Лабораторная работа №2
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

Из проекта Menzhulin-lab2-template была скопирована сеть (рис. 1).

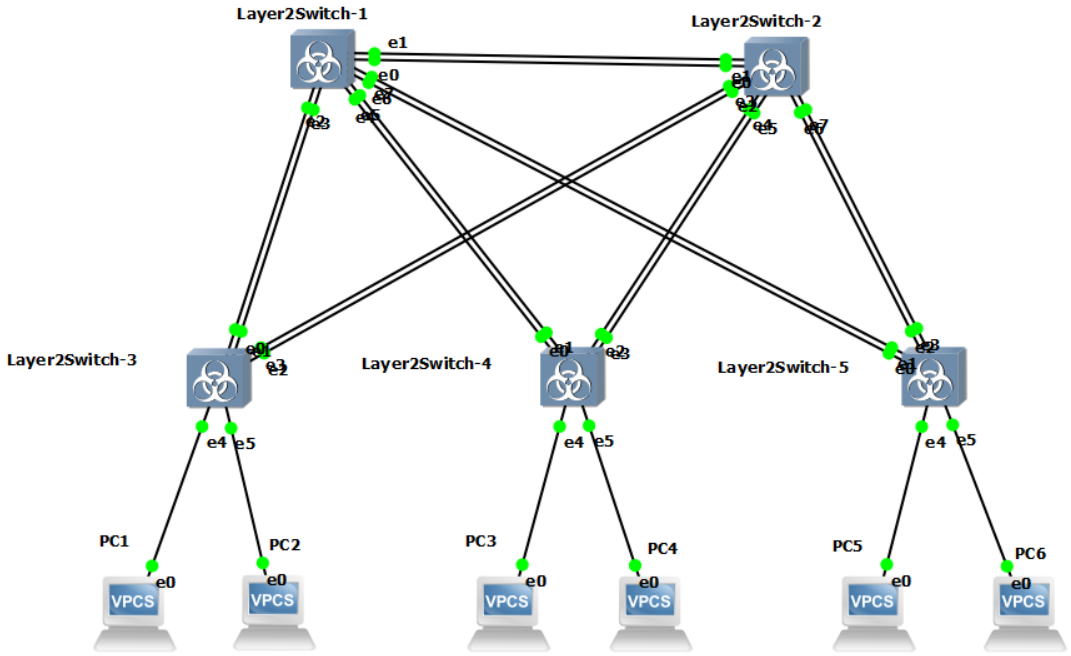


Рис. 1. Топология сети.

В качестве корневого коммутатора для сети был выбран Layer2Switch-1

Настройка адресов, масок и портов.

Hostname	IP-address	Subnet Mask	Gateway
Layer2Switch-1	192.168.10.1	255.255.255.0	
Layer2Switch-2	192.168.10.2	255.255.255.0	
Layer2Switch-3	192.168.10.3	255.255.255.0	
Layer2Switch-4	192.168.10.4	255.255.255.0	
PC1	192.168.10.11	255.255.255.0	192.168.10.254
PC2	192.168.10.12	255.255.255.0	192.168.10.254
PC3	192.168.10.21	255.255.255.0	192.168.10.254
PC4	192.168.10.22	255.255.255.0	192.168.10.254
PC5	192.168.10.31	255.255.255.0	192.168.10.254
PC6	192.168.10.32	255.255.255.0	192.168.10.254

Настройка коммутатора Layer2Switch-1:

```
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#interface vlan1
*Dec  9 10:13:24.156: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Vlan1, changed state to down
vIOS-L2-01(config-if)#ip address 192.168.10.1 255.255.255.0
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#end
vIOS-L2-01#
*Dec  9 10:15:06.654: %SYS-5-CONFIG_I: Configured from console by console
vIOS-L2-01#write memory
Building configuration...
Compressed configuration from 5306 bytes to 2041 bytes[OK]
vIOS-L2-01#
*Dec  9 10:15:33.446: %GRUB-5-CONFIG_WRITING: GRUB configuration is
being updated on disk. Please wait...
*Dec  9 10:15:34.212: %GRUB-5-CONFIG_WRITTEN: GRUB configuration
was written to disk successfully.
```

Настройка коммутатора Layer2Switch-2:

```
vIOS-L2-01(config-if)#ip address 198.168.10.2 255.255.255.0
```

Настройка коммутатора Layer2Switch-3:

```
vIOS-L2-01(config-if)#ip address 198.168.10.3 255.255.255.0
```

Настройка коммутатора Layer2Switch-4:

```
vIOS-L2-01(config-if)#ip address 198.168.10.4 255.255.255.0
```

Настройка коммутатора Layer2Switch-5:

```
vIOS-L2-01(config-if)#ip address 198.168.10.5198 255.255.255.0
```

Настройка PC1:

```
PC1> ip 192.168.10.11 192.168.10.254 24
Checking for duplicate address...
PC1 : 192.168.10.11 255.255.255.0 gateway 192.168.10.254
```

Настройка PC2:

PC2> ip 192.168.10.12 192.168.10.254 24
Checking for duplicate address...
PC2 : 192.168.10.12 255.255.255.0 gateway 192.168.10.254

Настройка PC3:

PC3> ip 192.168.10.21 192.168.10.254 24
Checking for duplicate address...
PC3 : 192.168.10.21 255.255.255.0 gateway 192.168.10.254

Настройка PC4:

PC4> ip 192.168.10.22 192.168.10.254 24
Checking for duplicate address...
PC4 : 192.168.10.22 255.255.255.0 gateway 192.168.10.254

Настройка PC5:

PC5> ip 192.168.10.31 192.168.10.254 24
Checking for duplicate address...
PC5 : 192.168.10.31 255.255.255.0 gateway 192.168.10.254

Настройка PC6:

PC6> ip 192.168.10.32 192.168.10.254 24
Checking for duplicate address...
PC6 : 192.168.10.32 255.255.255.0 gateway 192.168.10.254

Проверка работоспособности:

С PC1:
PC1> ping 192.168.10.12
PC1> ping 192.168.10.21
PC1> ping 192.168.10.22
PC1> ping 192.168.10.31
PC1> ping 192.168.10.32

Результат

```
PC1> ping 192.168.10.12

84 bytes from 192.168.10.12 icmp_seq=1 ttl=64 time=1.952 ms
84 bytes from 192.168.10.12 icmp_seq=2 ttl=64 time=0.915 ms
84 bytes from 192.168.10.12 icmp_seq=3 ttl=64 time=5.422 ms
```

```
84 bytes from 192.168.10.12 icmp_seq=4 ttl=64 time=0.818 ms
84 bytes from 192.168.10.12 icmp_seq=5 ttl=64 time=0.874 ms

PC1> ping 192.168.10.21

84 bytes from 192.168.10.21 icmp_seq=1 ttl=64 time=12.015 ms
84 bytes from 192.168.10.21 icmp_seq=2 ttl=64 time=16.402 ms
84 bytes from 192.168.10.21 icmp_seq=3 ttl=64 time=1.760 ms
84 bytes from 192.168.10.21 icmp_seq=4 ttl=64 time=6.699 ms
84 bytes from 192.168.10.21 icmp_seq=5 ttl=64 time=4.038 ms

PC1> ping 192.168.10.22

84 bytes from 192.168.10.22 icmp_seq=1 ttl=64 time=5.056 ms
84 bytes from 192.168.10.22 icmp_seq=2 ttl=64 time=13.403 ms
84 bytes from 192.168.10.22 icmp_seq=3 ttl=64 time=4.533 ms
84 bytes from 192.168.10.22 icmp_seq=4 ttl=64 time=2.562 ms
84 bytes from 192.168.10.22 icmp_seq=5 ttl=64 time=6.714 ms

PC1> ping 192.168.10.31

84 bytes from 192.168.10.31 icmp_seq=1 ttl=64 time=5.701 ms
84 bytes from 192.168.10.31 icmp_seq=2 ttl=64 time=7.840 ms
84 bytes from 192.168.10.31 icmp_seq=3 ttl=64 time=7.805 ms
84 bytes from 192.168.10.31 icmp_seq=4 ttl=64 time=8.791 ms
84 bytes from 192.168.10.31 icmp_seq=5 ttl=64 time=8.367 ms

PC1> ping 192.168.10.32

84 bytes from 192.168.10.32 icmp_seq=1 ttl=64 time=4.575 ms
84 bytes from 192.168.10.32 icmp_seq=2 ttl=64 time=7.546 ms
84 bytes from 192.168.10.32 icmp_seq=3 ttl=64 time=10.571 ms
84 bytes from 192.168.10.32 icmp_seq=4 ttl=64 time=18.408 ms
84 bytes from 192.168.10.32 icmp_seq=5 ttl=64 time=10.152 ms

PC1>
```

С PC1 успешно проходит сигнал на все остальные PC.

Проверка конфигураций STP на коммутаторах:

Layer2Switch-1:

```
vIOS-L2-01>show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0c3a.917b.0000
             Cost        4
             Port        5 (GigabitEthernet1/0)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0c4f.85c8.0000
             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               Root FWD 4         128.5    Shr
Gi1/1               Altn BLK 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
```

Layer2Switch-2:

```
vIOS-L2-01>show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0c3a.917b.0000
              Cost        4
              Port        5 (GigabitEthernet1/0)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0c9f.2895.0000
              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               Altn BLK 4         128.1    Shr
Gi0/1               Altn BLK 4         128.2    Shr
Gi0/2               Desg FWD 4         128.3    Shr
Gi0/3               Desg FWD 4         128.4    Shr
Gi1/0               Root FWD 4         128.5    Shr
Gi1/1               Altn BLK 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
```

Layer2Switch-3:

```
vIOS-L2-01>show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0c3a.917b.0000
              Cost        8
              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     0cd7.8b2d.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               Desg FWD 4         128.5    Shr
```

```
Gi1/1               Desg FWD 4         128.6    Shr
```

Layer2Switch-4:

```
vIOS-L2-01>show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0c3a.917b.0000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0c3a.917b.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
```

Layer2Switch-5:

```
vIOS-L2-01>show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0c3a.917b.0000
             Cost        8
             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     0cf9.77fa.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               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
```

Из полученных конфигураций STP видно, что сейчас Layer2Switch-4 является корневым (This bridge is the root), т.к. у него самый малый MAC-адрес из всех.

Установка более низкого приоритета у Layer2Switch-1:

vIOS-L2-01>enable

```
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#spanning-tree vlan 1 priority 0
vIOS-L2-01(config)#exit
vIOS-L2-01#write memory
```

Проверка:

```
vIOS-L2-01#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
             Address     0c4f.85c8.0000
             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     0c4f.85c8.0000
             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
```

Все порты назначены и коммутатор имеет приоритет 1.

2) Проверить доступность каждого с каждым всех персональных компьютеров (VPCS), результаты запротоколировать

Повторная проверка доступности VPCS:

```
PC1> ping 192.168.10.12

84 bytes from 192.168.10.12 icmp_seq=1 ttl=64 time=0.780 ms
84 bytes from 192.168.10.12 icmp_seq=2 ttl=64 time=4.255 ms
84 bytes from 192.168.10.12 icmp_seq=3 ttl=64 time=6.026 ms
84 bytes from 192.168.10.12 icmp_seq=4 ttl=64 time=8.152 ms
84 bytes from 192.168.10.12 icmp_seq=5 ttl=64 time=2.417 ms

PC1> ping 192.168.10.21

84 bytes from 192.168.10.21 icmp_seq=1 ttl=64 time=7.175 ms
84 bytes from 192.168.10.21 icmp_seq=2 ttl=64 time=7.860 ms
84 bytes from 192.168.10.21 icmp_seq=3 ttl=64 time=7.449 ms
84 bytes from 192.168.10.21 icmp_seq=4 ttl=64 time=6.510 ms
84 bytes from 192.168.10.21 icmp_seq=5 ttl=64 time=2.759 ms
```

```
PC1> ping 192.168.10.22

84 bytes from 192.168.10.22 icmp_seq=1 ttl=64 time=10.975 ms
84 bytes from 192.168.10.22 icmp_seq=2 ttl=64 time=4.222 ms
84 bytes from 192.168.10.22 icmp_seq=3 ttl=64 time=8.369 ms
84 bytes from 192.168.10.22 icmp_seq=4 ttl=64 time=13.979 ms
84 bytes from 192.168.10.22 icmp_seq=5 ttl=64 time=3.166 ms

PC1> ping 192.168.10.31

84 bytes from 192.168.10.31 icmp_seq=1 ttl=64 time=9.876 ms
84 bytes from 192.168.10.31 icmp_seq=2 ttl=64 time=8.451 ms
84 bytes from 192.168.10.31 icmp_seq=3 ttl=64 time=4.929 ms
84 bytes from 192.168.10.31 icmp_seq=4 ttl=64 time=8.232 ms
84 bytes from 192.168.10.31 icmp_seq=5 ttl=64 time=3.084 ms

PC1> ping 192.168.10.32

84 bytes from 192.168.10.32 icmp_seq=1 ttl=64 time=8.313 ms
84 bytes from 192.168.10.32 icmp_seq=2 ttl=64 time=6.370 ms
84 bytes from 192.168.10.32 icmp_seq=3 ttl=64 time=8.210 ms
84 bytes from 192.168.10.32 icmp_seq=4 ttl=64 time=14.972 ms
84 bytes from 192.168.10.32 icmp_seq=5 ttl=64 time=6.281 ms
```

Аналогичные результаты на других компьютерах. Из чего можно сделать вывод, что сеть работает.

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

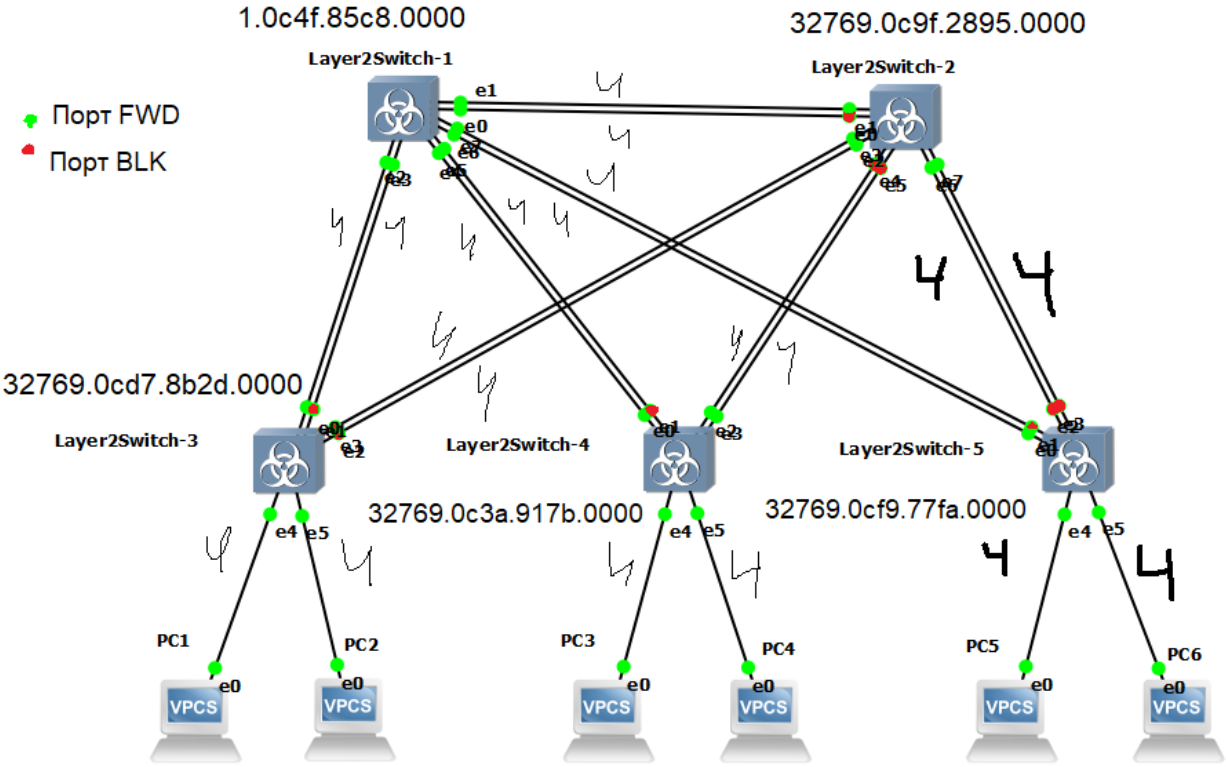
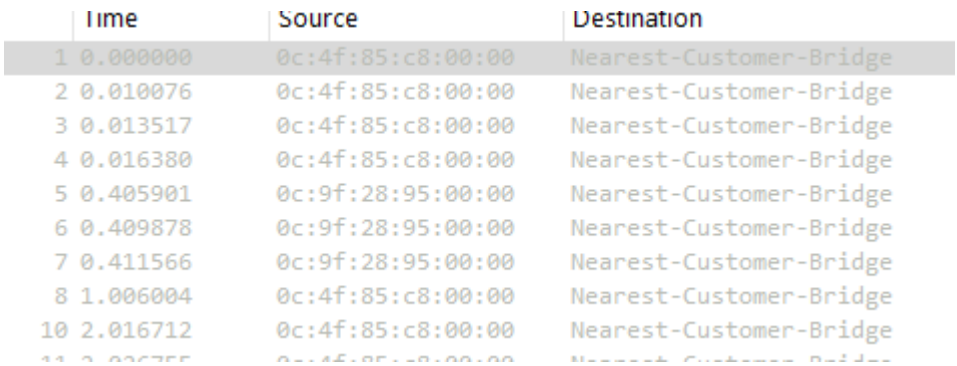


Рис. 2. Топология сети, BID и режимы работы портов.

4) При помощи wireshark отследить передачу пакетов hello от корневого коммутатора на всех линках (nb!), результаты включить в отчет

Для анализа трафика в wireshark применён фильтр “stp”. Из захвата трафика между портами e0 и e0 Layer2Switch-0 и Layer2Switch-1 (рис.3) видно, как они пересылают друг другу сообщения



	Time	Source	Destination
1	0.000000	0c:4f:85:c8:00:00	Nearest-Customer-Bridge
2	0.010076	0c:4f:85:c8:00:00	Nearest-Customer-Bridge
3	0.013517	0c:4f:85:c8:00:00	Nearest-Customer-Bridge
4	0.016380	0c:4f:85:c8:00:00	Nearest-Customer-Bridge
5	0.405901	0c:9f:28:95:00:00	Nearest-Customer-Bridge
6	0.409878	0c:9f:28:95:00:00	Nearest-Customer-Bridge
7	0.411566	0c:9f:28:95:00:00	Nearest-Customer-Bridge
8	1.006004	0c:4f:85:c8:00:00	Nearest-Customer-Bridge
10	2.016712	0c:4f:85:c8:00:00	Nearest-Customer-Bridge

Рис. 3. Передача сообщений между портами e0 Layer2Switch-0 (root) и e0 Layer2Switch-1.

MAC-адрес Layer2Switch-0 e0: 0c:4f:85:c8:00:00
И он имеет: Bridge Priority: 0 и Root Bridge Priority: 0

MAC-адрес Layer2Switch-1 e0: 0c:9f:28:95:00:00
И он имеет: Bridge Priority: 32768 и Root Bridge Priority: 32768

Оба имеют стоимость 0 (Root Path Cost: 0) и вещают на широковещательном адресе (Destination: Nearest-Customer-Bridge (01:80:c2:00:00:00))

Аналогично и для остальных линках. Все имеют стоимость 0, вещают на широковещательном адресах, и имеют приоритет в 32768. если она не. корневой и у всех них Hello Time: 2.

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

У Layer2Switch-3 изменю стоимость e0.

До

```
vIOS-L2-01#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    4097
              Address     0c4f.85c8.0000
              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     0cd7.8b2d.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               Desg FWD 4         128.5    Shr
Gi1/1               Desg FWD 4         128.6    Shr
```

После

```
vIOS-L2-01#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     0c4f.85c8.0000
             Cost        4
             Port        2 (GigabitEthernet0/1)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0cd7.8b2d.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               Altn BLK 4000      128.1    Shr
Gi0/1               Root FWD 4         128.2    Shr
Gi0/2               Altn BLK 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
```

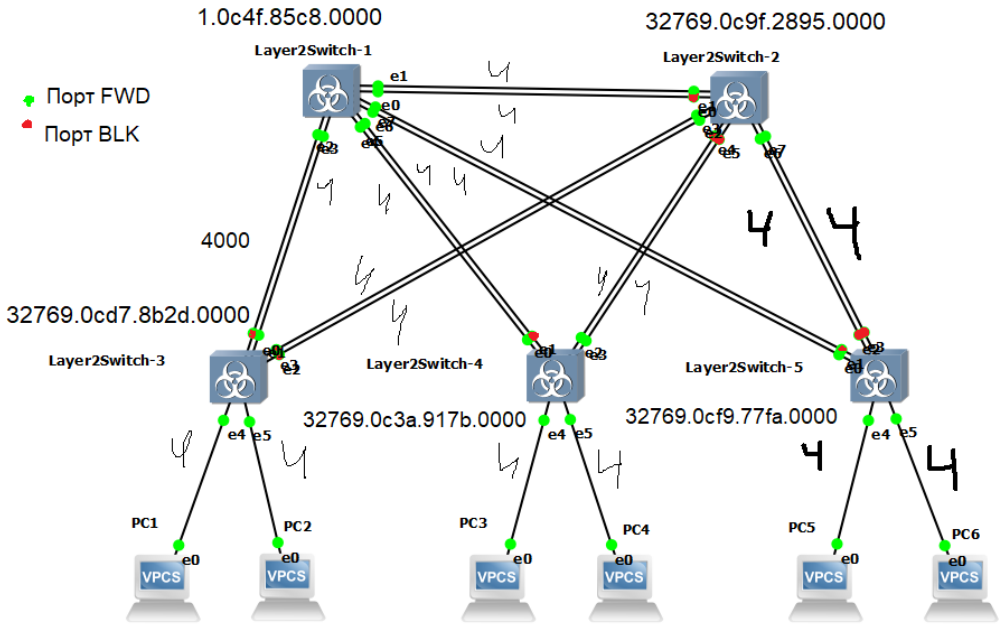


Рис. 4. Конфигурация сети, после изменения стоимости e0 у SW-3.