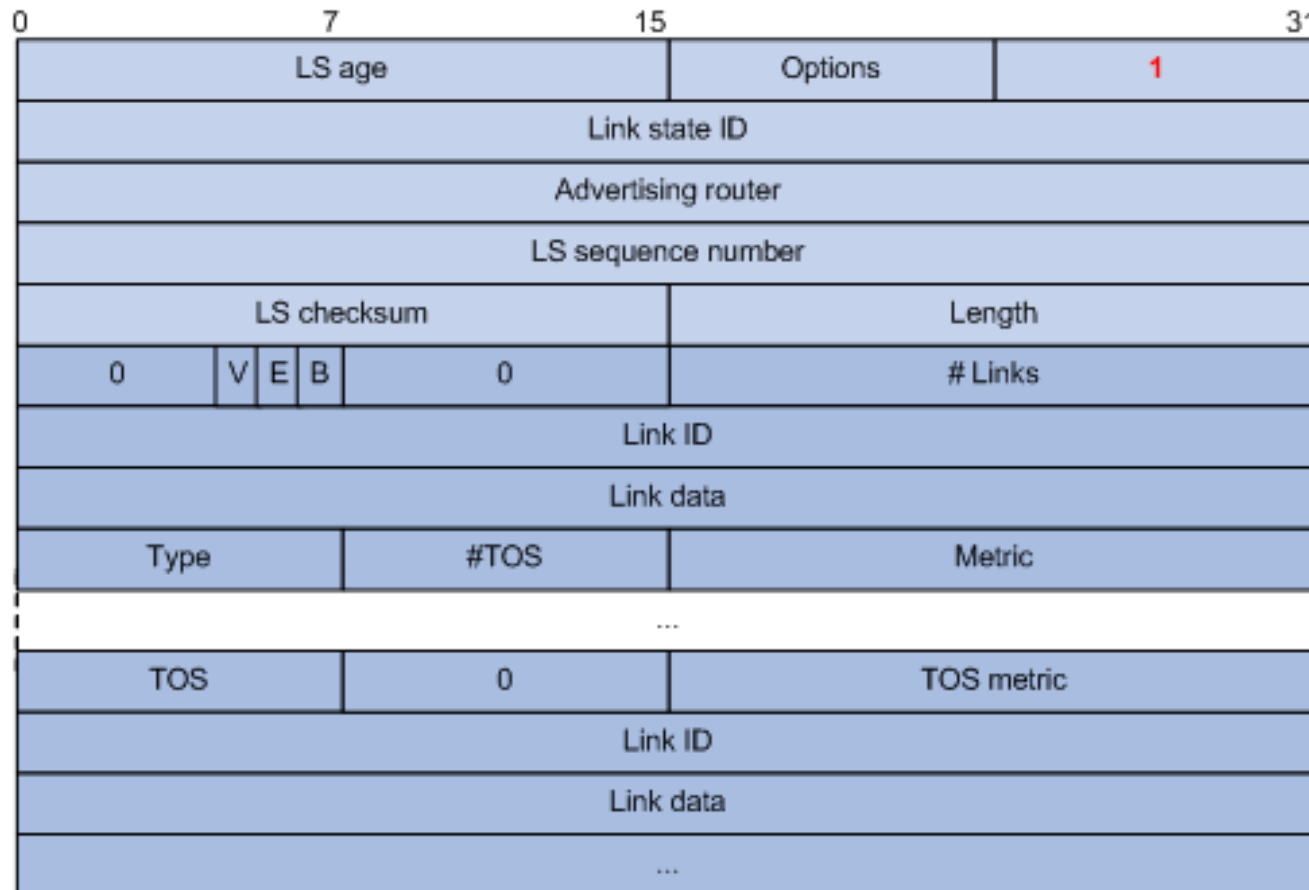
OSPF pro pokročilé

LSA (Link StateAdvertisement) typ 1: Router LSA (posílá každý router)



Typ 1 koukni i

<https://sites.google.com/site/amitsciscozone/ospf/ospf-packet-types>

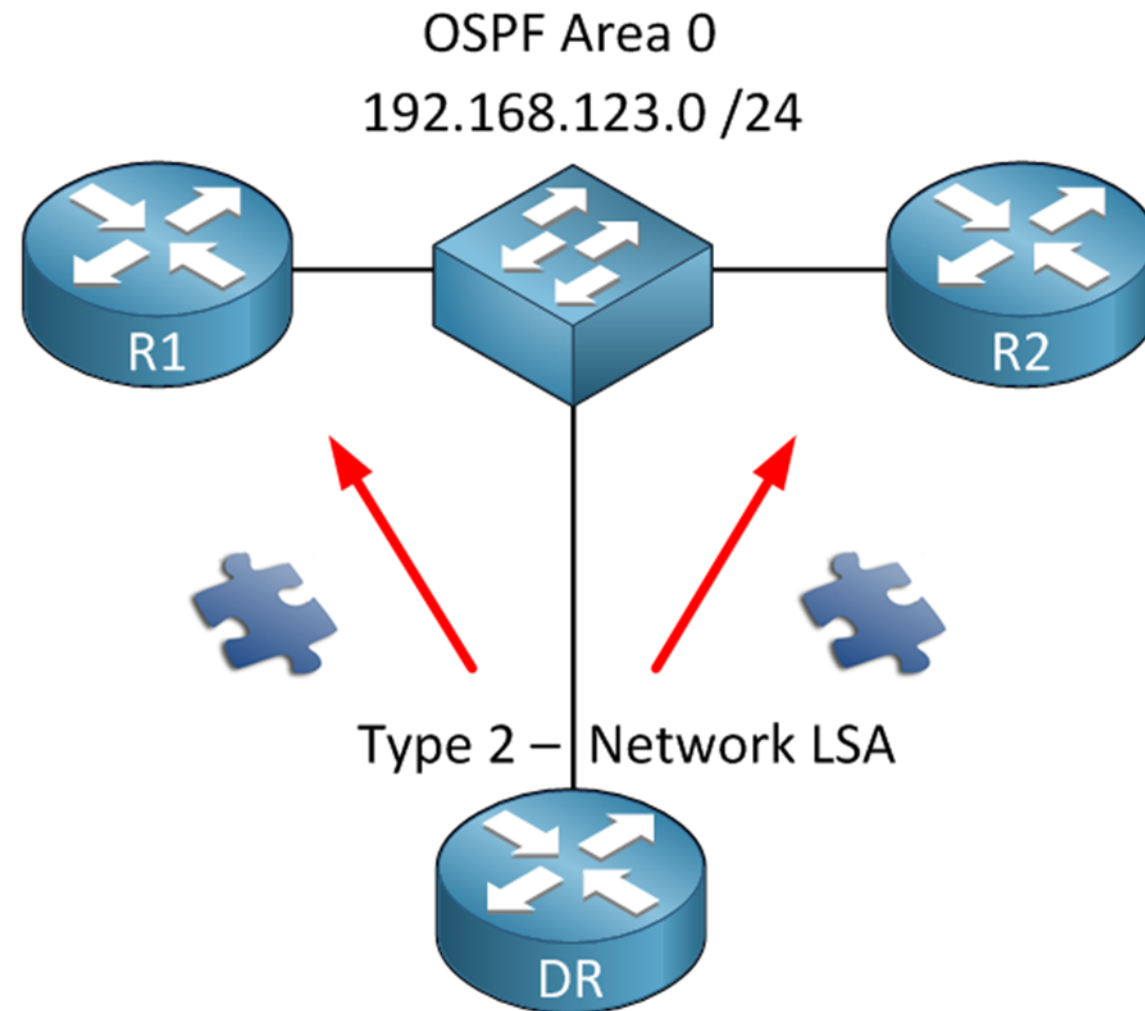


V (Virtual Link) 1: LSA je virtual link endpoint.

E (External) 1: router generující LSA je ASBR.

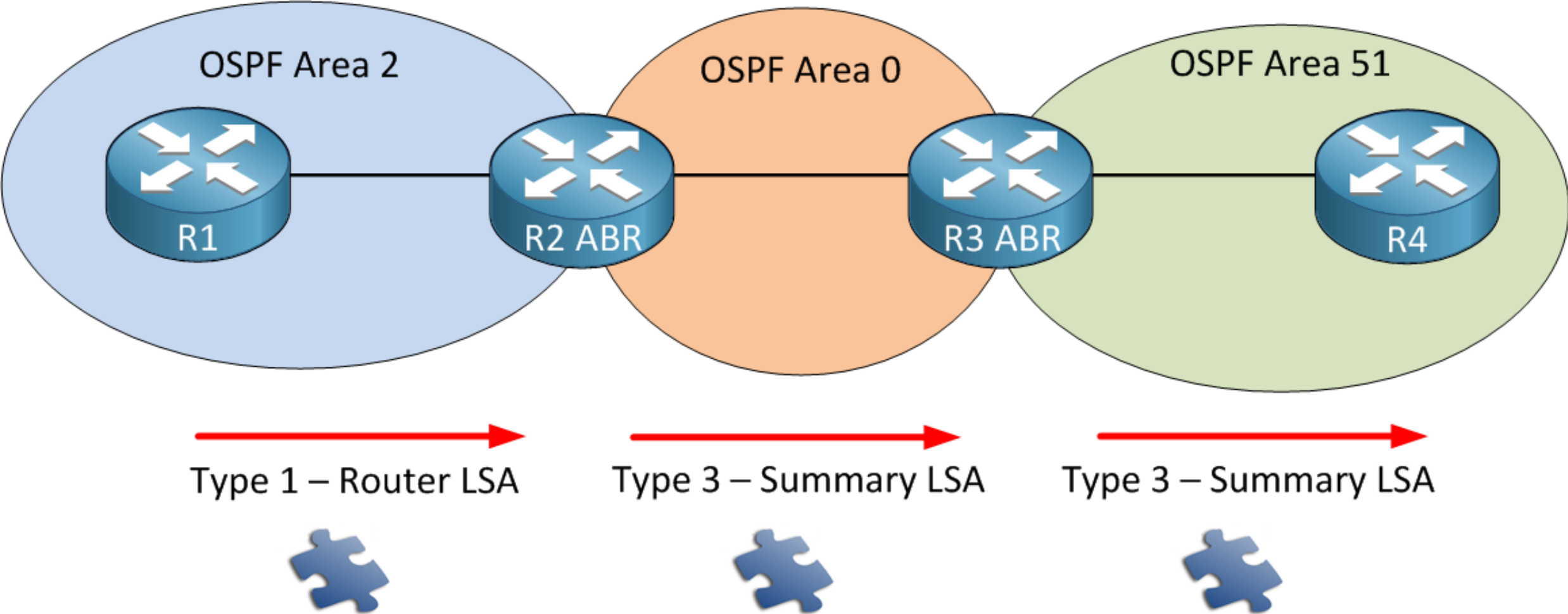
B (Border) 1: router generující LSA je ABR.

LSA Type 2: Network LSA (posílá DR, který zastupuje celou area)



LSA Type 3: Summary LSA

ABR (Autonomous Border Router).

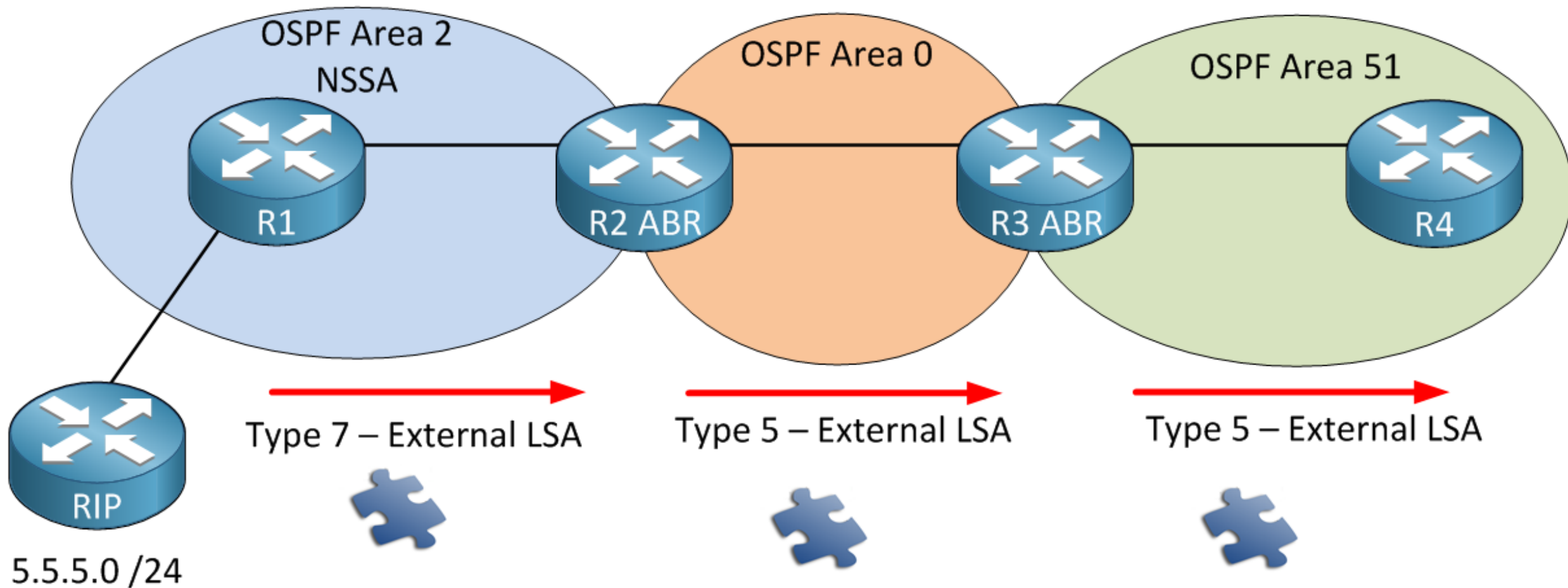


LSA Type 5: Autonomous system external LSA

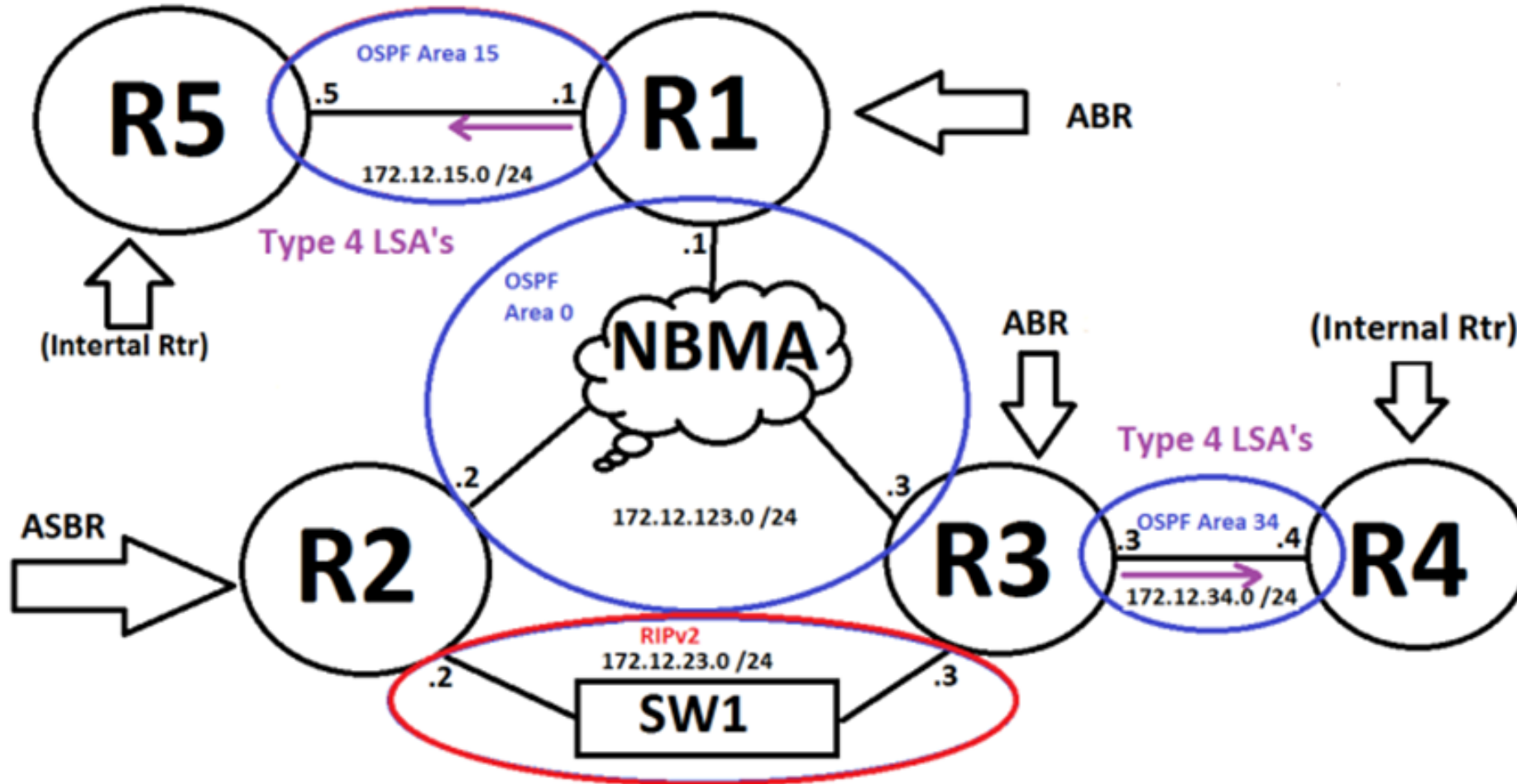
LSA Type 6: Multicast OSPF LSA – už se nepoužívá

LSA Type 7: Not-so-stubby area LSA – je za ním ještě jiný typ sítě, třeba RIP

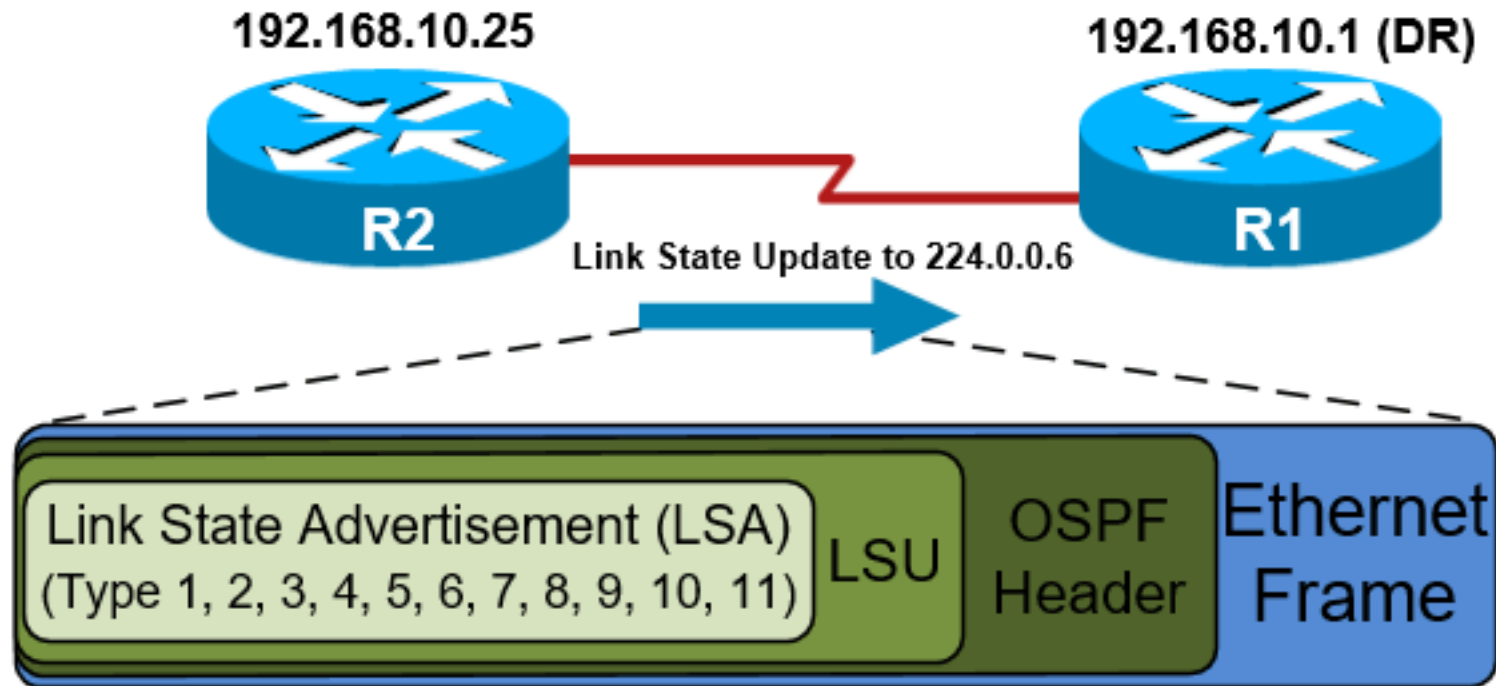
LSA Type 8: External attribute LSA for BGP



LSA Type 5: Brána do internetu – ASBR



LSU (Link State Update)



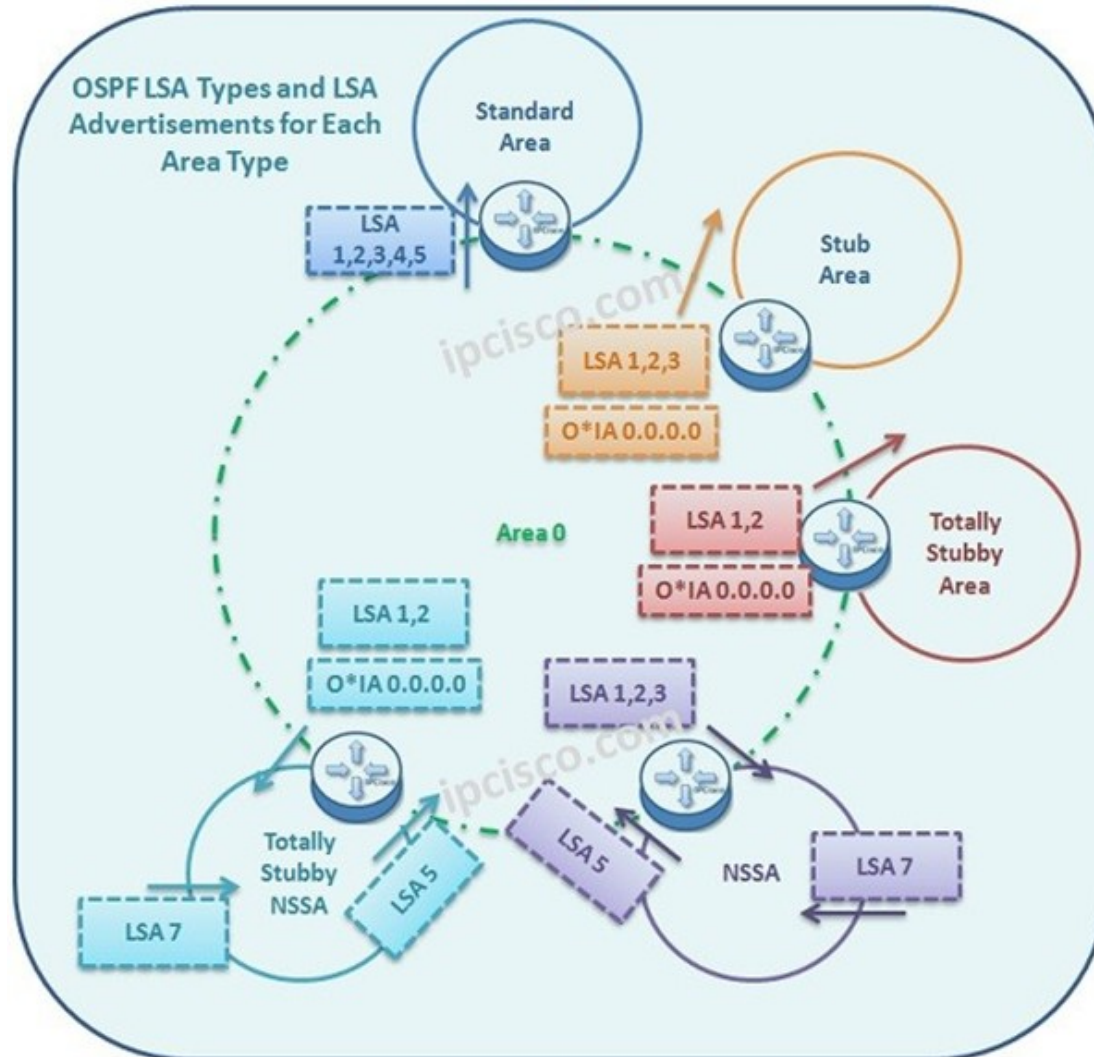
Rozdíly

Typ	Stops injection of type 4/5 LSAs	Stops injection of type 3 LSA	Internal routers originate type 7 LSA
Stubby	Yes	No	No
Totally stubby (TS)	Yes	Yes	No
Not-So-Stubby-Area (NSSA)	Yes	No	Yes
Totally NSSA (NSSA-TS)	Yes	Yes	Yes

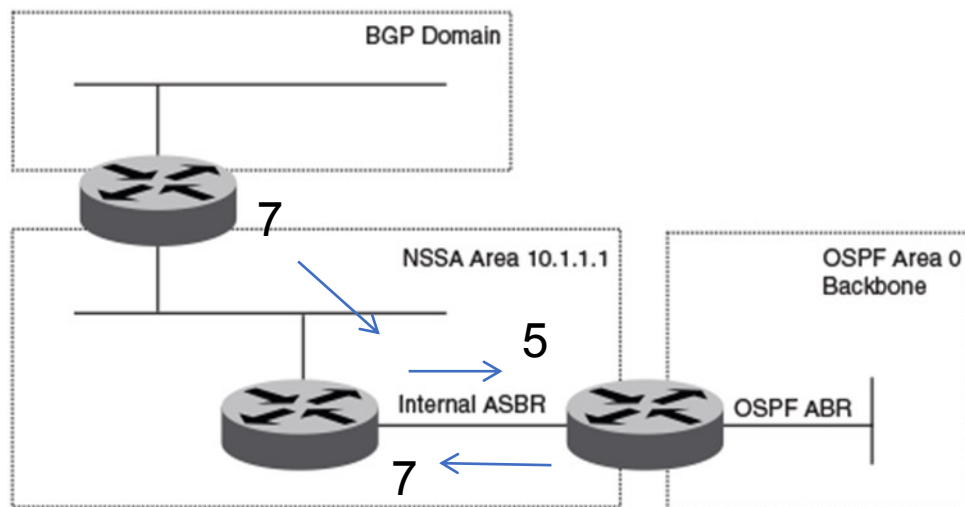
Příkazy

Type	Router OSPF subcommand
Stubby	area <area-id> stub
Totally stubby	area <area-id> stub no-summary
NSSA	area <area-id> nssa
Totally NSSA	area <area-id> nssa no-summary

Příklad typů OSPF LSA



NSSA



- Jsou zde dvě směrovací domény, doména BGP a doména OSPF.
- ASBR uvnitř NSSA importuje externí trasy z BGP do NSSA jako LSA typu 7, které ASBR zaplavuje v celém NSSA.
- ABR převádí LSA typu 7 na LSA typu 5. Pokud je pro NSSA nakonfigurována souhrnná adresa, ABR také shrnuje LSA do agregovaného LSA před zaplavením LSA typu 5 do páteře.

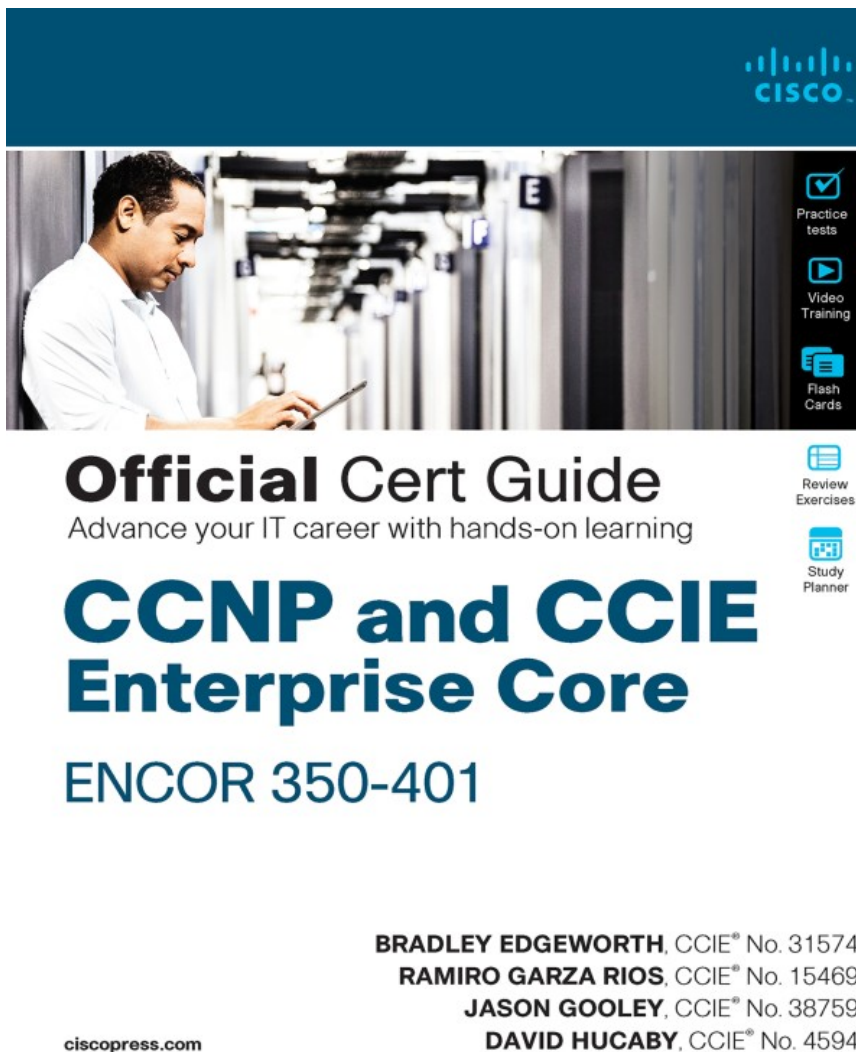
Vzhledem k tomu, že NSSA je no so stubby (částečně zavalitý), ABR nezaplavuje externí LSA z páteře do NSSA. Pro zajištění přístupu ke zbytku autonomního systému (AS) ABR generuje výchozí typ 7 LSA do NSSA.

ABR oblasti NSSA lze konfigurovat s parametrem no-summary, aby se zabránilo generování souhrnných LSA typu 3 a typu 4 do oblasti. Jedinou výjimkou je výchozí typ 3 LSA s předponou 0.0.0.0/0. Výchozí typ 7 LSA není v tomto případě vytvořen

Co je AREA

- **AREA** je logické seskupení směrovačů nebo konkrétněji logické seskupení rozhraní směrovačů.
- Členství v Area je nastaveno na úrovni rozhraní a ID oblasti je obsaženo v paketu HELLO.
- Rozhraní může patřit pouze do jedné oblasti.
- Všechny směrovače ve stejné oblasti OSPF udržují identickou kopii databáze stavu propojení (LSDB).

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Konfigurace Multi-Area OSPF a zjištění rozhraní ABR

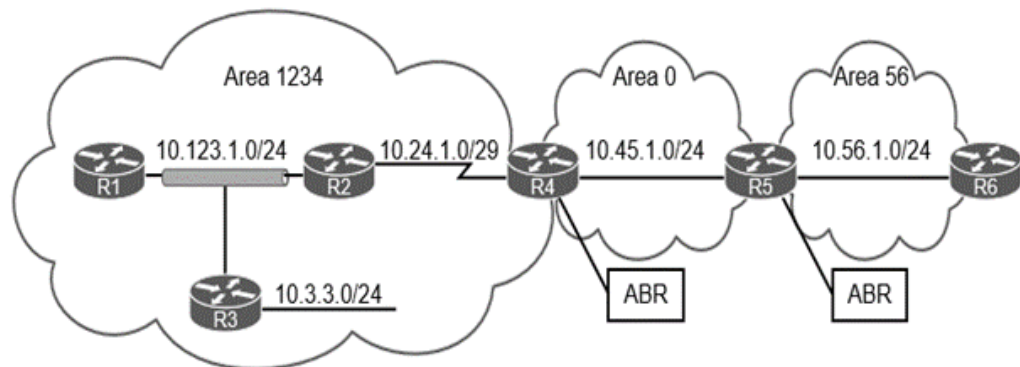


Figure 9-3 OSPF Multi-Area Topology

Example 9-1 Sample Multi-Area OSPF Configuration

```
R4
router ospf 1
router-id 192.168.4.4
network 10.24.1.0 0.0.0.255 area 1234
network 10.45.1.0 0.0.0.255 area 0
```

```
R5
router ospf 1
router-id 192.168.5.5
network 10.45.1.0 0.0.0.255 area 0
network 10.56.1.0 0.0.0.255 area 56
```

Example 9-2 Verifying Interfaces for ABRs

```
R4# show ip ospf interface brief
```

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Gi0/0	1	0	10.45.1.4/24	1	DR	1/1	
Se1/0	1	1234	10.24.1.4/29	64	P2P	1/1	

```
R5# show ip ospf interface brief
```

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Gi0/0	1	0	10.45.1.5/24	1	DR	1/1	
Gi0/1	1	56	10.56.1.5/24	1	BDR	1/1	

OSPF Intra-Area (O) and Interarea (O IA) trasy

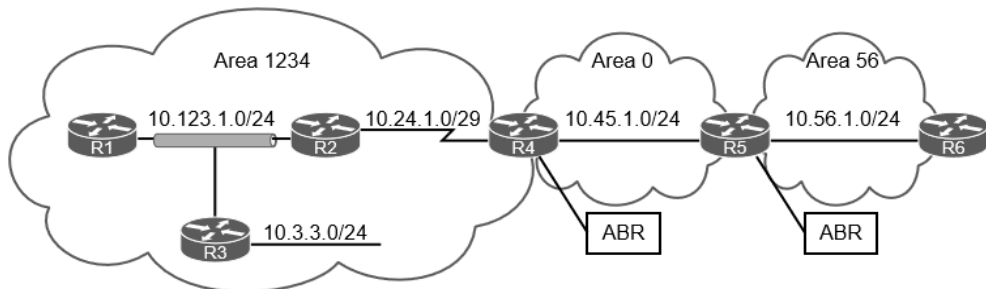


Figure 9-3 OSPF Multi-Area Topology

Example 9-3 OSPF Routing Tables for Sample Multi-Area OSPF Topology

```
R1# show ip route | begin Gateway
```

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

```
10.0.0.0/8 is variably subnetted, 6 subnets, 3 masks
```

```
! The following two routes are OSPF intra-area routes as they all come from  
! Area 1234
```

```
O 10.3.3.0/24 [110/20] via 10.123.1.3, 00:12:07, GigabitEthernet0/0  
O 10.24.1.0/29 [110/74] via 10.123.1.2, 00:12:07, GigabitEthernet0/0
```

```
! The following two routes are OSPF interarea routes as they all come from  
! outside of Area 1234
```

```
O IA 10.45.1.0/24 [110/84] via 10.123.1.2, 00:12:07, GigabitEthernet0/0  
O IA 10.56.1.0/24 [110/94] via 10.123.1.2, 00:12:07, GigabitEthernet0/0  
C 10.123.1.0/24 is directly connected, GigabitEthernet0/0
```

Example 9-4 OSPF Routing Table for ABR R4

```
R4# show ip route | begin Gateway
```

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

```
10.0.0.0/8 is variably subnetted, 7 subnets, 3 masks
```

```
O 10.3.3.0/24 [110/66] via 10.24.1.2, 00:03:45, Serial1/0  
C 10.24.1.0/29 is directly connected, Serial1/0  
C 10.45.1.0/24 is directly connected, GigabitEthernet0/0  
O IA 10.56.1.0/24 [110/2] via 10.45.1.5, 00:04:56, GigabitEthernet0/0  
O 10.123.1.0/24 [110/65] via 10.24.1.2, 00:13:19, Serial1/0
```


LSA Update

```
Internet Protocol Version 4, src: 10.123.4.2 (10.123.4.2), dst: 224.0.0.6 (224.0.0.6)
Open Shortest Path First
+ OSPF Header
- LS Update Packet
  Number of LSAs: 1
  - LS Type: Router-LSA
    LSA Type
    LS Age: 1 seconds
    LSA Age
    Do Not Age: False
    + Options: 0x22 (DC, E)
      Link-State Advertisement Type: Router-LSA (1)
      Link State ID: 192.168.2.2
      Advertising Router: 192.168.2.2 (192.168.2.2)
      Advertising Router
      LS Sequence Number: 0x80000007
      LSA Sequence
      LS Checksum: 0x3653
      Length: 60
    + Flags: 0x00
      Number of Links: 3
      + Type: Stub      ID: 192.168.2.2      Data: 255.255.255.255 Metric: 1
      + Type: Transit  ID: 10.123.4.4      Data: 10.123.4.2      Metric: 10
      + Type: Stub      ID: 10.2.2.0        Data: 255.255.255.0   Metric: 10
      Link IDs
```

Figure 9-4 Packet Capture of an LSA Update for the Second Interface

Jak vidím síť za

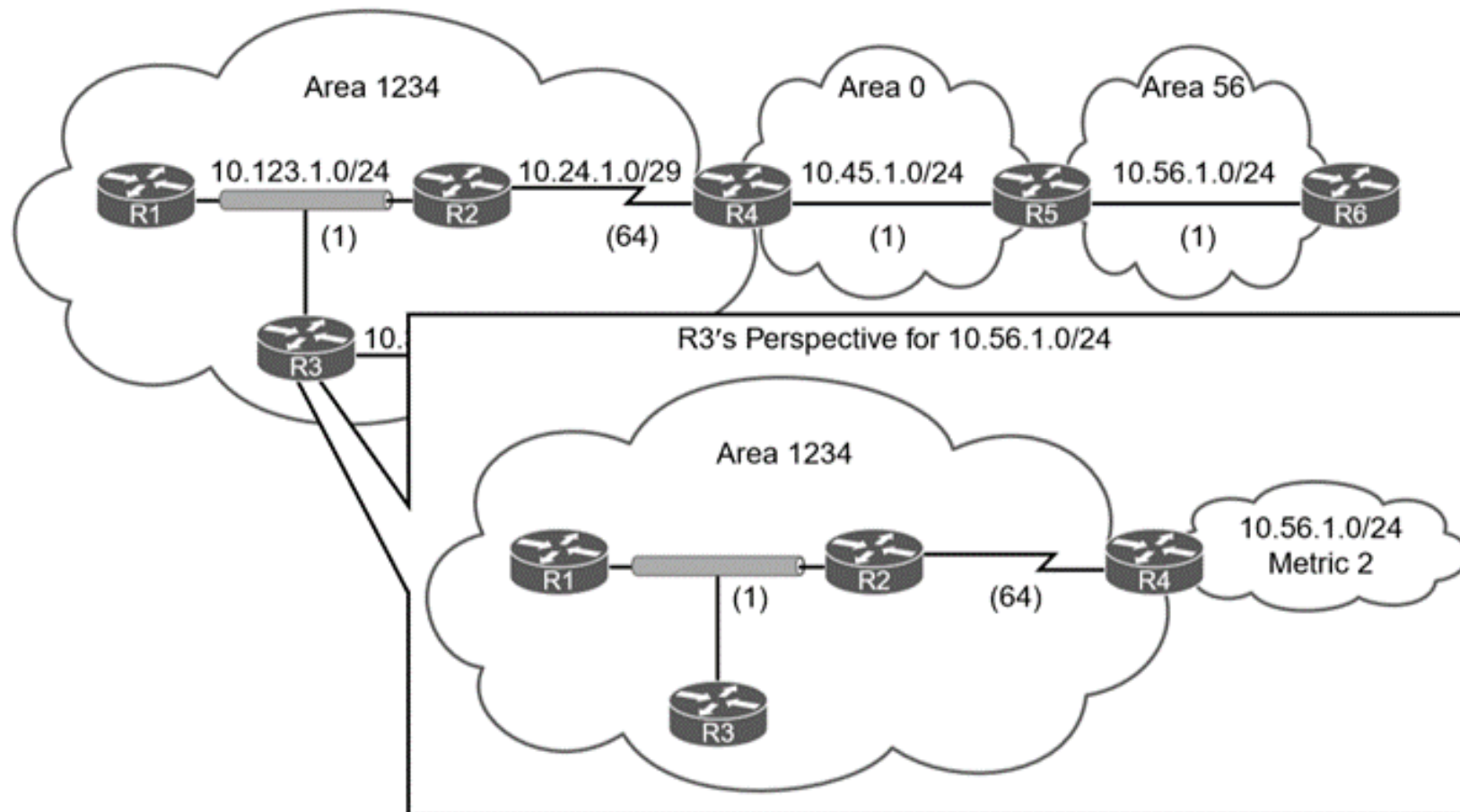


Figure 9-11 Visualization of 10.56.1.0/24 Type 3 LSA from Area 1234

Po které cestě půjdete?

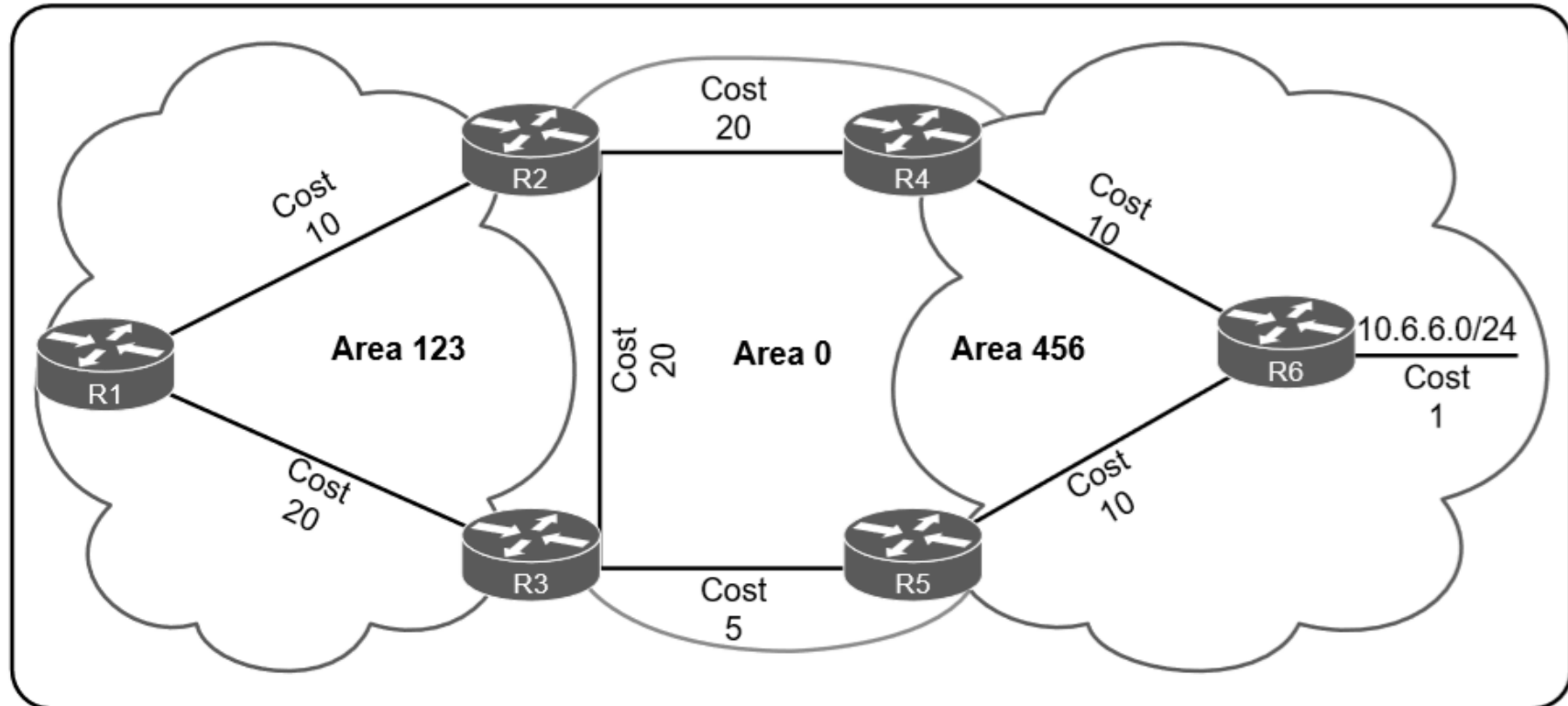


Figure 9-15 *Interarea Route Selection*

Přes který router půjdete od R1 k R4?

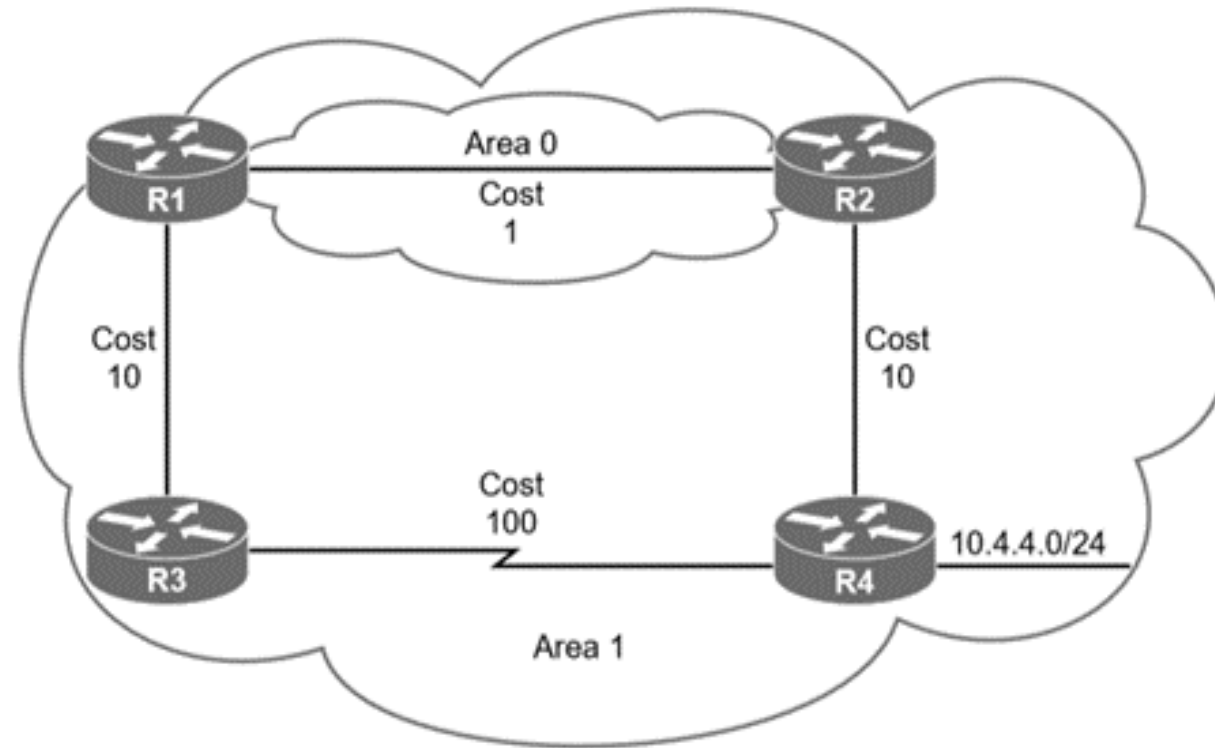


Figure 9-14 *Intra-Area Routes over Interarea Routes*

Řešení

Example 9-6 *R1's Routing Table for the 10.4.4.0/24 Network*

```
R1# show ip route 10.4.4.0
Routing entry for 10.4.4.0/24
  Known via "ospf 1", distance 110, metric 111, type intra area
  Last update from 10.13.1.3 on GigabitEthernet0/1, 00:00:42 ago
  Routing Descriptor Blocks:
  * 10.13.1.3, from 10.34.1.4, 00:00:42 ago, via GigabitEthernet0/1
    Route metric is 111, traffic share count is 1
```

Jaká cena a prefix po sumarizaci bude správně v Area 0?

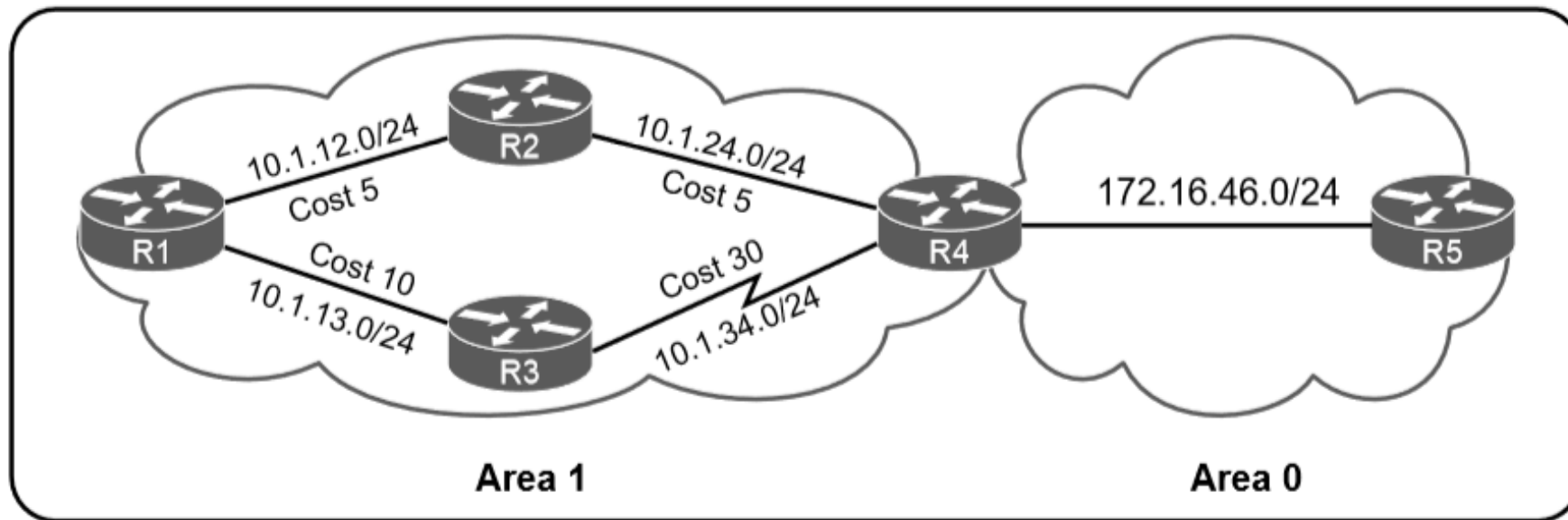


Figure 9-17 *The Impact of Summarization on SPF Topology Calculation*

Sumarizace

area *area-id* range *network subnet-mask* [advertise | not-advertise] [cost metric]

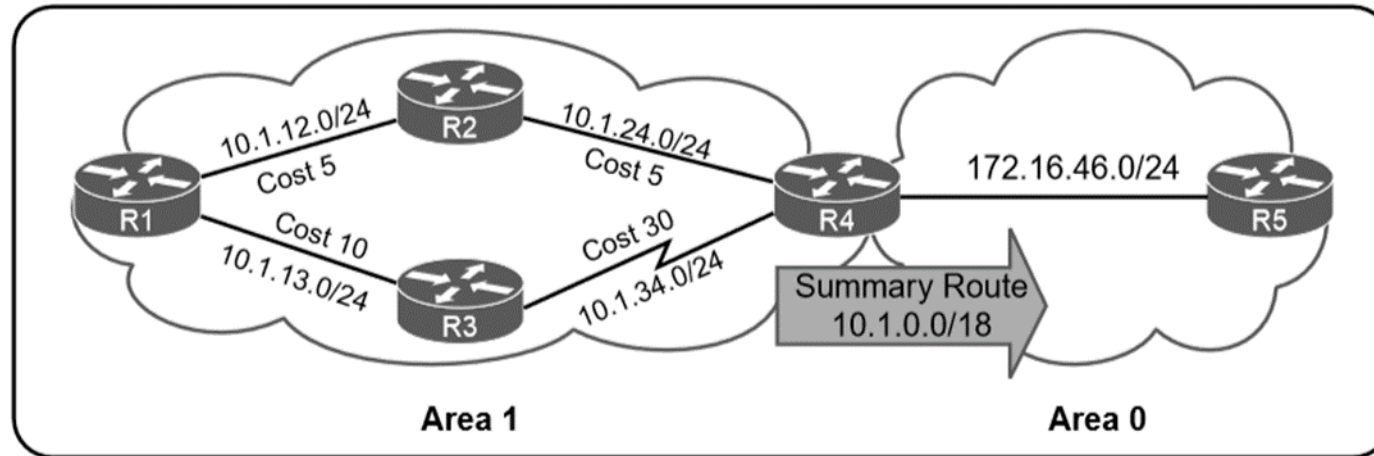
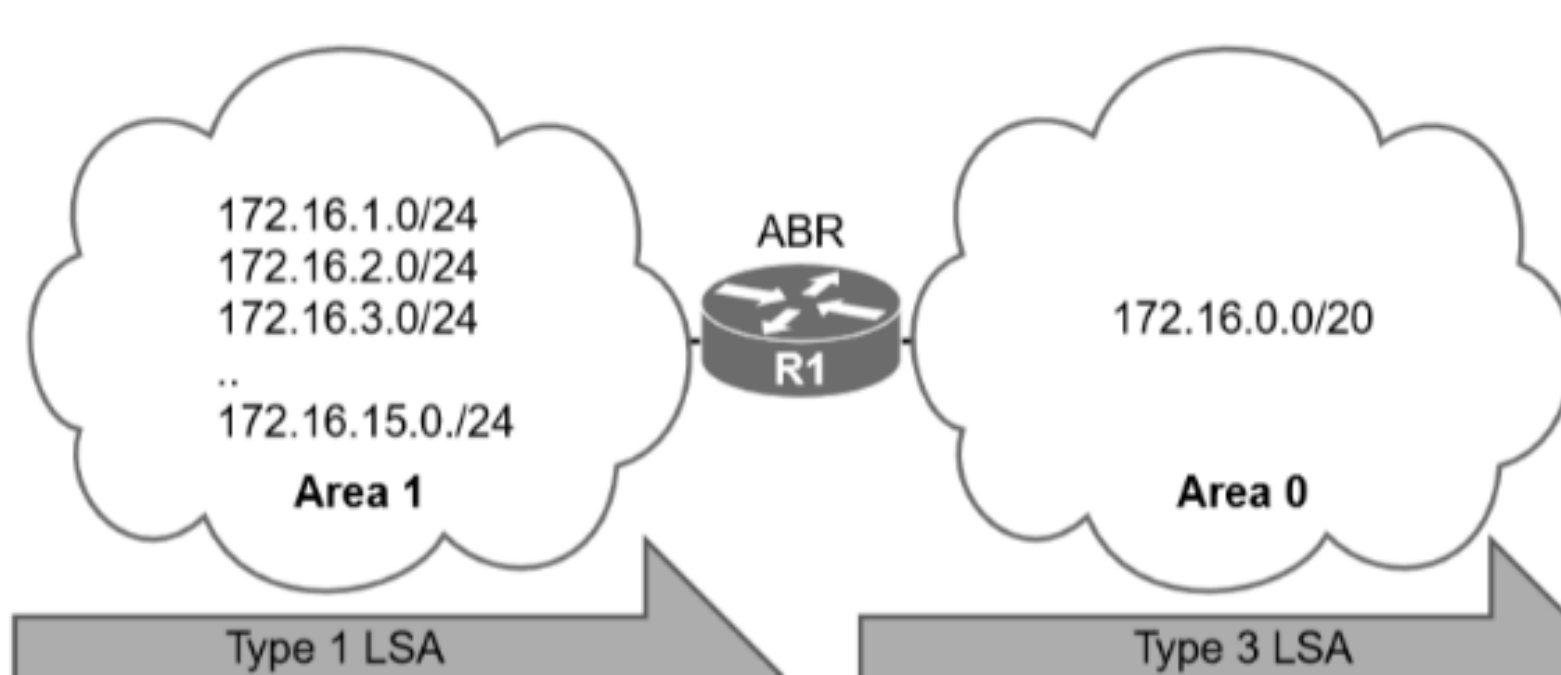


Figure 9-18 Topology Example with Summarization

Uved'te výsledný prefix v Area 0 po sumarizaci



Sumarizace

`area area-id range network subnet-mask [advertise | not-advertise] [cost metric]`

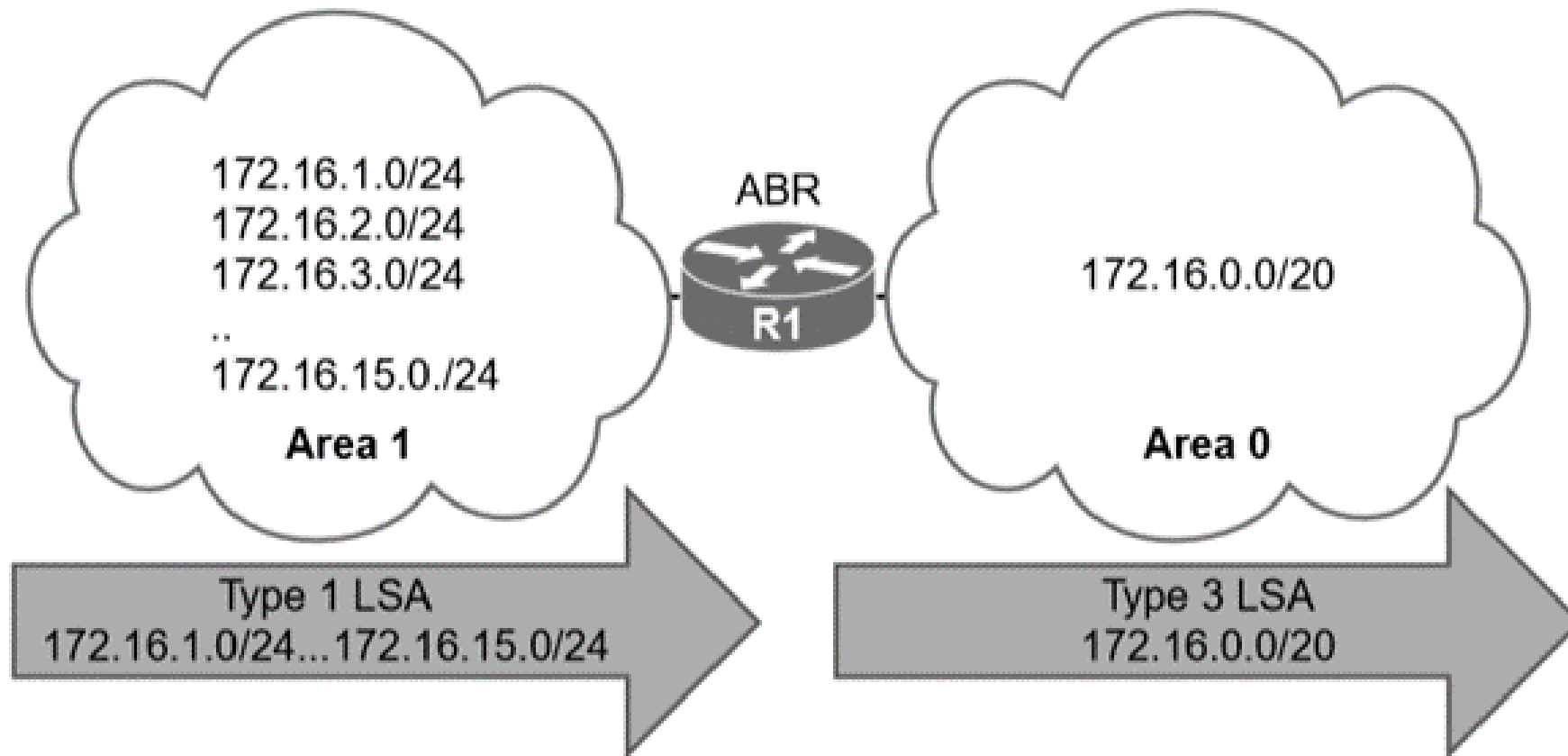


Figure 9-19 *OSPF Interarea Summarization*

Příklad

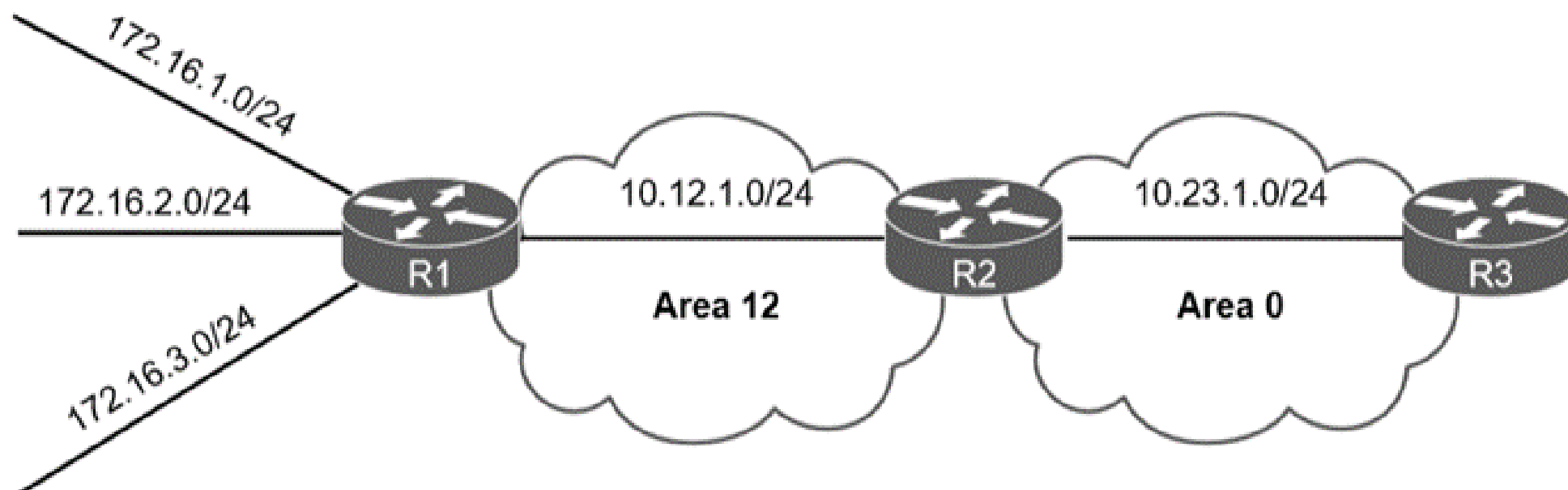
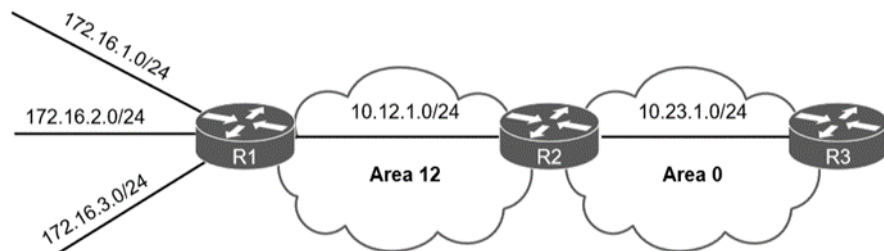


Figure 9-21 *OSPF Interarea Summarization Example*

Před sumarizací



Fig

Example 9-7 *Routing Table Before OSPF Interarea Route Summarization*

```
R3# show ip route ospf | b Gateway
```

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

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
```

```
O IA 10.12.1.0/24 [110/20] via 10.23.1.2, 00:02:22, GigabitEthernet0/1
```

```
172.16.0.0/24 is subnetted, 3 subnets
```

```
O IA 172.16.1.0 [110/3] via 10.23.1.2, 00:02:12, GigabitEthernet0/1
```

```
O IA 172.16.2.0 [110/3] via 10.23.1.2, 00:02:12, GigabitEthernet0/1
```

```
O IA 172.16.3.0 [110/3] via 10.23.1.2, 00:02:12, GigabitEthernet0/1
```

Sumarizace

Example 9-8 *R2's Interarea Route Summarization Configuration*

```
router ospf 1
  router-id 192.168.2.2
  area 12 range 172.16.0.0 255.255.0.0 cost 45
  network 10.12.0.0 0.0.255.255 area 12
  network 10.23.0.0 0.0.255.255 area 0
```

Po sumarizacii

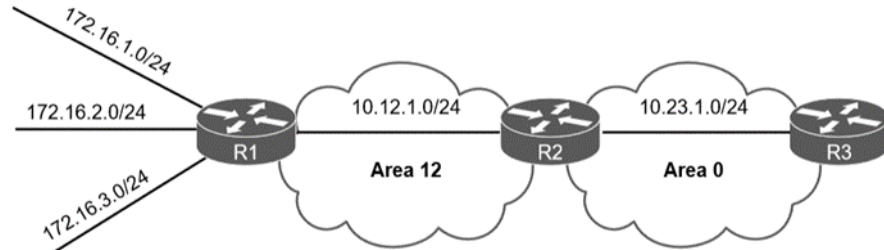


Figure 9-21 OSPF Interarea Summarization Example

Example 9-9 Routing Table After OSPF Interarea Route Summarization

```
R3# show ip route ospf | begin Gateway
Gateway of last resort is not set

    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O IA   10.12.1.0/24 [110/2] via 10.23.1.2, 00:02:04, GigabitEthernet0/1
O IA   172.16.0.0/16 [110/46] via 10.23.1.2, 00:00:22, GigabitEthernet0/1
```

Co s podsítí, která není?

Null0

Example 9-10 *Discarding a Route for Loop Prevention*

```
R2# show ip route ospf | begin Gateway
```

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

```
    172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
```

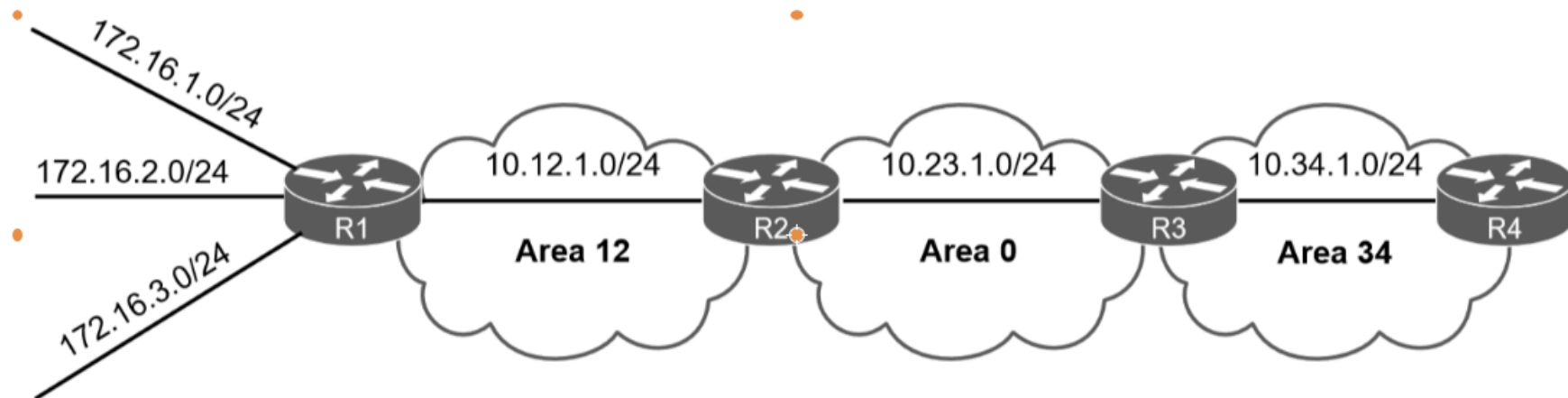
```
O    172.16.0.0/16 is a summary, 00:03:11, Null0
```

```
O    172.16.1.0/24 [110/2] via 10.12.1.1, 00:01:26, GigabitEthernet0/0
```

```
O    172.16.2.0/24 [110/2] via 10.12.1.1, 00:01:26, GigabitEthernet0/0
```

```
O    172.16.3.0/24 [110/2] via 10.12.1.1, 00:01:26, GigabitEthernet0/0
```

Jak odfiltruji pro area 0 na R2 cestu do 172.16.1.0_



Filtrace se sumarizací

Example 9-11 *R2's Configuration for Filtering via Summarization*

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# router ospf 1
R2(config-router)# area 12 range 172.16.2.0 255.255.255.0 not-advertise
```

Example 9-12 *Verifying Removal of 172.16.2.0 from Area 0*

```
R3# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O IA   10.12.1.0/24 [110/3] via 10.34.1.3, 00:02:24, GigabitEthernet0/0
      172.16.0.0/24 is subnetted, 2 subnets
O IA   172.16.1.0 [110/4] via 10.34.1.3, 00:00:17, GigabitEthernet0/0
O IA   172.16.3.0 [110/4] via 10.34.1.3, 00:00:17, GigabitEthernet0/0
```

Problém: 172.16.1.0/24 potřebuji v Area0
ale ne v Area34

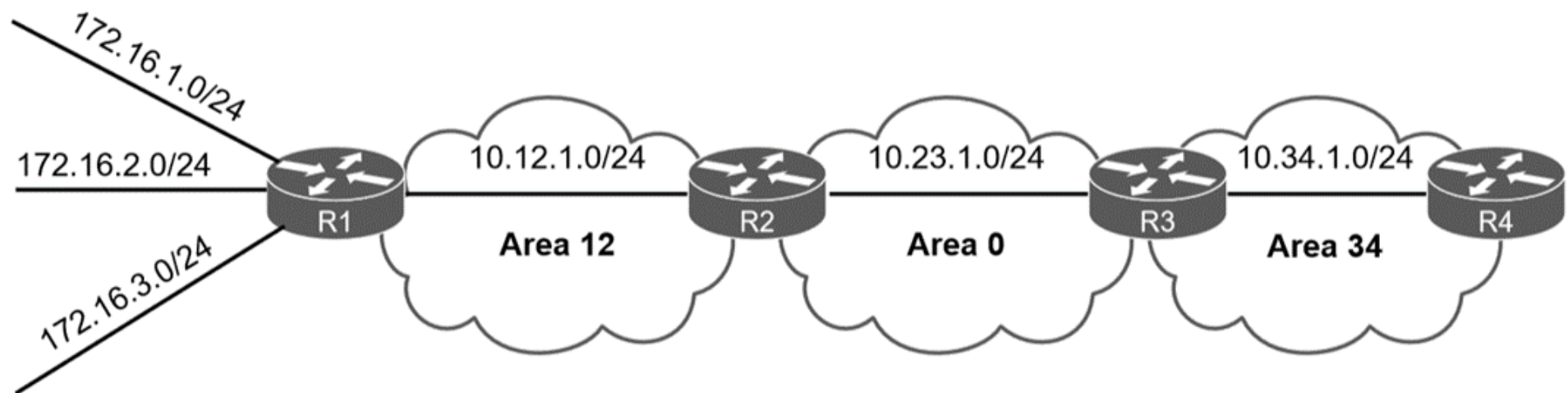


Figure 9-22 *Expanded Topology for Filtering Routes*

Řešení:

area *area-id* filter-list prefix *prefix-list-name* {in | out}

Example 9-13 *Configuring OSPF Area Filtering*

```
R2
ip prefix-list PREFIX-FILTER seq 5 deny 172.16.1.0/24
ip prefix-list PREFIX-FILTER seq 10 permit 0.0.0.0/0 le 32
!
router ospf 1
  router-id 192.168.2.2
  network 10.12.1.0 0.0.0.255 area 12
  network 10.23.1.0 0.0.0.255 area 0
  area 0 filter-list prefix PREFIX-FILTER in
```

```
!
router ospf 1
  router-id 192.168.3.3
  network 10.23.1.0 0.0.0.255 area 0
  network 10.34.1.0 0.0.0.255 area 34
  area 0 filter-list prefix PREFIX-FILTER out
```

Lokální filtrace pomocí distribučního seznamu

Example 9-15 *Configuring the OSPF Distribute List*

```
R2
ip access-list standard ACL-OSPF-FILTER
deny 172.16.3.0
permit any
!
router ospf 1
router-id 192.168.2.2
network 10.12.1.0 0.0.0.255 area 12
network 10.23.1.0 0.0.0.255 area 0
distribute-list ACL-OSPF-FILTER in
```

Example 9-16 *Verifying the OSPF Distribute List*

```
R2# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O IA   10.34.1.0/24 [110/2] via 10.23.1.3, 00:02:21, GigabitEthernet0/1
      172.16.0.0/24 is subnetted, 2 subnets
O      172.16.1.0 [110/2] via 10.12.1.1, 00:02:21, GigabitEthernet0/0
O      172.16.2.0 [110/2] via 10.12.1.1, 00:02:21, GigabitEthernet0/0

R3# show ip route ospf | begin Gateway
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O IA   10.12.1.0/24 [110/2] via 10.23.1.2, 00:24:11, GigabitEthernet0/1
      172.16.0.0/24 is subnetted, 3 subnets
O IA   172.16.1.0 [110/3] via 10.23.1.2, 00:01:54, GigabitEthernet0/1
O IA   172.16.2.0 [110/3] via 10.23.1.2, 00:23:02, GigabitEthernet0/1
O IA   172.16.3.0 [110/3] via 10.23.1.2, 00:23:02, GigabitEthernet0/1
```