

1-

SW1:

```
Switch(config)#spanning-tree vlan 1 priority 8192
```

2-

```
Switch(config)#hostname S1
S1(config)#enable secret class
S1(config)#no ip domain-lookup
S1(config)#line console 0
S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#line vty 0 15
S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#end
```

3-

SW3:

```
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan1
Switch(config-if)#
*Nov 29 22:28:30.505: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
Switch(config-if)#ip address 172.17.10.3 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
*Nov 29 22:28:50.818: %LINK-3-UPDOWN: Interface Vlan1, changed state to up
*Nov 29 22:28:51.818: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
```

4-

a)

```
S1#show spanning-tree
```

```
VLAN0001
```

```
Spanning tree enabled protocol rstp
```

```
Root ID      Priority      1
             Address      0cd1.13bc.d000
             Cost         4
             Port         2 (GigabitEthernet0/1)
             Hello Time    2 sec  Max Age 20 sec  Forward Delay 15 sec
```

```
Bridge ID    Priority      8193  (priority 8192 sys-id-ext 1)
             Address      0cd1.13cf.ab00
             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	Root	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

b)

```
S1#sh spanning-tree bridge
```

Vlan	Bridge ID	Hello Time	Max Age	Fwd Dly	Protocol
-----	-----	-----	-----	-----	-----
VLAN0001	8193 (8192, 1) 0cd1.1361.e100	2	20	15	rstp

```
S1#
```

c)

S1-S3 – enviada por sw1

```
> Frame 2: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> IEEE 802.3 Ethernet
> Logical-Link Control
  > Spanning Tree Protocol
    Protocol Identifier: Spanning Tree Protocol (0x0000)
    Protocol Version Identifier: Rapid Spanning Tree (2)
    BPDU Type: Rapid/Multiple Spanning Tree (0x02)
    > BPDU flags: 0x3c, Forwarding, Learning, Port Role: Designated
    > Root Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
      Root Path Cost: 4
    > Bridge Identifier: 8192 / 1 / 0c:d1:13:61:e1:00
      Port identifier: 0x8001
      Message Age: 1
      Max Age: 20
      Hello Time: 2
      Forward Delay: 15
      Version 1 Length: 0
```

S1-S2 – enviada por sw2

```

> Frame 13: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> IEEE 802.3 Ethernet
> Logical-Link Control
▼ Spanning Tree Protocol
  Protocol Identifier: Spanning Tree Protocol (0x0000)
  Protocol Version Identifier: Rapid Spanning Tree (2)
  BPDU Type: Rapid/Multiple Spanning Tree (0x02)
> BPDU flags: 0x3c, Forwarding, Learning, Port Role: Designated
> Root Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
  Root Path Cost: 0
> Bridge Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
  Port identifier: 0x8002
  Message Age: 0
  Max Age: 20
  Hello Time: 2
  Forward Delay: 15
  Version 1 Length: 0

```

Em ambos os casos as mensagens são mensagens de BPDU em que a bridge manda aos seus vizinhos quem são os root's para elas e qual o seu custo até estas, desta forma é possível calcular os caminhos menos custosos até à root

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SW2

```

> Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> IEEE 802.3 Ethernet
> Logical-Link Control
▼ Spanning Tree Protocol
  Protocol Identifier: Spanning Tree Protocol (0x0000)
  Protocol Version Identifier: Rapid Spanning Tree (2)
  BPDU Type: Rapid/Multiple Spanning Tree (0x02)
> BPDU flags: 0x3c, Forwarding, Learning, Port Role: Designated
> Root Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
  Root Path Cost: 0
> Bridge Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
  Port identifier: 0x8002
  Message Age: 0
  Max Age: 20
  Hello Time: 2
  Forward Delay: 15
  Version 1 Length: 0

```

SW1

```

> Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> IEEE 802.3 Ethernet
> Logical-Link Control
▼ Spanning Tree Protocol
  Protocol Identifier: Spanning Tree Protocol (0x0000)
  Protocol Version Identifier: Rapid Spanning Tree (2)
  BPDU Type: Rapid/Multiple Spanning Tree (0x02)
> BPDU flags: 0x3c, Forwarding, Learning, Port Role: Designated
> Root Identifier: 0 / 1 / 0c:d1:13:bc:d0:00
  Root Path Cost: 4
> Bridge Identifier: 8192 / 1 / 0c:d1:13:61:e1:00
  Port identifier: 0x8001
  Message Age: 1
  Max Age: 20
  Hello Time: 2
  Forward Delay: 15
  Version 1 Length: 0

```

SW2

```
> Frame 756: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> IEEE 802.3 Ethernet
> Logical-Link Control
> Spanning Tree Protocol
  Protocol Identifier: Spanning Tree Protocol (0x0000)
  Protocol Version Identifier: Rapid Spanning Tree (2)
  BPDU Type: Rapid/Multiple Spanning Tree (0x02)
> BPDU flags: 0x1f, Learning, Port Role: Designated, Proposal, Topology Change
> Root Identifier: 0 / 1 / 0c:d1:13:0a:9d:00
  Root Path Cost: 0
> Bridge Identifier: 0 / 1 / 0c:d1:13:0a:9d:00
  Port identifier: 0x8002
  Message Age: 0
  Max Age: 20
  Hello Time: 2
  Forward Delay: 15
  Version 1 Length: 0
```

6-

Root = S2 , Cost = 0

BPDU S1

Root = S2, Cost = 0

BPDU S3, via S1

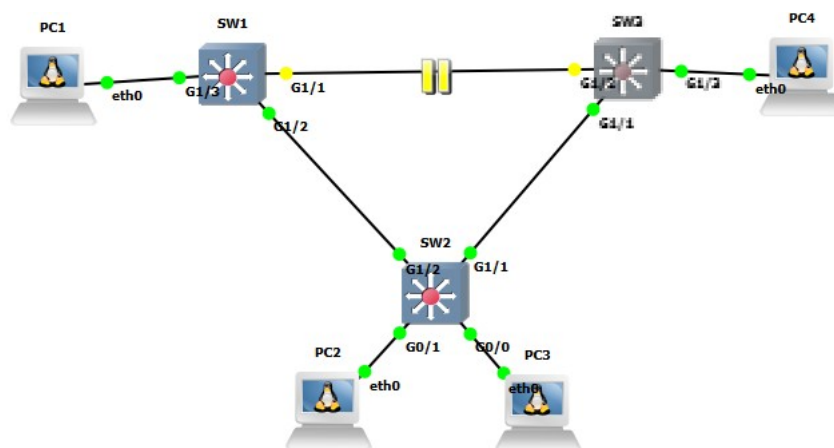
Root = S3, Cost = 38

BPDU S3

Root = S3, Cost = 19

8-

a)



b e c)

SW1

```
S1#debug spanning-tree events
Spanning Tree event debugging is on
S1#
*Dec 13 16:32:36.427: RSTP(1): Gi1/1 rcvd info expired
*Dec 13 16:32:36.427: RSTP(1): updt roles, information on root port Gi1/1 expired
*Dec 13 16:32:36.428: RSTP(1): we become the root bridge
*Dec 13 16:32:36.428: RSTP(1): Gi1/1 is now designated
*Dec 13 16:32:36.454: RSTP(1): updt roles, received superior bpdu on Gi1/2
*Dec 13 16:32:36.455: RSTP(1): Gi1/2 is now root port
*Dec 13 16:32:36.457: STP[1]: Generating TC trap for port GigabitEthernet1/2
```

SW2

```
S2#
*Dec 13 16:32:37.581: RSTP(1): updt roles, received superior bpdu on Gi1/2
*Dec 13 16:32:37.581: RSTP(1): Gi1/2 is now designated
*Dec 13 16:32:37.587: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:38.856: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:40.879: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:42.901: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:44.928: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:46.954: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:48.984: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:51.013: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:52.583: RSTP(1): Gi1/2 fdwhile Expired
*Dec 13 16:32:53.041: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:55.065: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:57.088: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:32:59.111: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:33:01.131: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:33:03.153: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:33:05.178: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:33:07.205: RSTP(1): transmitting a proposal on Gi1/2
*Dec 13 16:33:07.583: RSTP(1): Gi1/2 fdwhile Expired
*Dec 13 16:33:07.585: STP[1]: Generating TC trap for port GigabitEthernet1/2
```

SW 3- Nada

d)

SW1

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	Root	FWD	4	128.7	Shr
Gi1/3	Desg	FWD	4	128.8	Shr
Gi2/0	Desg	FWD	4	128.9	Shr
Gi2/1	Desg	FWD	4	128.10	Shr
Gi2/2	Desg	FWD	4	128.11	Shr
Gi2/3	Desg	FWD	4	128.12	Shr

SW2

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	Root	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
Gi2/1	Desg	FWD	4	128.10	Shr
Gi2/2	Desg	FWD	4	128.11	Shr
Gi2/3	Desg	FWD	4	128.12	Shr

e)

SW1 percebe-se que perdeu a sua melhor ligação à root

SW1 assume que é o root e manda bpdu a SW2

SW2 envia mensagem a SW1 a dizer que tem ligação ao root e que o BID deste é menor

SW1 pega nesse custo e adiciona o custo até SW2 e guarda-o como root cost e a porta que liga a SW2 como root port

f)

SW1 – G1/1 volta a root port

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	Root	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
Gi2/1	Desg	FWD	4	128.10	Shr
Gi2/2	Desg	FWD	4	128.11	Shr
Gi2/3	Desg	FWD	4	128.12	Shr

SW2

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	Root	FWD	4	128.6	Shr
Gi1/2	Altn	BLK	4	128.7	Shr
Gi1/3	Desg	FWD	4	128.8	Shr
Gi2/0	Desg	FWD	4	128.9	Shr
Gi2/1	Desg	FWD	4	128.10	Shr
Gi2/2	Desg	FWD	4	128.11	Shr
Gi2/3	Desg	FWD	4	128.12	Shr

10

```
root@PC1:~# ping 172.17.10.22
PING 172.17.10.22 (172.17.10.22) 56(84) bytes of data.
64 bytes from 172.17.10.22: icmp_seq=1 ttl=64 time=53.7 ms
64 bytes from 172.17.10.22: icmp_seq=2 ttl=64 time=15.0 ms
^C
--- 172.17.10.22 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 15.051/34.411/53.772/19.361 ms
root@PC1:~# ping 172.17.10.23
PING 172.17.10.23 (172.17.10.23) 56(84) bytes of data.
64 bytes from 172.17.10.23: icmp_seq=1 ttl=64 time=48.1 ms
64 bytes from 172.17.10.23: icmp_seq=2 ttl=64 time=16.3 ms
64 bytes from 172.17.10.23: icmp_seq=3 ttl=64 time=18.7 ms
^C
--- 172.17.10.23 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 16.385/27.738/48.101/14.430 ms
root@PC1:~# ping 172.17.10.27
PING 172.17.10.27 (172.17.10.27) 56(84) bytes of data.
64 bytes from 172.17.10.27: icmp_seq=1 ttl=64 time=30.8 ms
64 bytes from 172.17.10.27: icmp_seq=2 ttl=64 time=7.80 ms
64 bytes from 172.17.10.27: icmp_seq=3 ttl=64 time=7.83 ms
^C
--- 172.17.10.27 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 7.809/15.488/30.821/10.842 ms
root@PC1:~# ping 172.17.10.1
PING 172.17.10.1 (172.17.10.1) 56(84) bytes of data.
64 bytes from 172.17.10.1: icmp_seq=1 ttl=255 time=37.3 ms
64 bytes from 172.17.10.1: icmp_seq=2 ttl=255 time=3.34 ms
^C
--- 172.17.10.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 3.349/20.327/37.306/16.979 ms
root@PC1:~# ping 172.17.10.2
PING 172.17.10.2 (172.17.10.2) 56(84) bytes of data.
64 bytes from 172.17.10.2: icmp_seq=1 ttl=255 time=15.9 ms
64 bytes from 172.17.10.2: icmp_seq=2 ttl=255 time=14.1 ms
^C
--- 172.17.10.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 14.192/15.080/15.968/0.888 ms
root@PC1:~# ping 172.17.10.3
PING 172.17.10.3 (172.17.10.3) 56(84) bytes of data.
64 bytes from 172.17.10.3: icmp_seq=1 ttl=255 time=10.6 ms
64 bytes from 172.17.10.3: icmp_seq=2 ttl=255 time=10.6 ms
^C
--- 172.17.10.3 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 10.653/10.669/10.685/0.016 ms
```

11- Está presente o mac-address de PC1 nas respectivas portas, mas após o tempo de timeout este desaparece

12- Vai de S2 para S3 e de S3 para S1 e de S1 para PC1

13-

O caminho que era $S1 \rightarrow S3 \rightarrow S2$ passa a $S1 \rightarrow S2$ e a transmissão do ping prossegue