Лаба 2 Eltex
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Тема: Настройка протокола STP (IEEE 802.1D)

1) Для заданной на схеме schema-lab2 сети, состоящей из управляемых коммутаторов и персональных компьютеров настроить протокол STP, назначив явно один из коммутаторов корневым настройкой приоритета.

На Switch2 (делаем его Root):

```
enable
configure terminal
spanning-tree mode pvst
spanning-tree vlan 1 priority 0
end
write memory
```

На всех остальных коммутаторах (Switch1, Switch3, Switch4, Switch5):

```
enable
configure terminal
spanning-tree mode pvst
end
write memory
```

```
vIOS-L2-01>enable
vIOS-L2-01#configure terminnal
*Jan  3 13:09:17.790: %PLATFORM-5-SIGNATURE_VERIFIED: Image 'flash0:/vios_l2-adv
enterprisek9-m' passed code signing verification
vIOS-L2-01#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#
vIOS-L2-01(config)#spanning-tree mode pvst
vIOS-L2-01(config)#spanning-tree vlan 1 priority 0
vIOS-L2-01(config)#end
vIOS-L2-01#
*Jan  3 13:10:07.319: %SYS-5-CONFIG_I: Configured from console by console
vIOS-L2-01#write memory
Building configuration...
Compressed configuration from 5273 bytes to 2022 bytes[OK]
vIOS-L2-01#
*Jan  3 13:10:20.413: %GRUB-5-CONFIG_WRITING: GRUB configuration is being update
d on disk. Please wait...
*Jan  3 13:10:21.189: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was written to
disk successfully.
vIOS-L2-01#
```

Рисунок 1.1 - Настройка коммутатора Switch2

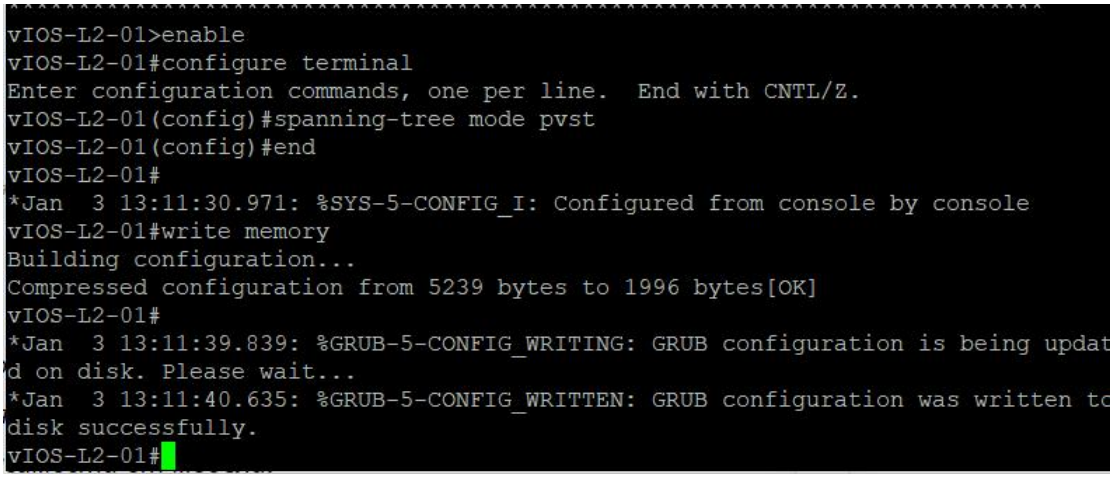

Рисунок 1.2 - Настройка коммутатора Switch1

2) Проверить доступность каждого с каждым всех персональных компьютеров (VPCS), результаты запротоколировать.
Назначим компьютерам следующие ip-адреса:

PC1: 192.168.1.11/24
PC2: 192.168.1.12/24
PC3: 192.168.1.13/24
PC4: 192.168.1.14/24
PC5: 192.168.1.15/24
PC6: 192.168.1.16/24

Теперь проверим доступность командой ping.

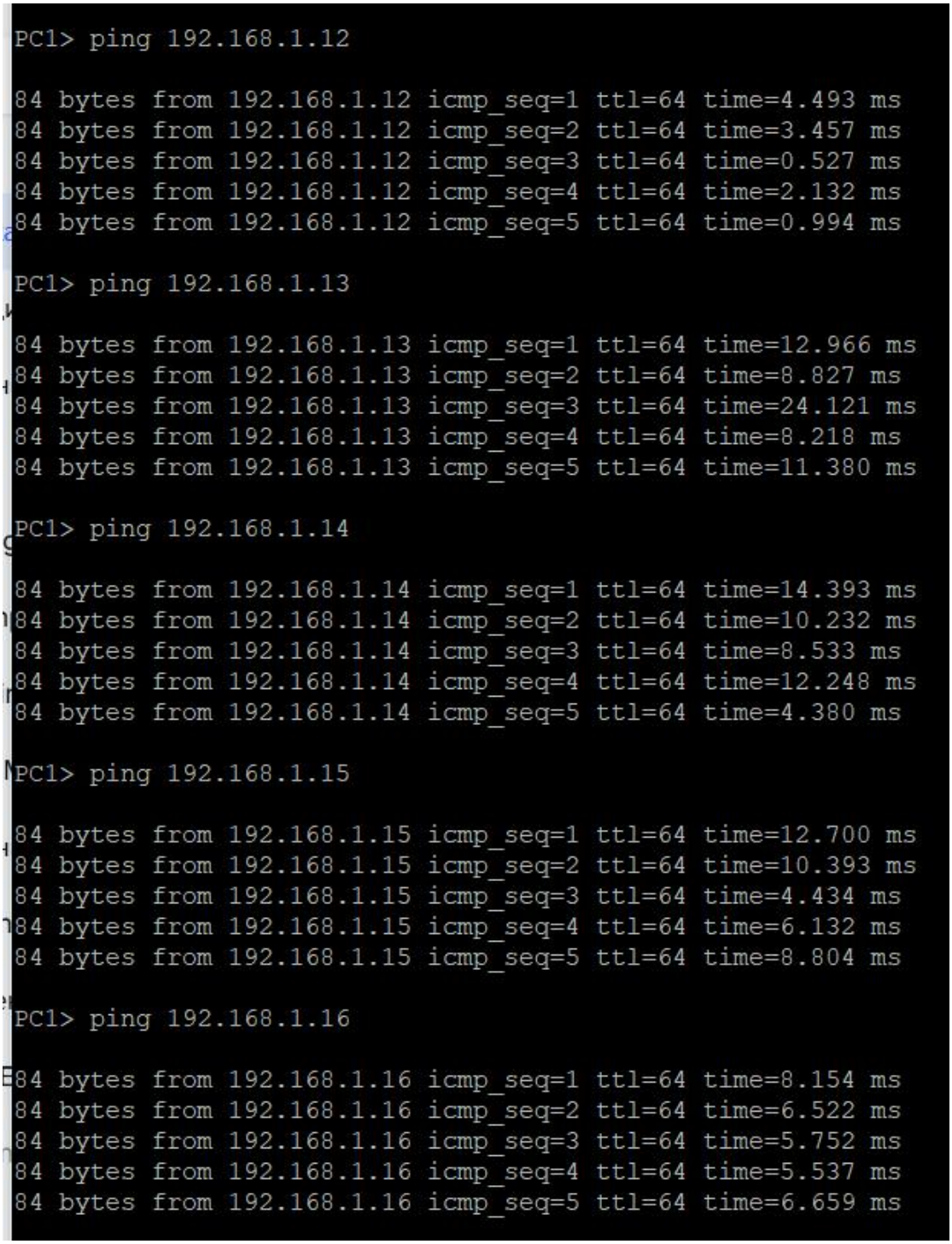

Рисунок 2.1 - Пинг на PC1

```
PC2> ping 192.168.1.11

84 bytes from 192.168.1.11 icmp_seq=1 ttl=64 time=6.547 ms
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=3.953 ms
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=7.202 ms
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=9.688 ms
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=7.019 ms

PC2> ping 192.168.1.13

84 bytes from 192.168.1.13 icmp_seq=1 ttl=64 time=12.456 ms
84 bytes from 192.168.1.13 icmp_seq=2 ttl=64 time=6.192 ms
84 bytes from 192.168.1.13 icmp_seq=3 ttl=64 time=10.412 ms
84 bytes from 192.168.1.13 icmp_seq=4 ttl=64 time=8.517 ms
84 bytes from 192.168.1.13 icmp_seq=5 ttl=64 time=18.767 ms

PC2> ping 192.168.1.14

84 bytes from 192.168.1.14 icmp_seq=1 ttl=64 time=4.144 ms
84 bytes from 192.168.1.14 icmp_seq=2 ttl=64 time=8.233 ms
84 bytes from 192.168.1.14 icmp_seq=3 ttl=64 time=21.659 ms
84 bytes from 192.168.1.14 icmp_seq=4 ttl=64 time=14.949 ms
84 bytes from 192.168.1.14 icmp_seq=5 ttl=64 time=3.617 ms

PC2> ping 192.168.1.15

84 bytes from 192.168.1.15 icmp_seq=1 ttl=64 time=9.934 ms
84 bytes from 192.168.1.15 icmp_seq=2 ttl=64 time=7.494 ms
84 bytes from 192.168.1.15 icmp_seq=3 ttl=64 time=24.173 ms
84 bytes from 192.168.1.15 icmp_seq=4 ttl=64 time=4.020 ms
84 bytes from 192.168.1.15 icmp_seq=5 ttl=64 time=5.109 ms

PC2> ping 192.168.1.16

84 bytes from 192.168.1.16 icmp_seq=1 ttl=64 time=12.336 ms
84 bytes from 192.168.1.16 icmp_seq=2 ttl=64 time=5.920 ms
84 bytes from 192.168.1.16 icmp_seq=3 ttl=64 time=2.153 ms
84 bytes from 192.168.1.16 icmp_seq=4 ttl=64 time=7.387 ms
84 bytes from 192.168.1.16 icmp_seq=5 ttl=64 time=4.124 ms
```

Рисунок 2.2 - Пинг на PC2

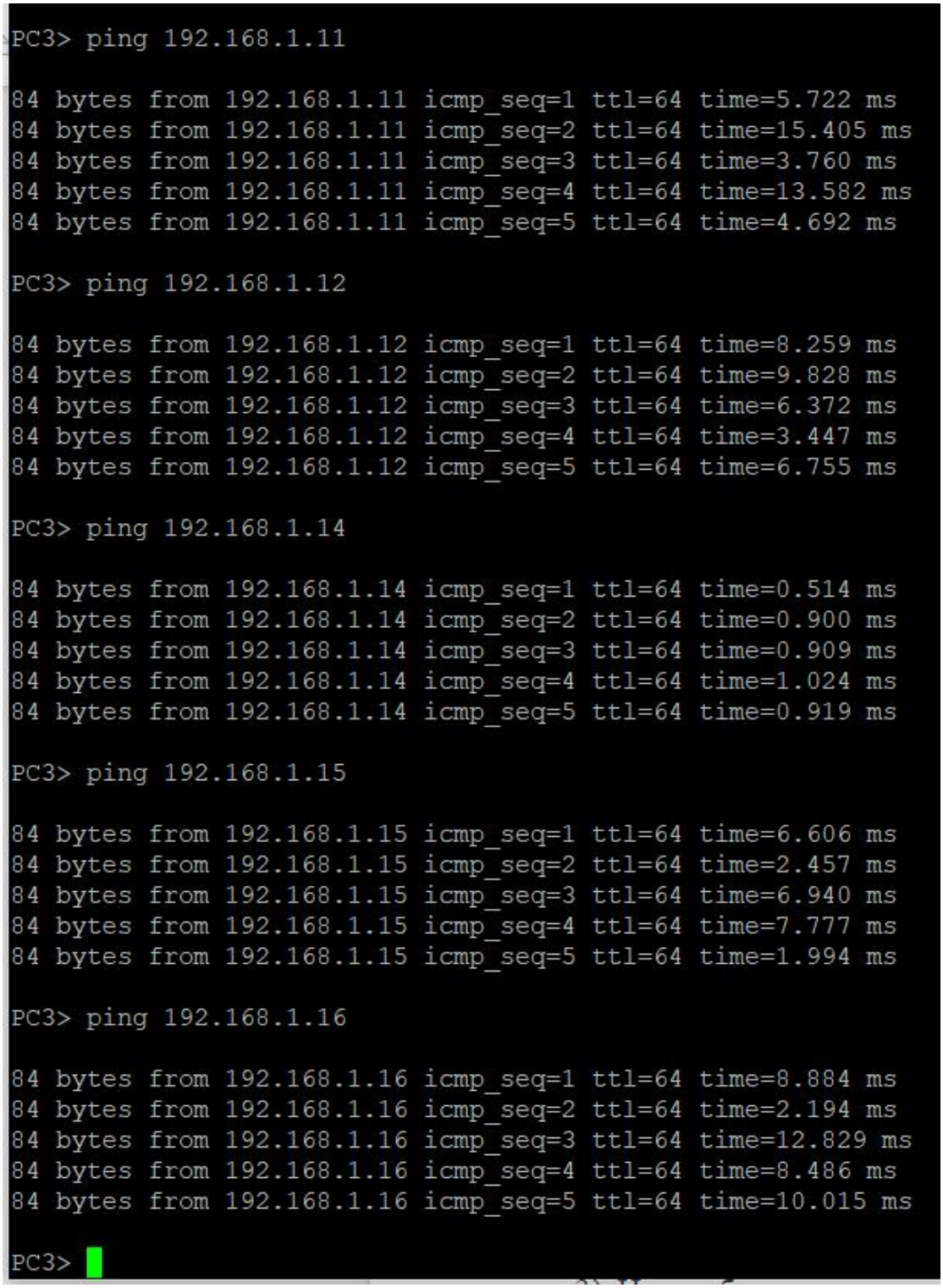

Рисунок 2.3 - Пинг на PC3

```
PC4> ping 192.168.1.11

84 bytes from 192.168.1.11 icmp_seq=1 ttl=64 time=2.815 ms
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=8.595 ms
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=10.820 ms
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=12.107 ms
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=14.775 ms

PC4> ping 192.168.1.12

84 bytes from 192.168.1.12 icmp_seq=1 ttl=64 time=6.021 ms
84 bytes from 192.168.1.12 icmp_seq=2 ttl=64 time=9.145 ms
84 bytes from 192.168.1.12 icmp_seq=3 ttl=64 time=17.108 ms
84 bytes from 192.168.1.12 icmp_seq=4 ttl=64 time=9.391 ms
84 bytes from 192.168.1.12 icmp_seq=5 ttl=64 time=11.224 ms

PC4> ping 192.168.1.13

84 bytes from 192.168.1.13 icmp_seq=1 ttl=64 time=1.564 ms
84 bytes from 192.168.1.13 icmp_seq=2 ttl=64 time=6.171 ms
84 bytes from 192.168.1.13 icmp_seq=3 ttl=64 time=2.533 ms
84 bytes from 192.168.1.13 icmp_seq=4 ttl=64 time=0.651 ms
84 bytes from 192.168.1.13 icmp_seq=5 ttl=64 time=0.982 ms

PC4> ping 192.168.1.15

84 bytes from 192.168.1.15 icmp_seq=1 ttl=64 time=15.186 ms
84 bytes from 192.168.1.15 icmp_seq=2 ttl=64 time=8.866 ms
84 bytes from 192.168.1.15 icmp_seq=3 ttl=64 time=2.575 ms
84 bytes from 192.168.1.15 icmp_seq=4 ttl=64 time=15.369 ms
84 bytes from 192.168.1.15 icmp_seq=5 ttl=64 time=12.747 ms

PC4> ping 192.168.1.16

84 bytes from 192.168.1.16 icmp_seq=1 ttl=64 time=12.513 ms
84 bytes from 192.168.1.16 icmp_seq=2 ttl=64 time=2.050 ms
84 bytes from 192.168.1.16 icmp_seq=3 ttl=64 time=9.894 ms
84 bytes from 192.168.1.16 icmp_seq=4 ttl=64 time=7.883 ms
84 bytes from 192.168.1.16 icmp_seq=5 ttl=64 time=11.295 ms
```

Рисунок 2.4 - Пинг на PC4

```
PC5> ping 192.168.1.11

84 bytes from 192.168.1.11 icmp_seq=1 ttl=64 time=7.762 ms
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=12.018 ms
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=9.106 ms
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=10.955 ms
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=10.739 ms

PC5> ping 192.168.1.12

84 bytes from 192.168.1.12 icmp_seq=1 ttl=64 time=6.506 ms
84 bytes from 192.168.1.12 icmp_seq=2 ttl=64 time=8.406 ms
84 bytes from 192.168.1.12 icmp_seq=3 ttl=64 time=14.679 ms
84 bytes from 192.168.1.12 icmp_seq=4 ttl=64 time=5.853 ms
84 bytes from 192.168.1.12 icmp_seq=5 ttl=64 time=9.016 ms

PC5> ping 192.168.1.13

84 bytes from 192.168.1.13 icmp_seq=1 ttl=64 time=13.161 ms
84 bytes from 192.168.1.13 icmp_seq=2 ttl=64 time=6.211 ms
84 bytes from 192.168.1.13 icmp_seq=3 ttl=64 time=8.512 ms
84 bytes from 192.168.1.13 icmp_seq=4 ttl=64 time=8.350 ms
84 bytes from 192.168.1.13 icmp_seq=5 ttl=64 time=3.538 ms

PC5> ping 192.168.1.14

84 bytes from 192.168.1.14 icmp_seq=1 ttl=64 time=3.527 ms
84 bytes from 192.168.1.14 icmp_seq=2 ttl=64 time=12.048 ms
84 bytes from 192.168.1.14 icmp_seq=3 ttl=64 time=16.464 ms
84 bytes from 192.168.1.14 icmp_seq=4 ttl=64 time=4.893 ms
84 bytes from 192.168.1.14 icmp_seq=5 ttl=64 time=5.582 ms

PC5> ping 192.168.1.16

84 bytes from 192.168.1.16 icmp_seq=1 ttl=64 time=7.844 ms
84 bytes from 192.168.1.16 icmp_seq=2 ttl=64 time=3.720 ms
84 bytes from 192.168.1.16 icmp_seq=3 ttl=64 time=6.686 ms
84 bytes from 192.168.1.16 icmp_seq=4 ttl=64 time=8.369 ms
84 bytes from 192.168.1.16 icmp_seq=5 ttl=64 time=0.911 ms
```

Рисунок 2.5 - Пинг на PC5

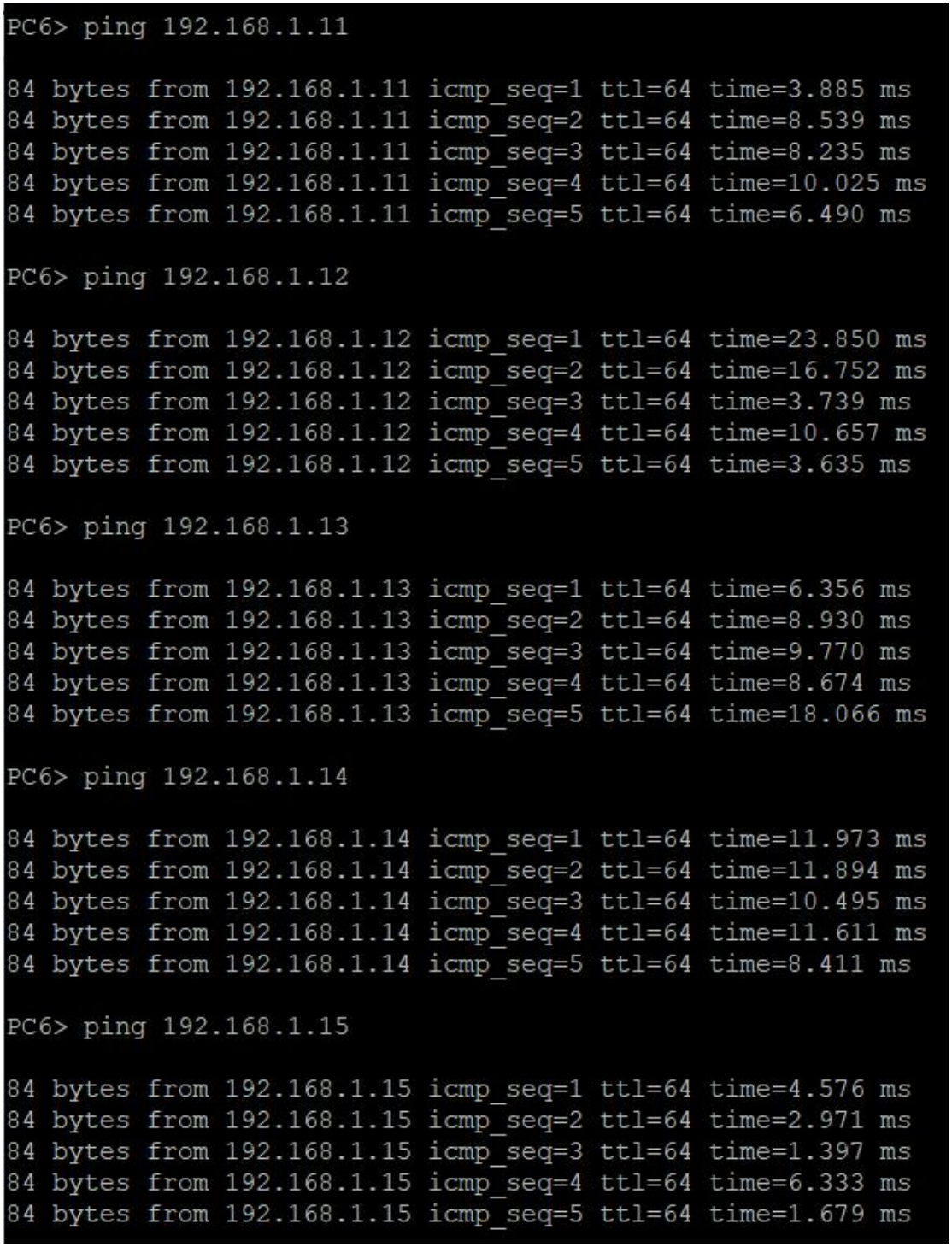

Рисунок 2.6 - Пинг на PC6

3) На изображении схемы отметить BID каждого коммутатора и режимы работы портов (RP/DP/blocked) и стоимости маршрутов, результат сохранить в файл.

Командой `show spanning-tree` выведем необхожимую информацию.

```
vIOS-L2-01>show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
             Address     0cd5.e6cd.0000
             Cost        4
             Port        1 (GigabitEthernet0/0)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0cb3.1337.0000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------
Gi0/0               Root FWD 4         128.1    Shr
Gi0/1               Altn BLK 4         128.2    Shr
Gi0/2               Altn BLK 4         128.3    Shr
Gi0/3               Altn BLK 4         128.4    Shr
Gi1/0               Altn BLK 4         128.5    Shr
Gi1/1               Altn BLK 4         128.6    Shr
Gi1/2               Altn BLK 4         128.7    Shr
Gi1/3               Altn BLK 4         128.8    Shr
Gi2/0               Desg FWD 4         128.9    Shr
```

Рисунок 3.1 - Switch1

```
vIOS-L2-01>show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
             Address     0cd5.e6cd.0000
             Cost        4
             Port        3 (GigabitEthernet0/2)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0c75.7ad0.0000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------
Gi0/0               Desg FWD 4         128.1    Shr
Gi0/1               Desg FWD 4         128.2    Shr
Gi0/2               Root FWD 4         128.3    Shr
Gi0/3               Altn BLK 4         128.4    Shr
Gi1/0               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
```

Рисунок 3.2 - Switch3

```
vIOS-L2-01>show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    1
              Address     0cd5.e6cd.0000
              Cost        4
              Port        3 (GigabitEthernet0/2)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0c37.c2dd.0000
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------
Gi0/0               Desg FWD 4         128.1    Shr
Gi0/1               Desg FWD 4         128.2    Shr
Gi0/2               Root FWD 4         128.3    Shr
Gi0/3               Altn BLK 4         128.4    Shr
Gi1/0               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
```

Рисунок 3.3 - Switch4

```
vIOS-L2-01>show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    1
              Address     0cd5.e6cd.0000
              Cost        4
              Port        3 (GigabitEthernet0/2)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0c71.e13e.0000
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------
Gi0/0               Desg FWD 4         128.1    Shr
Gi0/1               Desg FWD 4         128.2    Shr
Gi0/2               Root FWD 4         128.3    Shr
Gi0/3               Altn BLK 4         128.4    Shr
Gi1/0               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
```

Рисунок 3.4 - Switch5

```
vIOS-L2-01>show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    1
              Address     0cd5.e6cd.0000
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    1      (priority 0 sys-id-ext 1)
              Address     0cd5.e6cd.0000
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------
Gi0/0               Desg FWD 4         128.1    Shr
Gi0/1               Desg FWD 4         128.2    Shr
Gi0/2               Desg FWD 4         128.3    Shr
Gi0/3               Desg FWD 4         128.4    Shr
Gi1/0               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
Gi1/2               Desg FWD 4         128.7    Shr
Gi1/3               Desg FWD 4         128.8    Shr
Gi2/0               Desg FWD 4         128.9    Shr
```

Рисунок 3.5 - Switch2

Получаем следующую схему (сохранена в файлк schema.png):

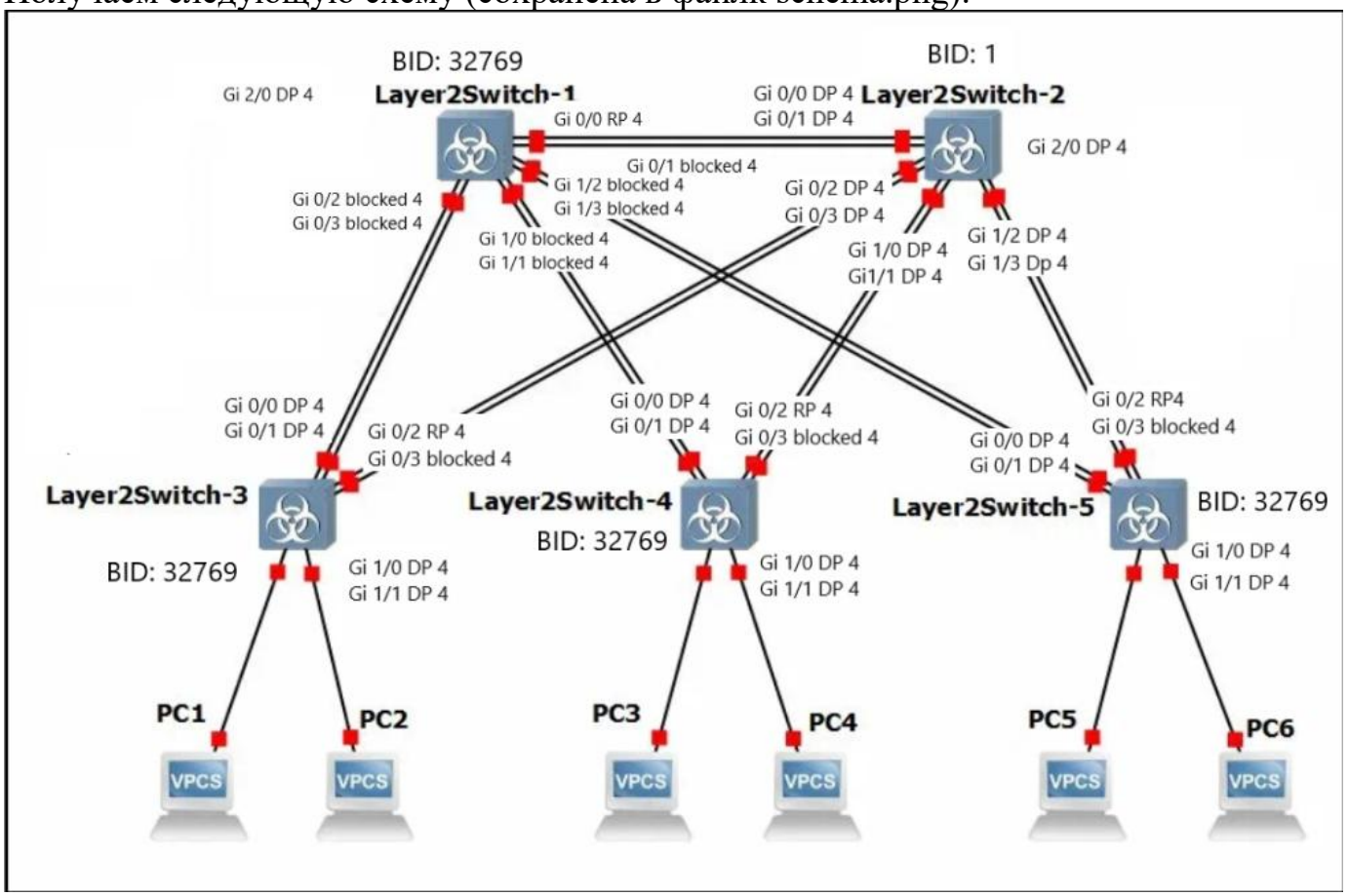

Рисунок 3.6 - Схема

4) При помощи wireshark отследить передачу пакетов hello от корневого коммутатора на всех линках (nb!), .

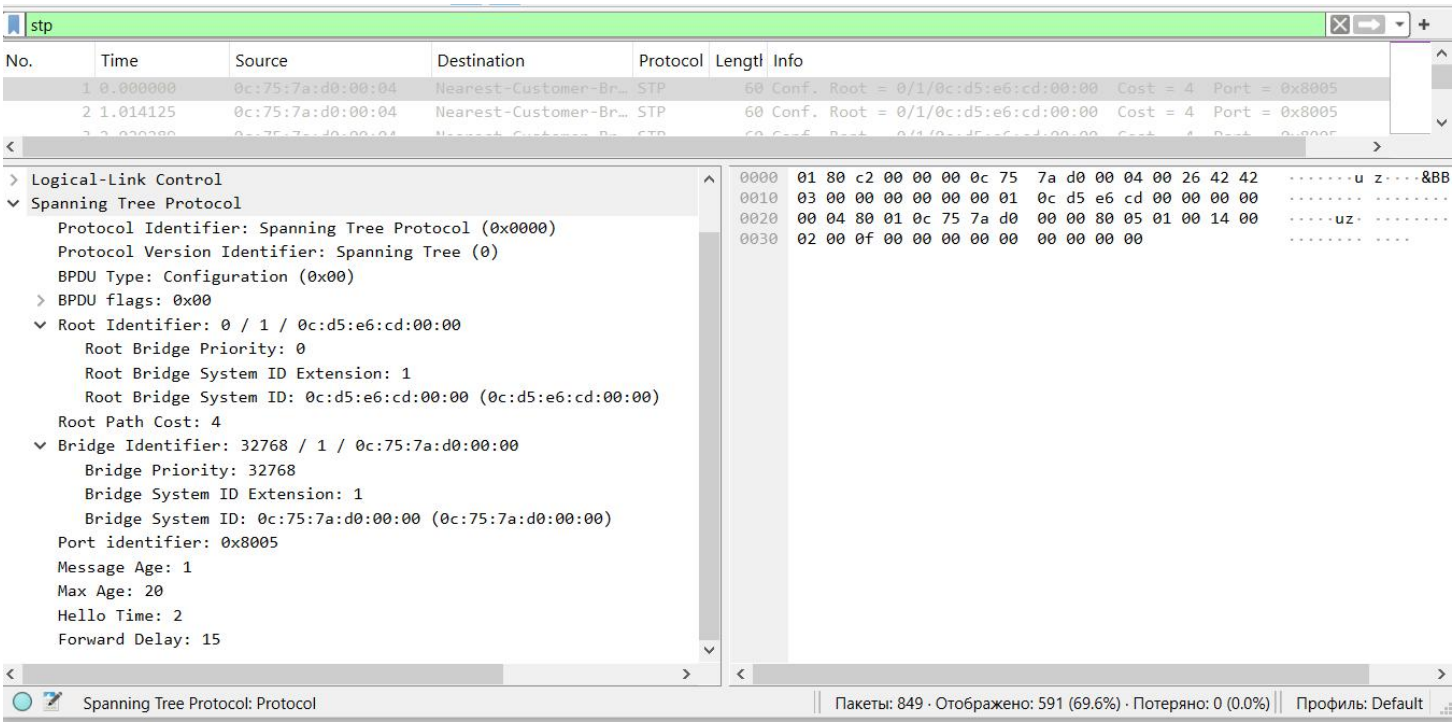

Рисунок 4.1 - Пакеты между Switch3 и PC1

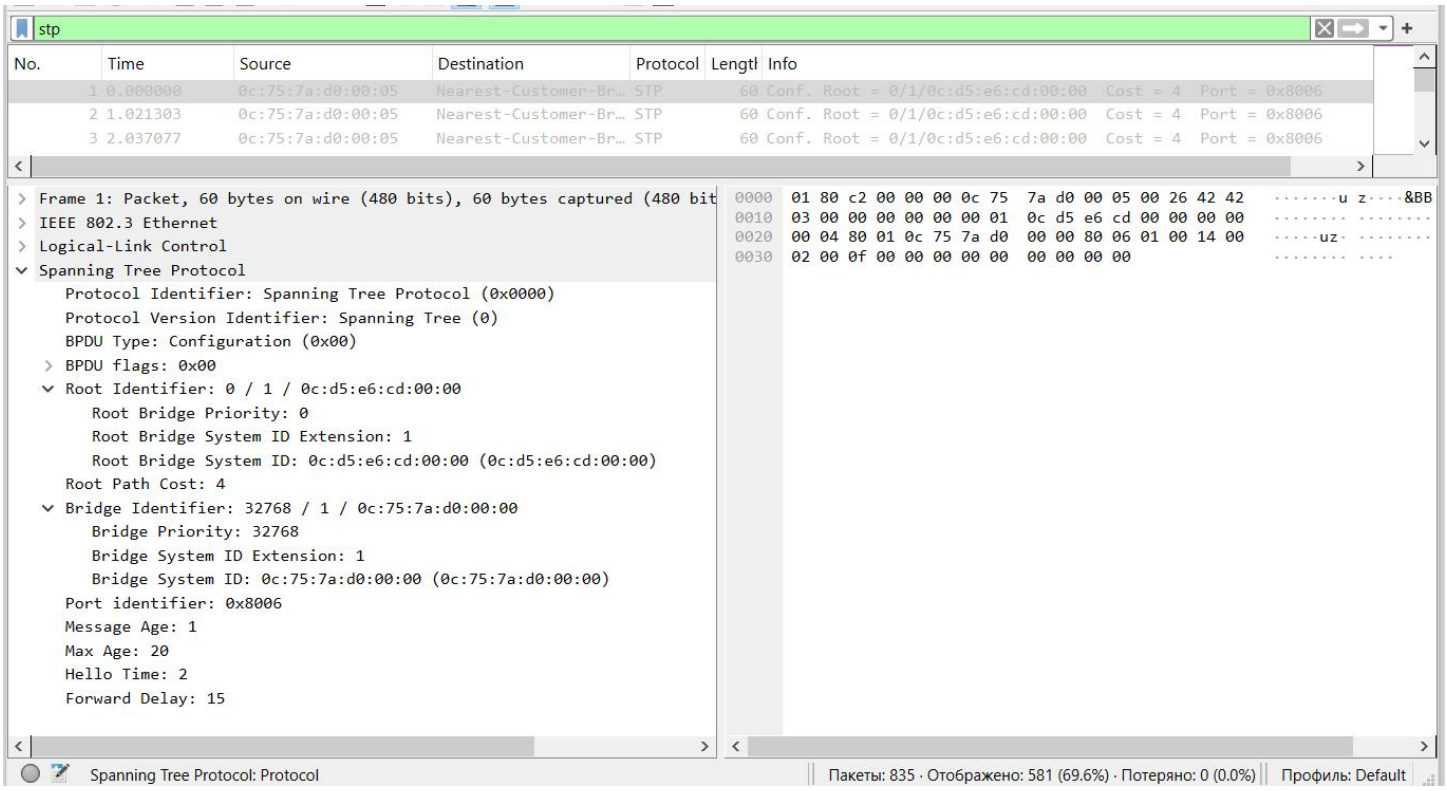

Рисунок 4.2 - Пакеты между Switch3 и PC2

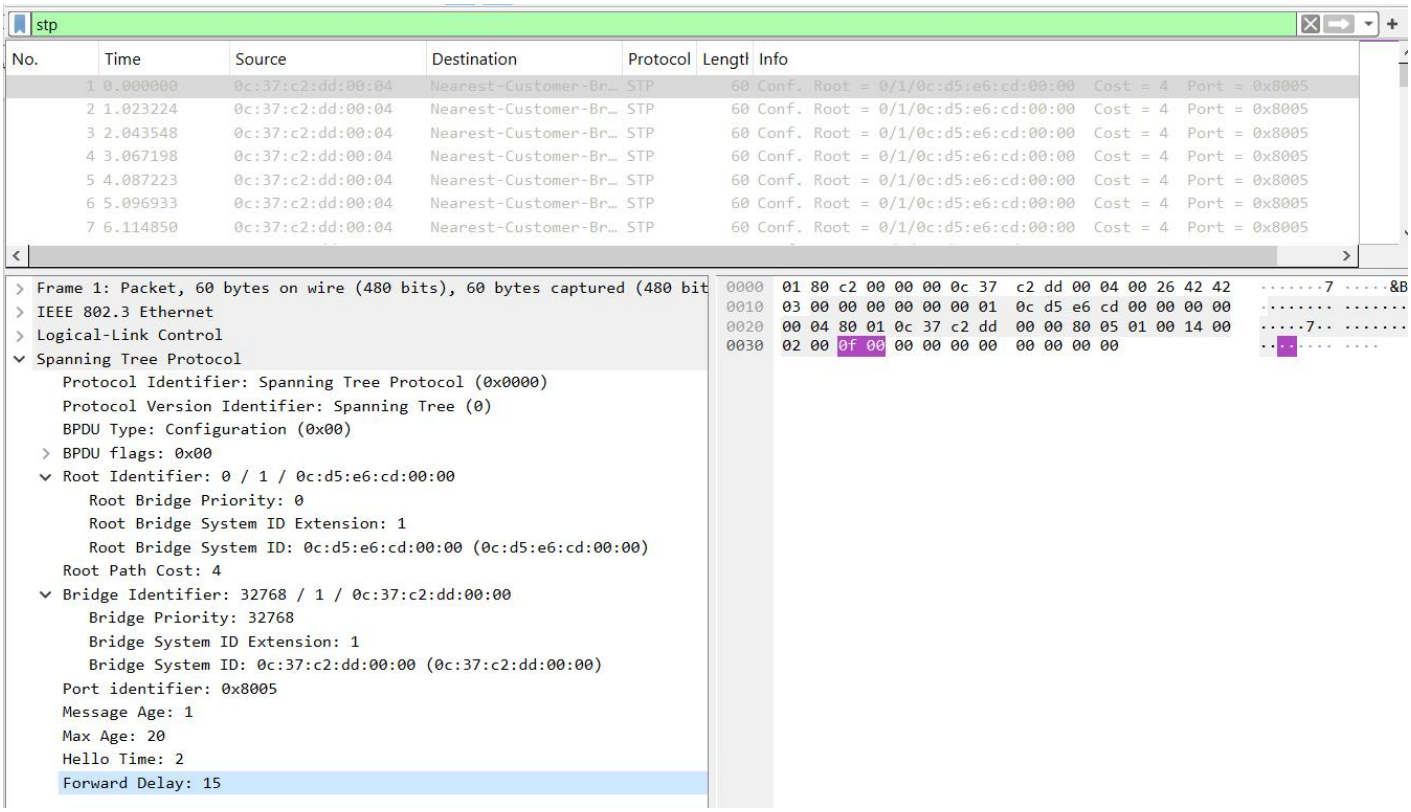

Рисунок 4.3 - Пакеты между Switch4 и PC3

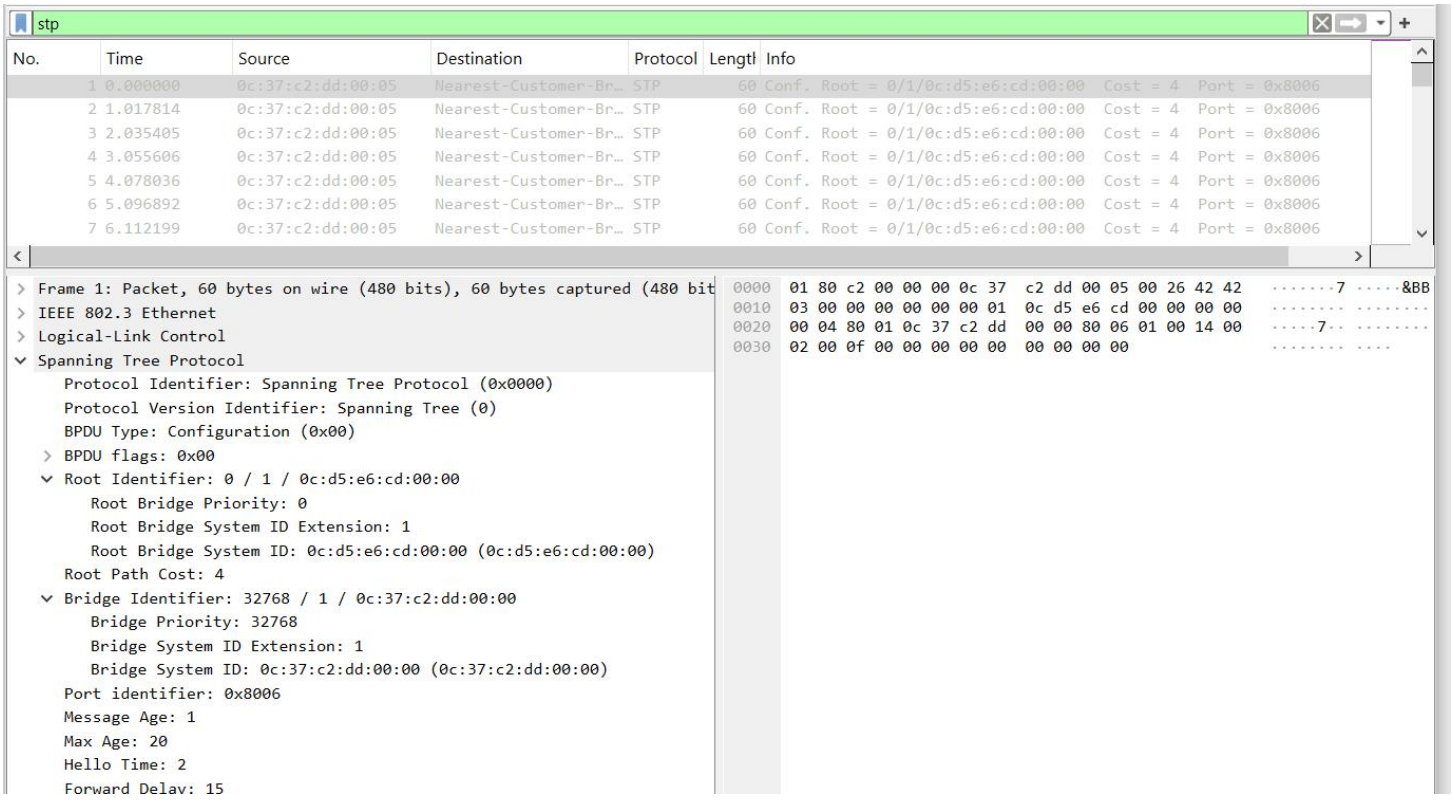

Рисунок 4.4 - Пакеты между Switch4 и PC4

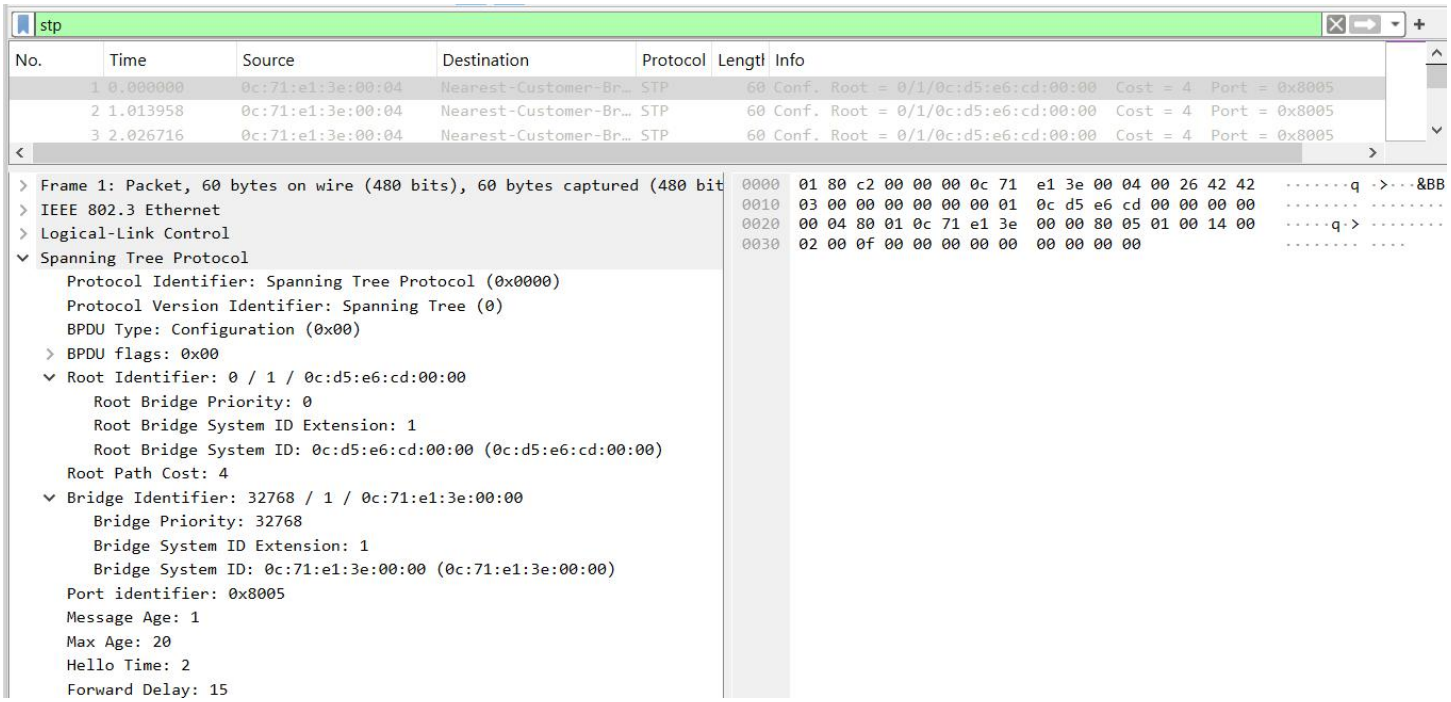

Рисунок 4.5 - Пакеты между Switch5 и PC5

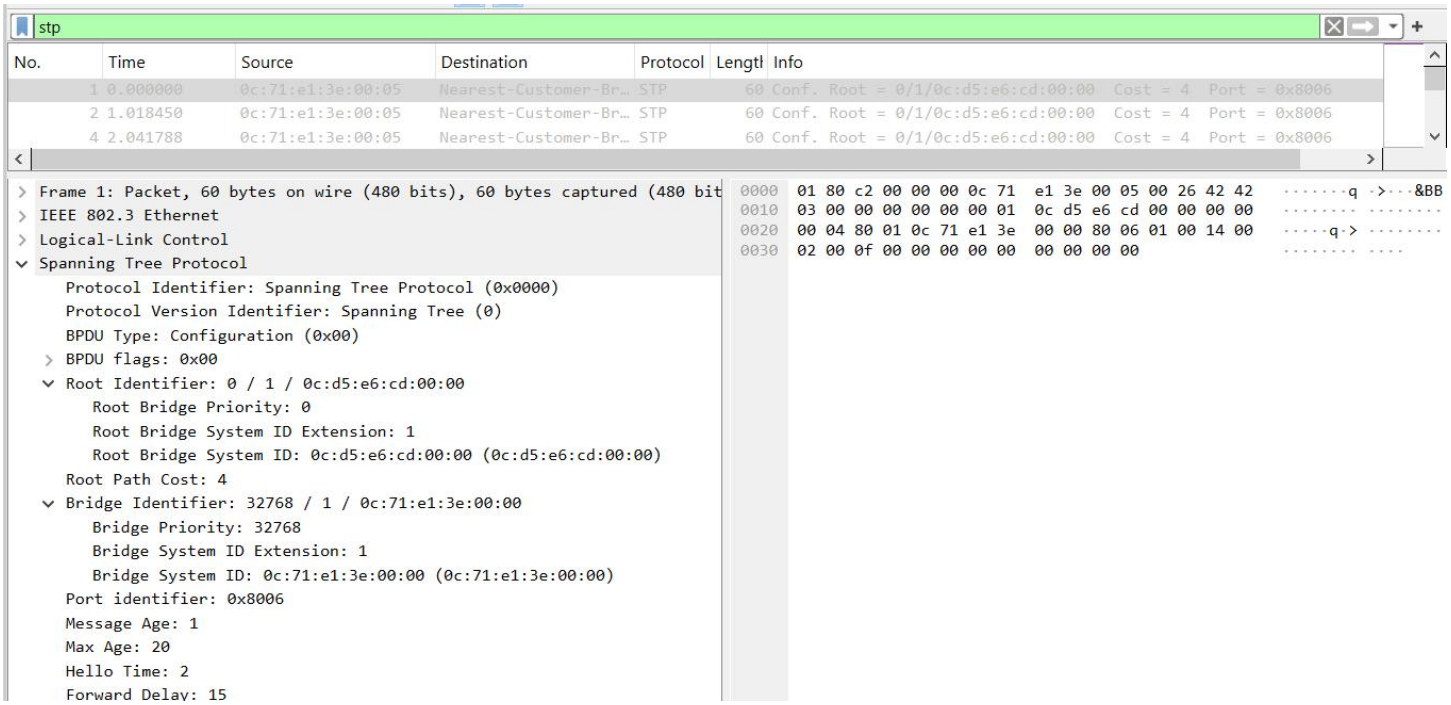

Рисунок 4.6 - Пакеты между Switch6 и PC6

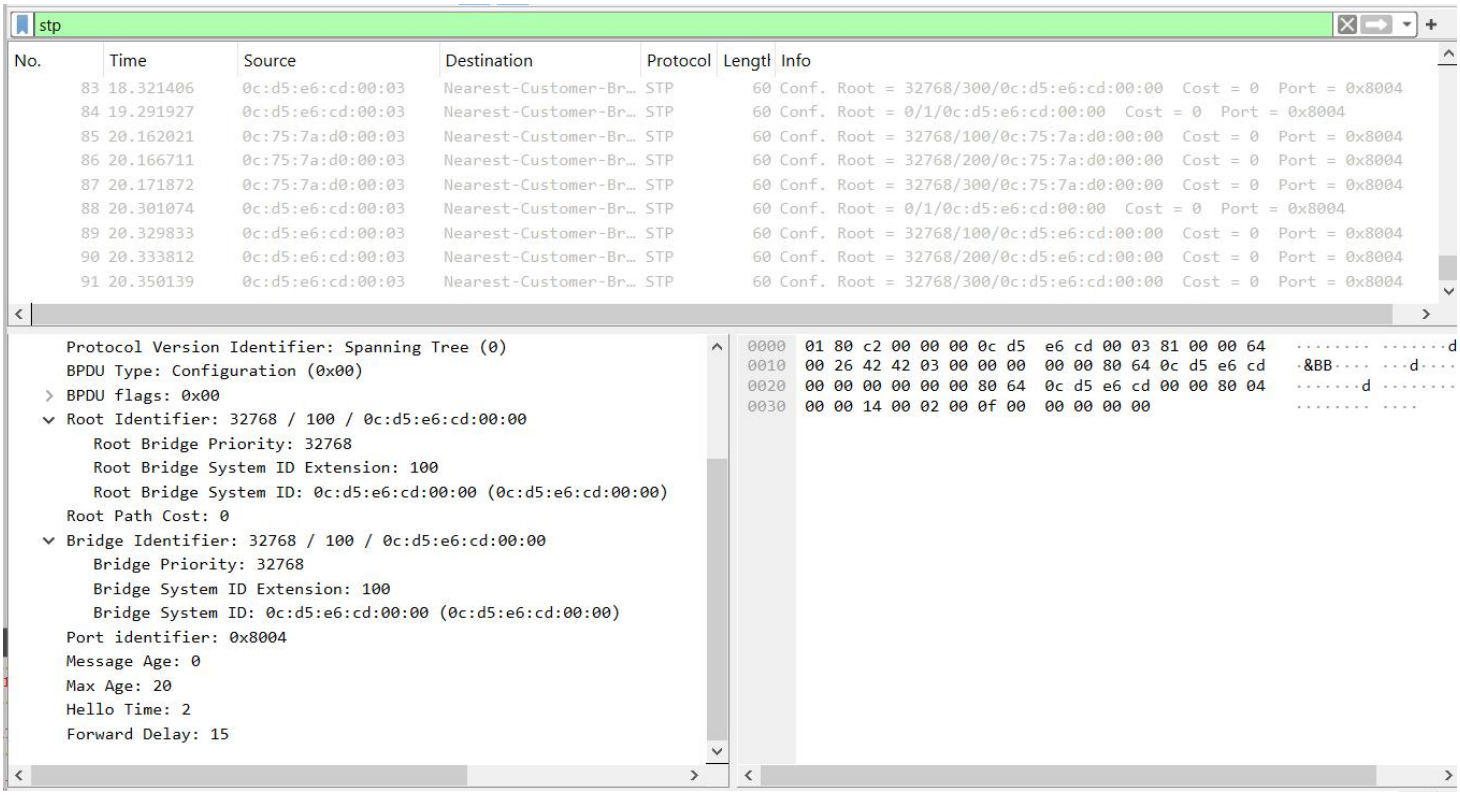

Рисунок 4.7 - Пакеты между Switch2 Switch3

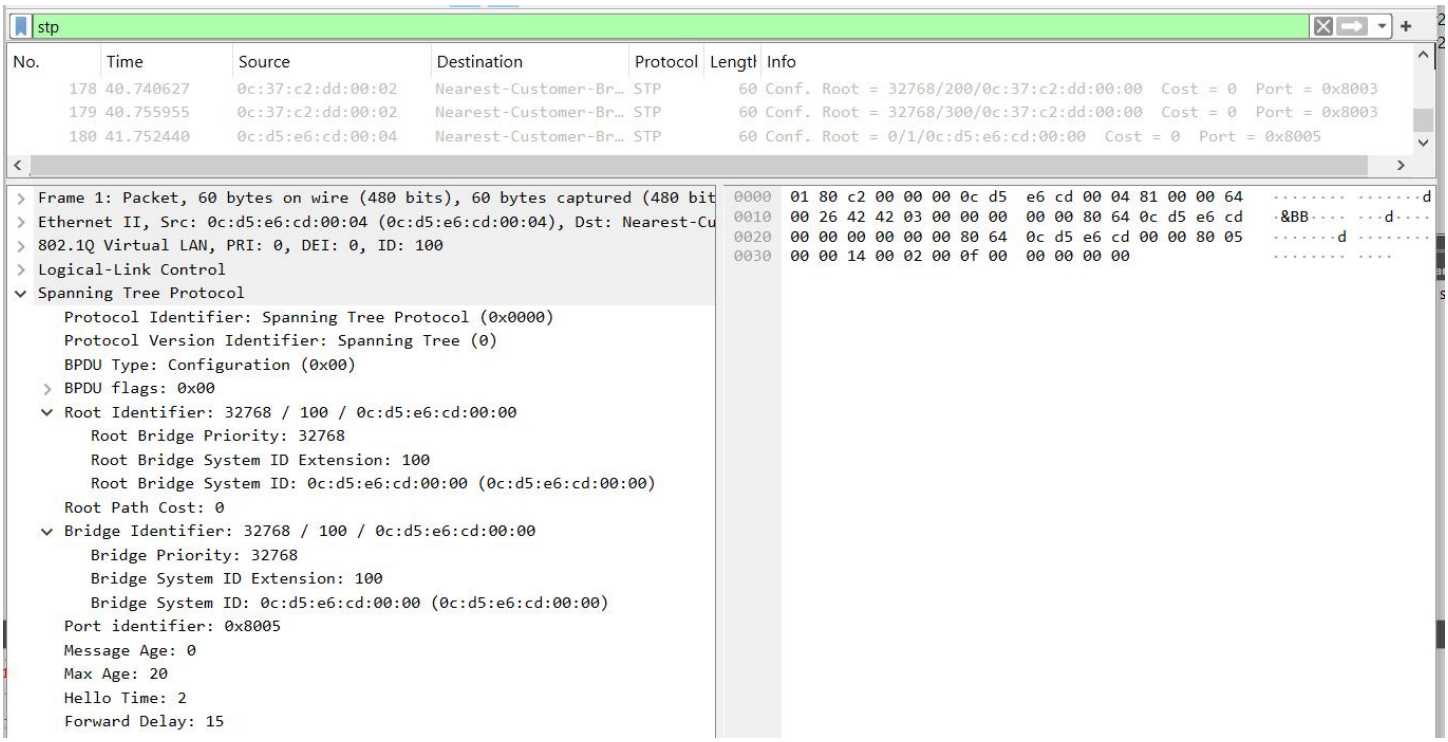

Рисунок 4.8 - Пакеты между Switch2 Switch4

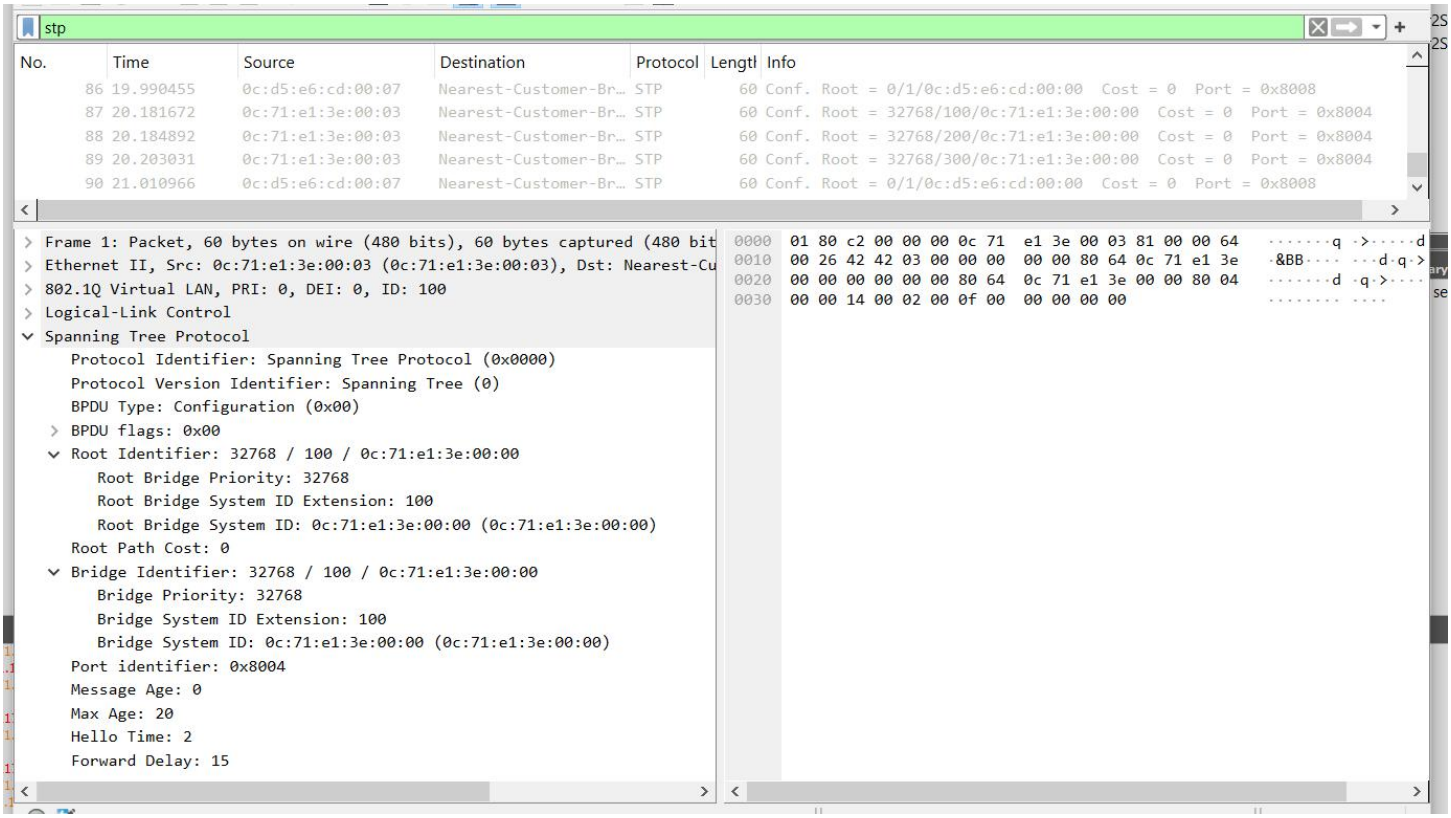

Рисунок 4.9 - Пакеты между Switch2 Switch5

5) Изменить стоимость маршрута для порта RP произвольного назначенного (designated) коммутатора, повторить действия из п.3, результат сохранить в отдельный файл.

На Switch4:

```
enable
configure terminal
interface GigabitEthernet0/0
spanning-tree cost 999
end
```

```
vIOS-L2-01>enable
vIOS-L2-01#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#interfase GigabitEthernet0/0
                           ^
% Invalid input detected at '^' marker.

vIOS-L2-01(config)#interface GigabitEthernet0/0
vIOS-L2-01(config-if)#spanning-tree cost 999
vIOS-L2-01(config-if)#end
vIOS-L2-01#
```

Рисунок 5.1 - Изменение стоимости маршрута на коммутаторе Switch4

Сделаем схему как в пункте 3 (изображение сохранено как schema_5.png).

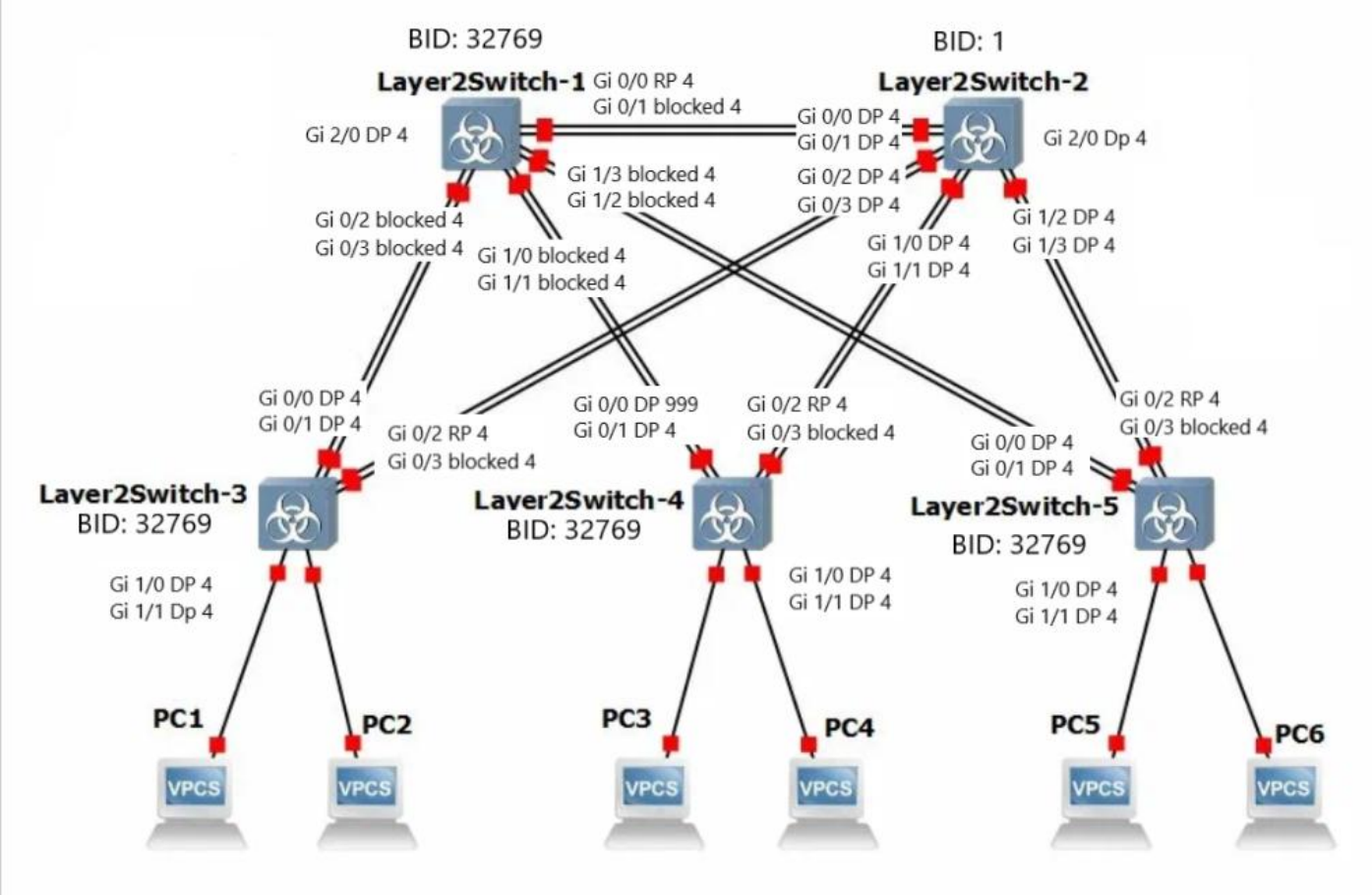

Рисунок 5.2 - Схема

6) Сохранить файлы конфигураций устройств в виде набора файлов с именами, соответствующими именам устройств.

Сохраненные файлы находятся в папке configs.

7*) Опциональное задание: заменить STP на RSTP (IEEE 802.1w), повторить 1-6, отметить резервные порты в п.3 и п.5, отличие работы протокола RSTP от протокола STP в п.4.

```
configure terminal
spanning-tree mode rapid-pvst
end
write memory
```

Пункт 3
Схема сохранена под названием schema7.png

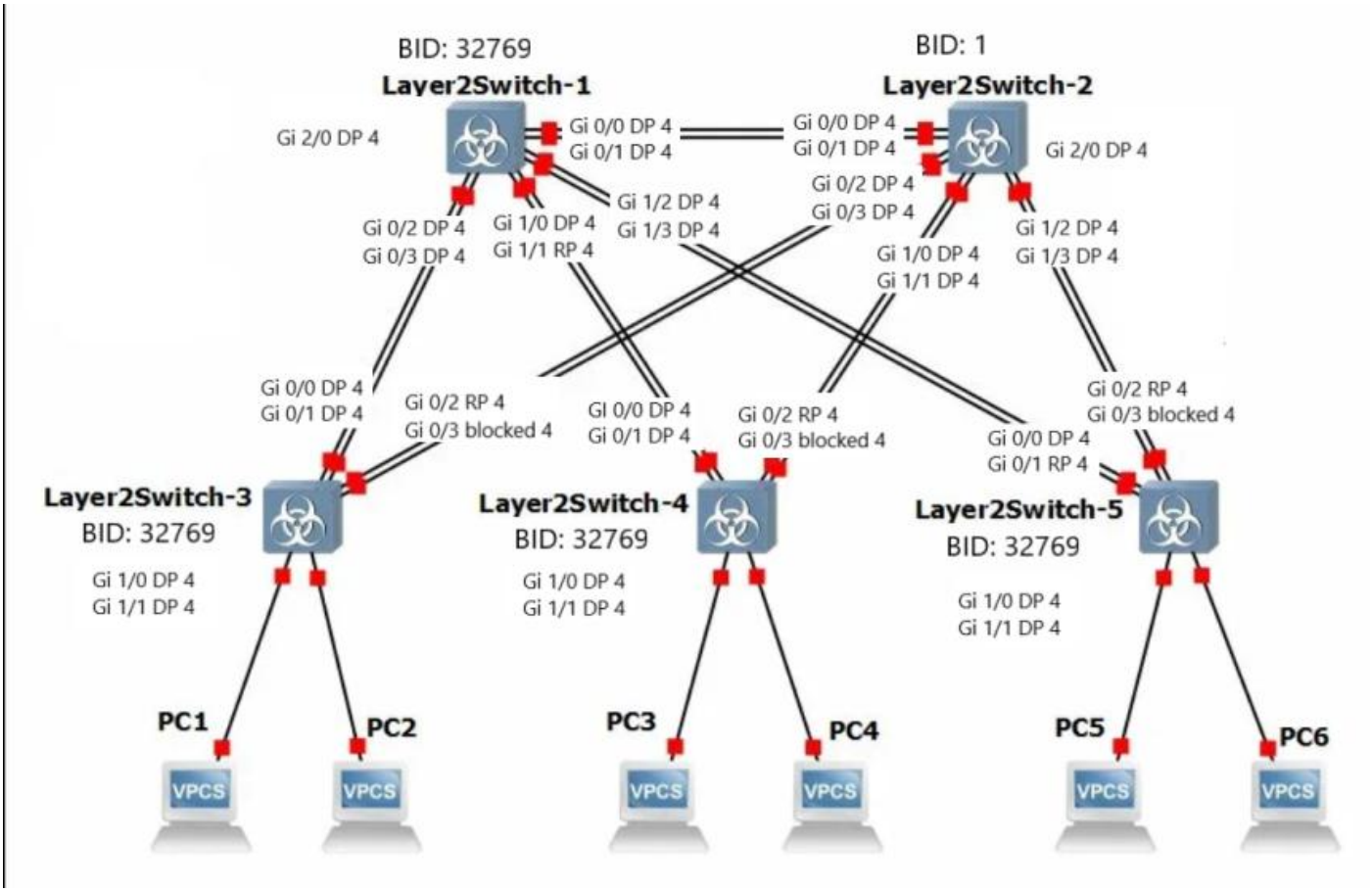

Рисунок 7.1 - Схема для пункта 3

Пункт 4

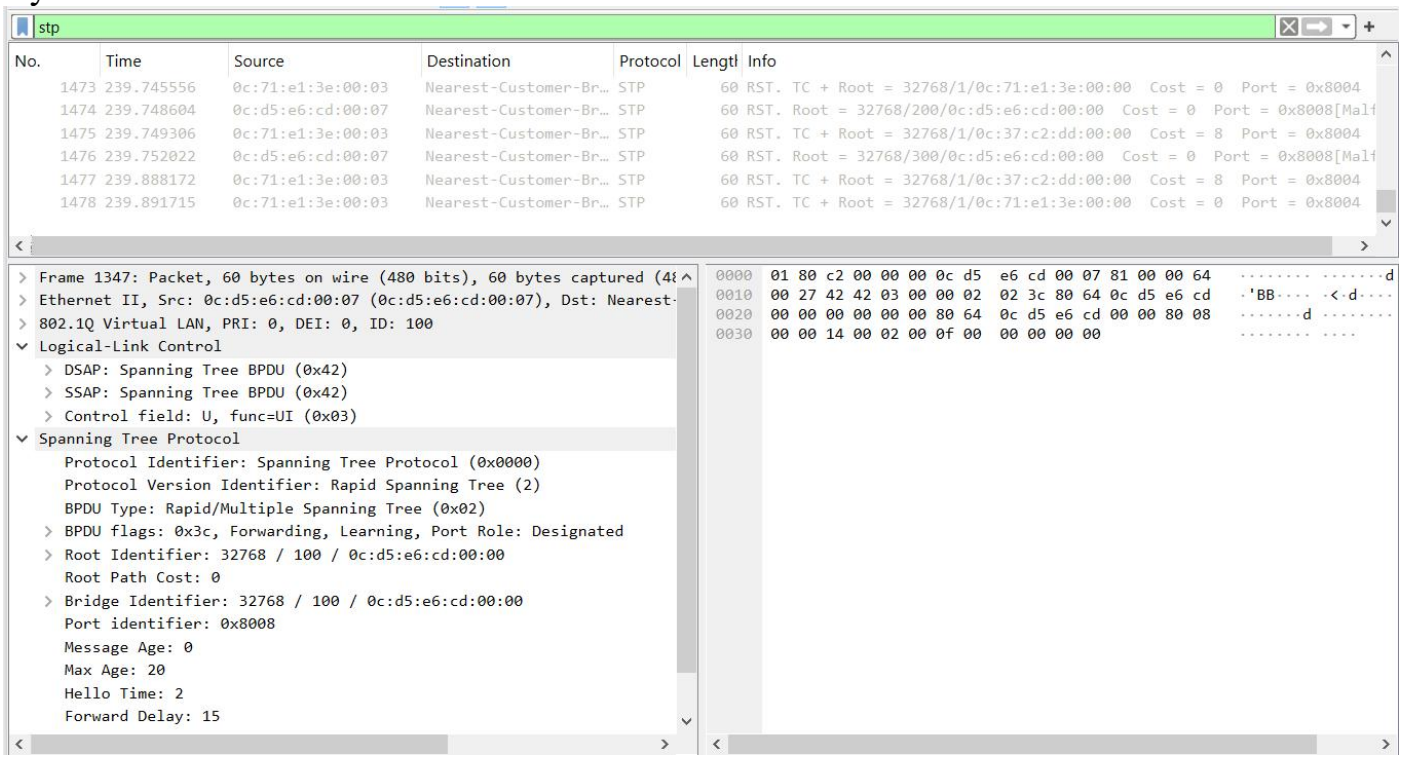

Рисунок 7.2 - Пакеты для Switch2 и Switch5

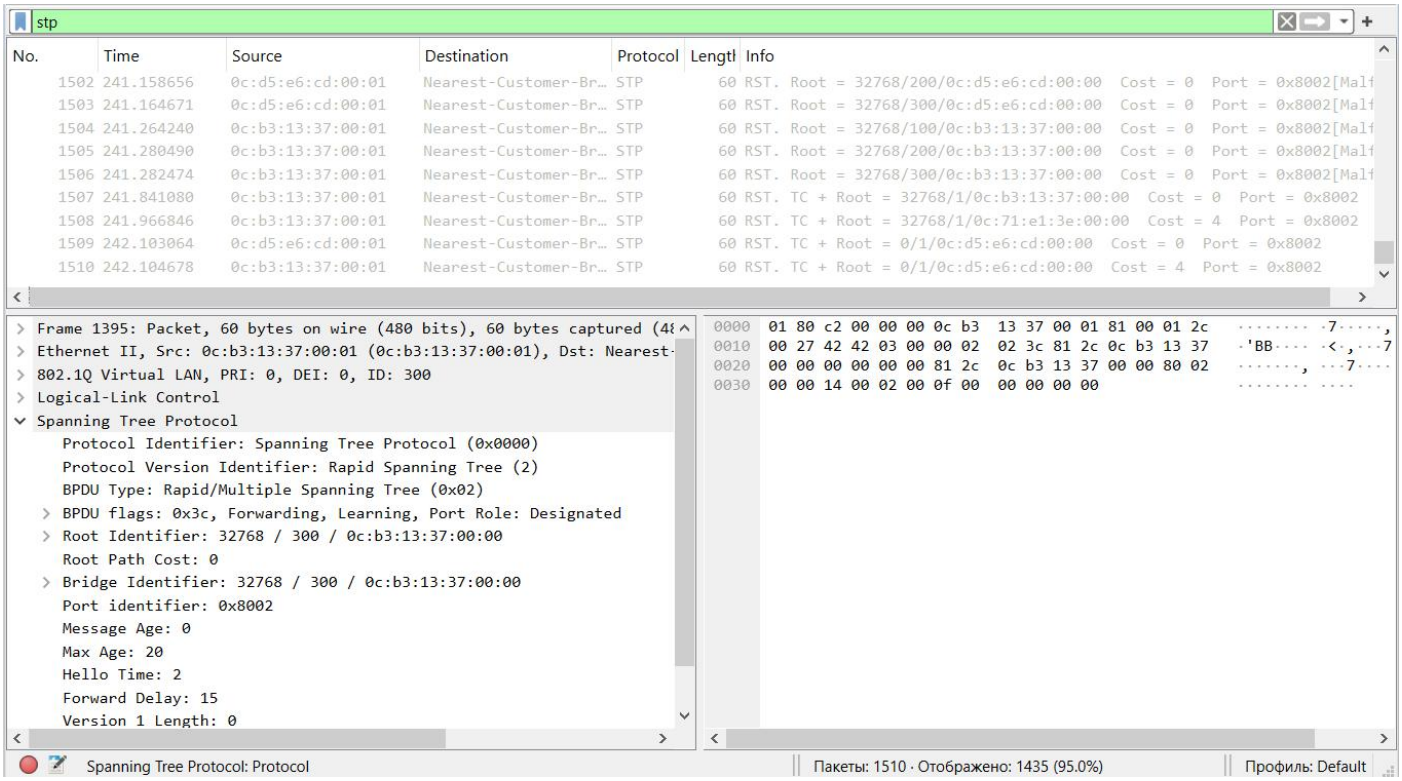

Рисунок 7.3 - Пакеты для Switch2 и Switch1

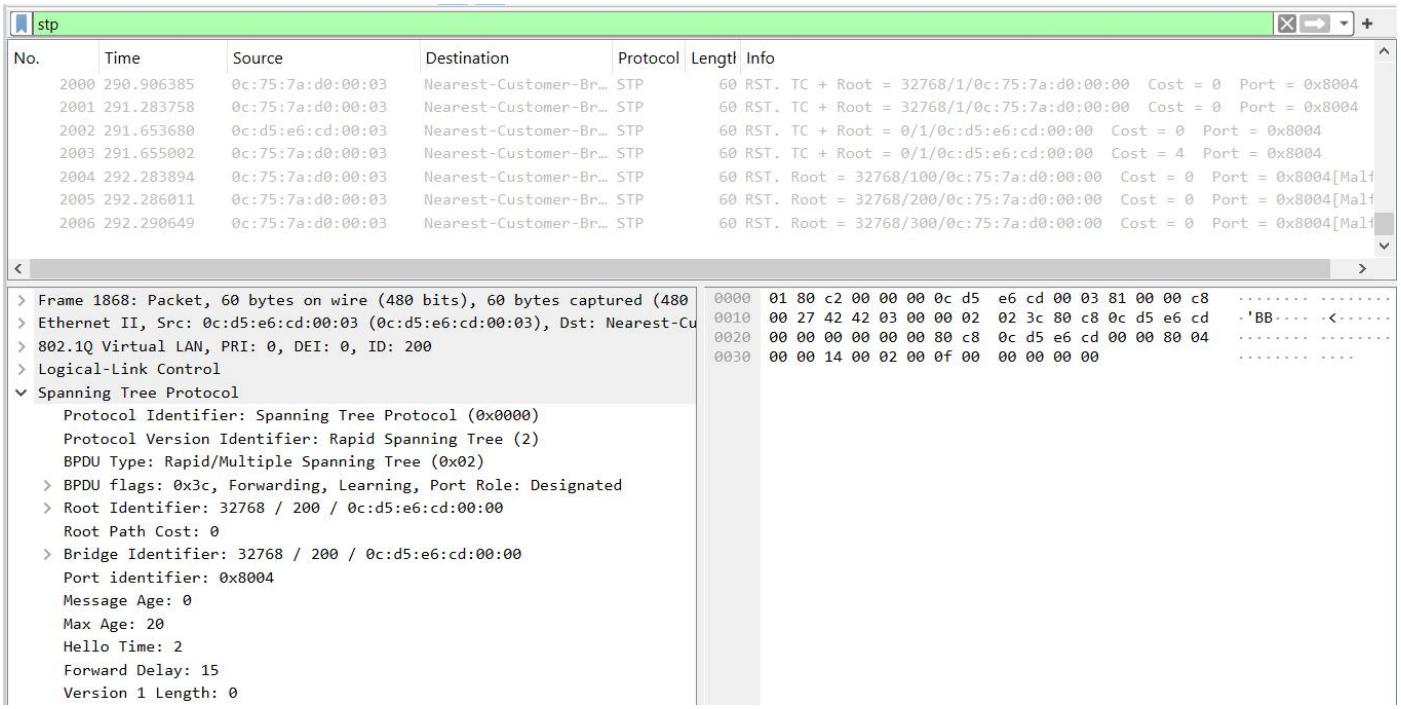

Рисунок 7.4 - Пакеты для Switch2 и Switch3

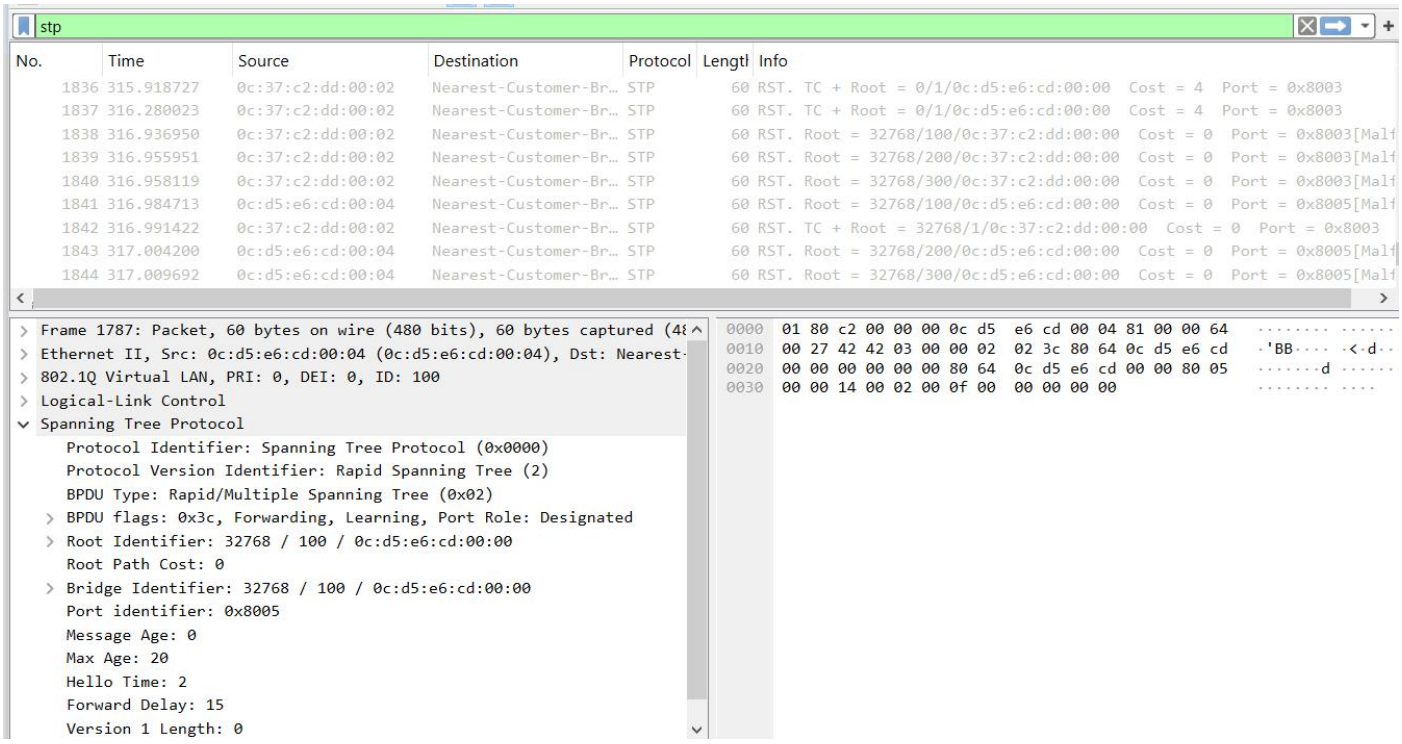

Рисунок 7.5 - Пакеты для Switch2 и Switch4

STP: Только корневой мост рассылает конфигурационные BPDU.
RSTP: Каждый коммутатор генерирует и отправляет свои BPDU с каждым Hello-таймером, независимо от получения их от корня.

Пункт 5
Схема сохранена под названием schema7_5.png

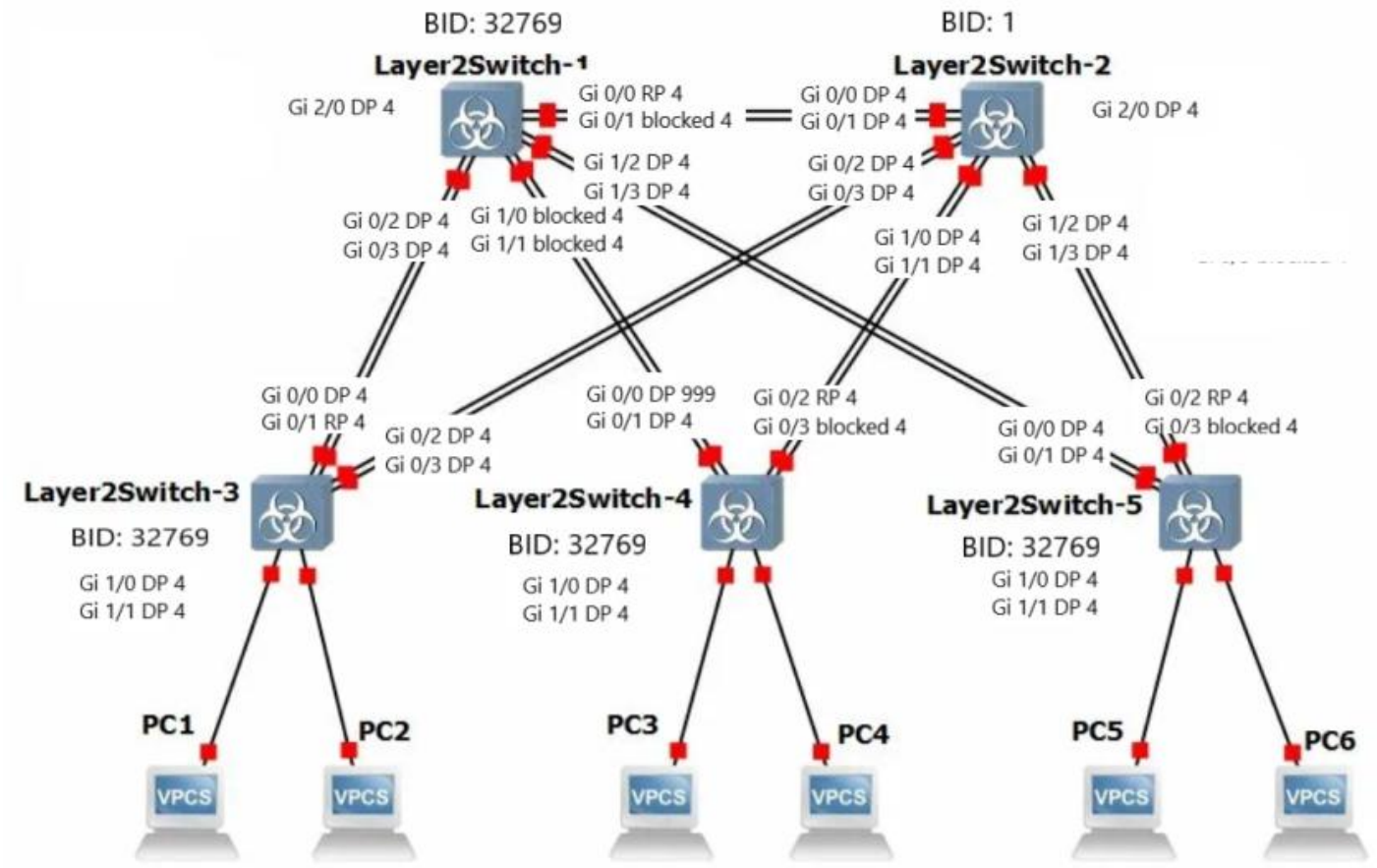

Рисунок 7.6 - Схема для пункта 5

Пункт 6
Сохраненные файлы находятся в папке configs7.