

Ověření IGMP snoopingu na přepínačích Cisco Catalyst

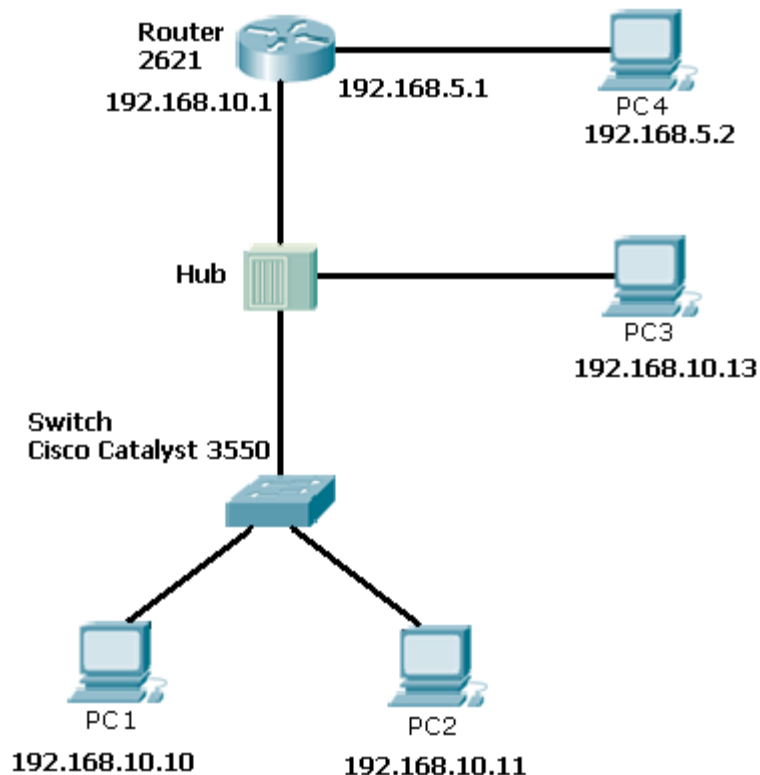
Dopracování semestrálního projektu do předmětu
Směrované a přepínané sítě

Praktické overenie IGMP snoopingu:

Pre popis IGMP správ a IGMP snoopingu pozri projekt

<http://www.cs.vsb.cz/grygarek/SPS/projekty0405/IGMPsnooping-Buzek.pdf>

Na obrázku vidíme testovacie zapojenie. Bol použitý switch Cisco Catalyst 3550. Počítače PC1 a PC2 boli použité ako príjemci multicastu, počítač PC4 ako zdroj multicastu. Na generovanie a príjem slúžil program VLC media player. Počítač PC3, ktorý je zapojený do hubu slúži na odchyt IGMP správ a je na ňom a všetkých ostatných počítačoch spustený program Ethereal. Práve tento program nám slúži na overenie, že multicastové data prijíma len klient, ktorý ma o ne záujem a pomáha nám zisťovať, ako switch potláča, mení a odchyťáva IGMP správy a multicastové dáta.



Konfigurácia PIM protokolu na routeri:

Na routeri povolíme ip multicast, na potrebných portoch aktivujeme routovací protokol PIM a IGMP v 3. Bez nakonfigurovaného PIM router nechcel smerovať multicast.

```
router> enable
router# configure terminal
router(config)# ip multicast-routing
```

```
router(config)# interface FastEthernet 0
router(config-if)# ip pim sparse-mode
router(config-if) # ip igmp version 3
```

```
router(config)# interface FastEthernet 1
router(config-if)# ip pim sparse-mode
router(config-if) # ip igmp version 3
```

pri použití pim sparse-mode je nutné zvolit si Rendezvous Point

```
router(config)#ip pim rp-address 192.168.10.1
```

Switch Cisco Catalyst 3550

Na prepínačoch Cisco Catalyst je IGMP snooping globálne povolený, takže netreba meniť jeho konfiguráciu. Počítače PC1 a PC2 sú členmi Vlan 1.

```
Switch#sho ip igmp snooping
Global IGMP Snooping configuration:
-----
IGMP snooping                : Enabled
IGMPv3 snooping (minimal)    : Enabled
Report suppression           : Enabled
TCN solicit query            : Disabled
TCN flood query count        : 2

Vlan 1:
-----
IGMP snooping                : Enabled
Immediate leave               : Disabled
Multicast router learning mode : pim-dvmrp
Source only learning age timer : 10
CGMP interoperability mode     : IGMP_ONLY
```

**Zdroj multicastu - 192.168.5.1 (PC4),
Multicastová adresa - 224.5.6.7**

**Prijemci multicastu – 192.168.10.10 (PC1)
192.168.10.11 (PC2)**

Počítače s OS Windows XP, na generovanie a príjem slúžil program VLC media player.

Metodika merania:

1. Spustenie VLC streamu na PC 4.
2. Spustenie ethereal na každom počítači. Keďže nemáme záujem zachytávať všetky dáta, nastavíme filter *dst host 224.5.6.7 or igmp*.
3. Necháme spustené asi 2 min., čo zaistí, že každý. počítač zachytí aspoň jeden router advertisement (general query), ktorý je zároveň synchronizačný paket pre ethereal.
4. Spustíme VLC na PC 1, začneme prijímať dáta a necháme prehrávať asi 2 min.
5. Vypíšeme zo switchu a routeru “ show ip igmp”.
6. Spustíme VLC na PC 2, začneme prijímať dáta a necháme prehrávať ďalšie 2 min.
7. Znova vypíšeme zo switchu a routeru “ show ip igmp”.
8. Odhlásime PC 1 z multicastovej skupiny zastavením VLC.
9. Sledujeme zmeny pomocou “ show ip igmp”.
10. Odhlásime PC 2 z multicastovej skupiny.
11. Sledujeme zmeny pomocou “ show ip igmp”.
12. Zastavíme zachytávanie paketov etherealom na všetkých počítačoch.
13. Analýza zachytených dát etherealom na počítačoch, a výpisov z routeru a switchu.

Analýza zachytených dát etherealom

- **No.** Číslo zachyteného paketu.
- **Time** Čas zachytenia paketu.
- **Source** Zdrojová IP adresa.
- **Destination** Cieľová IP adresa.
- **Protocol** Názov protokolu.
- **Info** Doplnujúce informácie o pakete.
- **IGMP Version** Verzia IGMP.
- **Type** Typ IGMP správy.
- **Header checksum** Kontrola integrity dát pomocou kontrolného sučtu.
- **Num Group Records** Počet záznamov multicastových skupín.
- **Group Record** Záznam skupiny.

	<i>Počiatkový stav, router generuje každú minútu IGMP Membership Query</i>				
PC3	<pre> No. Time Source Destination Protocol Info 5 60.015078 192.168.10.1 224.0.0.1 IGMP V3 Membership Query Frame 5 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:00:00:01 (01:00:5e:00:00:01) Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.0.0.1 (224.0.0.1) Internet Group Management Protocol IGMP Version: 3 Type: Membership Query (0x11) Max Response Time: 10,0 sec (0x64) Header checksum: 0xec5f [correct] Multicast Address: 0.0.0.0 (0.0.0.0) QRV=2 S=Do not suppress router side processing QQIC: 60 Num Src: 0 </pre>				
PC1 & PC2	<pre> No. Time Source Destination Protocol Info 3 60.015620 192.168.10.1 224.0.0.1 IGMP V3 Membership Query Frame 3 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:00:00:01 (01:00:5e:00:00:01) Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.0.0.1 (224.0.0.1) Internet Group Management Protocol IGMP Version: 3 Type: Membership Query (0x11) Max Response Time: 10,0 sec (0x64) Header checksum: 0xec5f [correct] Multicast Address: 0.0.0.0 (0.0.0.0) QRV=2 S=Do not suppress router side processing QQIC: 60 Num Src: 0 </pre>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Address Type Version Port List ---- - </pre>				
router	<pre> router#sho ip igmp groups IGMP Connected Group Membership Group Address Interface Uptime Expires Last Reporter </pre>				

	<i>PC1 sa prihlásilo do skupiny. Na switch je poslaný Exclude Mode membership report, ten ho poslal na router nezmenený, ale potlačil jeho poslanie na ostatne porty (PC2 ho nepočuje).</i>				
PC1	<pre> No. Time Source Destination Protocol Info 7 134.959717 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 7 (54 bytes on wire, 54 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf3f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Exclude Mode </pre>				
PC3	<pre> No. Time Source Destination Protocol Info 13 134.960387 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 13 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf3f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Exclude Mode </pre>				
PC2	bez zmeny				
router	<pre> router#sho ip igmp groups Group Address Interface Uptime Expires Last Reporter 224.5.6.7 FastEthernet0/1 00:00:15 00:02:44 192.168.10.10 </pre>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Type Version Port List ----- 1 224.5.6.7 igmp Fa0/17, Fa0/19 </pre>				

	<i>PC1 začína prijímať multicastové dáta, tie podľa predpokladu prijíma len PC1.</i>					
PC1	No.	Time	Source	Destination	Protocol	Info
	8	134.992505	192.168.5.2	224.5.6.7	UDP	Source
	port: 1085 Destination port: 1234					
	Frame 8 (1370 bytes on wire, 1370 bytes captured)					
	Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07)					
	Internet Protocol, Src: 192.168.5.2 (192.168.5.2), Dst: 224.5.6.7 (224.5.6.7)					
	User Datagram Protocol, Src Port: 1085 (1085), Dst Port: 1234 (1234)					
	Source port: 1085 (1085)					
	Destination port: 1234 (1234)					
	Length: 1336					
	Checksum: 0xc75b [correct]					
	Data (1328 bytes)					
PC3	No.	Time	Source	Destination	Protocol	Info
	14	134.991407	192.168.5.2	224.5.6.7	UDP	Source
	port: 1085 Destination port: 1234					
	Frame 14 (1370 bytes on wire, 1370 bytes captured)					
	Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07)					
	Internet Protocol, Src: 192.168.5.2 (192.168.5.2), Dst: 224.5.6.7 (224.5.6.7)					
	User Datagram Protocol, Src Port: 1085 (1085), Dst Port: 1234 (1234)					
	Source port: 1085 (1085)					
	Destination port: 1234 (1234)					
	Length: 1336					
	Checksum: 0xc75b [correct]					
	Data (1328 bytes)					
PC2	bez zmeny					
	<i>Dáta stále prúdia na PC1, router vždy raz za minútu vyšle general membership query, ktoré switch rozpošle na všetky svoje porty.</i>					
PC3	No.	Time	Source	Destination	Protocol	Info
	1062	180.036837	192.168.10.1	224.0.0.1	IGMP	V3
	Membership Query					
	Frame 1062 (60 bytes on wire, 60 bytes captured)					
	Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:00:00:01 (01:00:5e:00:00:01)					
	Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.0.0.1 (224.0.0.1)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Query (0x11)					
	Max Response Time: 10,0 sec (0x64)					
	Header checksum: 0xec5f [correct]					
	Multicast Address: 0.0.0.0 (0.0.0.0)					
	QRV=2 S=Do not suppress router side processing					
	QQIC: 60					
	Num Src: 0					

PC1	No. 1056 Time 180.038463 Source 192.168.10.1 Destination 224.0.0.1 Protocol IGMP Info V3 Membership Query Frame 1056 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:00:00:01 (01:00:5e:00:00:01) Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.0.0.1 (224.0.0.1) Internet Group Management Protocol IGMP Version: 3 Type: Membership Query (0x11) Max Response Time: 10,0 sec (0x64) Header checksum: 0xec5f [correct] Multicast Address: 0.0.0.0 (0.0.0.0) QRV=2 S=Do not suppress router side processing QQIC: 60 Num Src: 0
	No. 7 Time 180.036612 Source 192.168.10.1 Destination 224.0.0.1 Protocol IGMP Info V3 Membership Query Frame 7 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:00:00:01 (01:00:5e:00:00:01) Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.0.0.1 (224.0.0.1) Internet Group Management Protocol IGMP Version: 3 Type: Membership Query (0x11) Max Response Time: 10,0 sec (0x64) Header checksum: 0xec5f [correct] Multicast Address: 0.0.0.0 (0.0.0.0) QRV=2 S=Do not suppress router side processing QQIC: 60 Num Src: 0
	<i>Dáta stále prúdia a PC1-3 odpovedjú na membership query v náhodnom čase (max. ale 10 sek., tak ako je definované v Max Response Time) pomocou membership report. Rozdiel v odpovediach PC1 a PC2-3 je v Group Record. Group Record : 239.255.255.250 je UPnP broadcast.</i>
PC1	1218 186.964712 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 1218 (62 bytes on wire, 62 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0x03f6 [correct] Num Group Records: 2 Group Record : 224.5.6.7 Mode Is Exclude

PC2	<pre> No. Time Source Destination Protocol Info 1249 187.949225 192.168.10.11 224.0.0.22 IGMP V3 Membership Report Frame 1249 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xec03 [correct] Num Group Records: 1 Group Record : 239.255.255.250 Mode Is Exclude </pre>				
	<pre> 1243 187.740858 192.168.10.13 224.0.0.22 IGMP V3 Membership Report Frame 1243 (54 bytes on wire, 54 bytes captured) Ethernet II, Src: Intel_69:01:c8 (00:16:76:69:01:c8), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.13 (192.168.10.13), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xec03 [correct] Num Group Records: 1 Group Record : 239.255.255.250 Mode Is Exclude </pre>				
router	<pre> router#sho ip igmp groups Group Address Interface Uptime Expires Last Reporter 224.5.6.7 FastEthernet0/1 00:00:15 00:02:44 192.168.10.10 </pre>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Type Version Port List ----- 1 224.5.6.7 igmp Fa0/17, Fa0/19 </pre>				

	PC2 sa prihlásilo do skupiny poslaním <i>change to exclude mode membership report</i> . Túto správu zachytil switch a poslal len na port, na ktorom je pripojený router. Switch si uložil nový záznam o členovi skupiny a priradil nový port (Fa0/15) do tabuľky.				
PC2	<pre> 13 359.538889 192.168.10.11 224.0.0.22 IGMP V3 Membership Report Frame 13 (54 bytes on wire, 54 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf3f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Exclude Mode </pre>				
PC3	<pre> No. Time Source Destination Protocol Info 5247 359.540637 192.168.10.11 224.0.0.22 IGMP V3 Membership Report Frame 5247 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf3f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Exclude Mode </pre>				
PC1	<i>Dáta stále prúdia</i>				
router	<pre> router#sho ip igmp groups Group Address Interface Uptime Expires Last Reporter 224.5.6.7 FastEthernet0/1 00:05:54 00:02:57 192.168.10.10 </pre>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Type Version Port List ----- 1 224.5.6.7 igmp Fa0/15, Fa0/17, Fa0/19 </pre>				

	<i>PC2 začalo prijímať multicastové dáta</i>					
PC2	<pre> No. Time Source Destination Protocol Info 14 359.568805 192.168.5.2 224.5.6.7 UDP Source port: 1085 Destination port: 1234 Frame 14 (1370 bytes on wire, 1370 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07) Internet Protocol, Src: 192.168.5.2 (192.168.5.2), Dst: 224.5.6.7 (224.5.6.7) User Datagram Protocol, Src Port: 1085 (1085), Dst Port: 1234 (1234) Source port: 1085 (1085) Destination port: 1234 (1234) Length: 1336 Checksum: 0x2c41 [correct] </pre>					
	<i>PC1 a PC2 odpovedú v pravidelných intervaloch na membership query a switch posiela oba membership reporty nezmenené na router, ale neposiela ich na ostaté porty. Toto je nevyhnutné pre switch, aby si udržal funkčnú tabuľku portov, ktoré majú záujem o multicastové dáta.</i>					
PC1	<pre> No. Time Source Destination Protocol Info 2522 242.965199 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 2522 (62 bytes on wire, 62 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0x03f6 [correct] Num Group Records: 2 Group Record : 224.5.6.7 Mode Is Exclude Group Record : 239.255.255.250 Mode Is Exclude </pre>					
PC2	<pre> No. Time Source Destination Protocol Info 211 367.933531 192.168.10.11 224.0.0.22 IGMP V3 Membership Report Frame 211 (62 bytes on wire, 62 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0x03f6 [correct] Num Group Records: 2 Group Record : 224.5.6.7 Mode Is Exclude Group Record : 239.255.255.250 Mode Is Exclude </pre>					

	<i>PC1 opúšťa skupinu a posiela change to include mode membership report.</i>				
PC1	<pre> No. Time Source Destination Protocol Info 12665 678.466336 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 12665 (54 bytes on wire, 54 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf4f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Include Mode </pre>				
PC3	<pre> No. Time Source Destination Protocol Info 12691 678.461563 192.168.10.10 224.0.0.22 IGMP V3 Membership Report Frame 12691 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: QuantaCo_4d:a0:e4 (00:16:36:4d:a0:e4), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.10 (192.168.10.10), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf4f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Change To Include Mode </pre>				
PC2	<i>Dáta stále prúdia</i>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Type Version Port List ----- 1 224.5.6.7 igmp Fa0/15, Fa0/19 </pre>				

	<i>Router odpovedá na opustenie PC1 tak, že posiela 2 group-specific query s 1 sekundovým maximum response time a switch ho rozpošle na všetky svoje porty, dokonca aj na tie, na ktorých sú PC bez záujmu o multicast.</i> <i>Switch zachytí túto požiadavku (vidno na MAC adrese u PC1) a vygeneruje vlastnú group-specific query no zmení značku suppress router-side processing flag, takže na PC1 dorazia celkovo 4 group-specific query (group-specific query od routru neodfiltruje). To sa deje len u PC1, ktoré chce opustiť skupinu, PC2 nič nevidí.</i>					
PC3	No.	Time	Source	Destination	Protocol	Info
	12692	678.462188	192.168.10.1	224.5.6.7	IGMP	V3
	Membership Query					
	Frame 12692 (60 bytes on wire, 60 bytes captured)					
	Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07)					
	Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.5.6.7 (224.5.6.7)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Query (0x11)					
	Max Response Time: 1,0 sec (0x0a)					
	Header checksum: 0x06ad [correct]					
	Multicast Address: 224.5.6.7 (224.5.6.7)					
	QRV=2 S=Do not suppress router side processing					
	QQIC: 60					
	Num Src: 0					
PC1	No.	Time	Source	Destination	Protocol	Info
	12666	678.466813	192.168.10.1	224.5.6.7	IGMP	V3
	Membership Query					
	Frame 12666 (60 bytes on wire, 60 bytes captured)					
	Ethernet II, Src: Cisco_37:b7:93 (00:18:b9:37:b7:93), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07)					
	Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.5.6.7 (224.5.6.7)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Query (0x11)					
	Max Response Time: 1,0 sec (0x0a)					
	Header checksum: 0xfeac [correct]					
	Multicast Address: 224.5.6.7 (224.5.6.7)					
	QRV=2 S=SUPPRESS router side processing					
	QQIC: 60					
	Num Src: 0					
PC2	No.	Time	Source	Destination	Protocol	Info
	7445	678.461872	192.168.10.1	224.5.6.7	IGMP	V3
	Membership Query					
	Frame 7445 (60 bytes on wire, 60 bytes captured)					
	Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07)					
	Internet Protocol, Src: 192.168.10.1 (192.168.10.1), Dst: 224.5.6.7 (224.5.6.7)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Query (0x11)					
	Max Response Time: 1,0 sec (0x0a)					
	Header checksum: 0x06ad [correct]					
	Multicast Address: 224.5.6.7 (224.5.6.7)					
	QRV=2 S=Do not suppress router side processing					
	QQIC: 60					
	Num Src: 0					

	<i>PC2 odpovedá na group-specific query, že ma stále záujem prijímať dáta. Posledný dátový paket na PC1 prišiel asi 2,5 sekundy po odoslani Change To Include Mode na router.</i>					
PC2	No. 7470	Time 679.433961	Source 192.168.10.11	Destination 224.0.0.22	Protocol IGMP	Info V3 Membership Report Frame 7470 (54 bytes on wire, 54 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf5f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Mode Is Exclude
PC3	No. 12718	Time 679.435950	Source 192.168.10.11	Destination 224.0.0.22	Protocol IGMP	Info V3 Membership Report Frame 12718 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22) Internet Group Management Protocol IGMP Version: 3 Type: Membership Report (0x22) Header checksum: 0xf5f1 [correct] Num Group Records: 1 Group Record : 224.5.6.7 Mode Is Exclude
PC1	No. 12729	Time 680.934386	Source 192.168.5.2	Destination 224.5.6.7	Protocol UDP	Info Source port: 1085 Destination port: 1234 Frame 12729 (1370 bytes on wire, 1370 bytes captured) Ethernet II, Src: Cisco_4b:5d:d7 (00:17:5a:4b:5d:d7), Dst: 01:00:5e:05:06:07 (01:00:5e:05:06:07) Internet Protocol, Src: 192.168.5.2 (192.168.5.2), Dst: 224.5.6.7 (224.5.6.7) User Datagram Protocol, Src Port: 1085 (1085), Dst Port: 1234 (1234) Source port: 1085 (1085) Destination port: 1234 (1234) Length: 1336 Checksum: 0x425a [correct] Data (1328 bytes)

	<i>Ďalších pár minút PC2 príma dáta. Router pravidelne posiela General queries a switch ich rozosiela na všetky porty. PC2 vždy odpovedá s membership report. Potom PC2 opustí skupinu, vygeneruje change to include mode report, ktorý je poslaný na router a potlačený na ostatných portoch switchu.</i>					
PC2	No.	Time	Source	Destination	Protocol	Info
	12426	892.375450	192.168.10.11	224.0.0.22	IGMP	V3
	Membership Report					
	Frame 12426 (54 bytes on wire, 54 bytes captured)					
	Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16)					
	Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Report (0x22)					
	Header checksum: 0xf4f1 [correct]					
	Num Group Records: 1					
	Group Record : 224.5.6.7 Change To Include Mode					
PC3	No.	Time	Source	Destination	Protocol	Info
	17680	892.377925	192.168.10.11	224.0.0.22	IGMP	V3
	Membership Report					
	Frame 17680 (60 bytes on wire, 60 bytes captured)					
	Ethernet II, Src: Intel_69:01:fa (00:16:76:69:01:fa), Dst: 01:00:5e:00:00:16 (01:00:5e:00:00:16)					
	Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.22 (224.0.0.22)					
	Internet Group Management Protocol					
	IGMP Version: 3					
	Type: Membership Report (0x22)					
	Header checksum: 0xf4f1 [correct]					
	Num Group Records: 1					
	Group Record : 224.5.6.7 Change To Include Mode					
PC1	bez zmeny					
	<i>Router tak, ako v predchádzajúcom prípade pošle 2 group-specific queries a switch k nim pripojí vlastné group-specific queries, ale zmení u nich značku S=suppress router-side processing flag. Posledný dátový paket dorazil na PC2 2,6 sekundy po odoslaní Change To Include Mode na router.</i>					

	<i>Nakoniec switch posla spravu IGMP v2 Leave Group, čo znamená, že už nemá pripojených žiadnych záujemcov o multicastové dáta. Na zdrojovej MAC adrese vidno, že spravu poslal naozaj switch.</i> <i>Je dosiahnutý počiatočný stav, router generuje každú minútu general query.</i>				
PC3	<pre> No. Time Source Destination Protocol Info 17745 894.948259 192.168.10.11 224.0.0.2 IGMP V2 Leave Group Frame 17745 (60 bytes on wire, 60 bytes captured) Ethernet II, Src: Cisco_37:b7:95 (00:18:b9:37:b7:95), Dst: 01:00:5e:00:00:02 (01:00:5e:00:00:02) Internet Protocol, Src: 192.168.10.11 (192.168.10.11), Dst: 224.0.0.2 (224.0.0.2) Internet Group Management Protocol IGMP Version: 2 Type: Leave Group (0x17) Max Response Time: 0,0 sec (0x00) Header checksum: 0x02f3 [correct] Multicast Address: 224.5.6.7 (224.5.6.7) </pre>				
router	<pre> router#sho ip igmp groups Group Address Interface Uptime Expires Last Reporter </pre>				
switch	<pre> Switch#sho ip igmp snooping multicast group 224.5.6.7 Vlan Group Type Version Port List ----- </pre>				

Vyhodnotenie:

1. Multicastové dáta skutočne prijímajú len účastníci, ktorý majú o dáta záujem. Switch správne počúva IGMP správy a udržiava si funkčnú tabuľku záujemcov o multicast.
2. Switch nijak nefiltruje komunikáciu medzi PC a routerom. Membership report prechádza cez switch nezmenený od každého PC, takže nieje pravda, že switch posla len jeden membership report za skupinu. Naopak filtruje membership report smerom k ostatným PC a nerozosiela ho na všetky porty.
3. Switch generuje group-specific query, pri prijatí žiadosti o opustenie skupiny, ale so zmenenou značkou *S=suppress router-side processing flag*, ktorú následuje group-specific query od routra.
4. Keď PC1 a PC2 opustí skupinu, switch vygeneruje spravu *IGMP v2 Leave Group*, ktorú pošle na router a tým je dosiahnutý počiatočný stav.

Záver:

Z uvedených výsledkov môžeme vidieť správnu implementáciu IGMP snoopingu do prepínačov Cisco Catalyst. Samozrejme, že funkčnosť sa môže líšiť od verzie použitého IOS. Jediné, v čom by mohol byť switch "rozumnejší", je posielanie iba jedného IGMP reportu za skupinu.