

# Лабораторная Работа №9. Использование протокола STP. Агрегирование каналов.

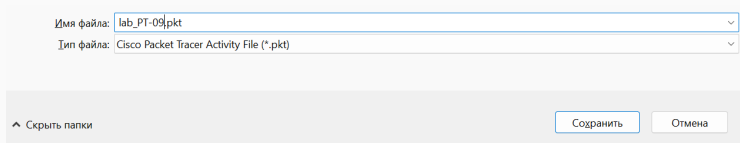
Администрирование локальных сетей

---

Исаев Б.А.

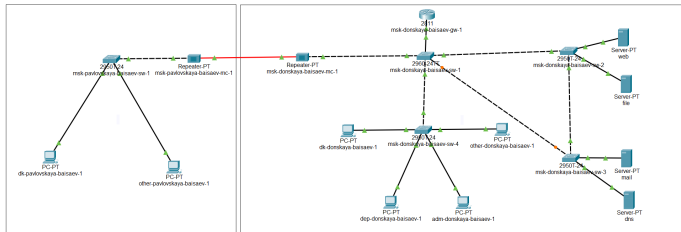
Российский университет дружбы народов им. Патриса Лумумбы, Москва, Россия

- Исаев Булат Абубакарович
- НПИБд-01-22
- Российский университет дружбы народов
- [1132227131@pfur.ru]



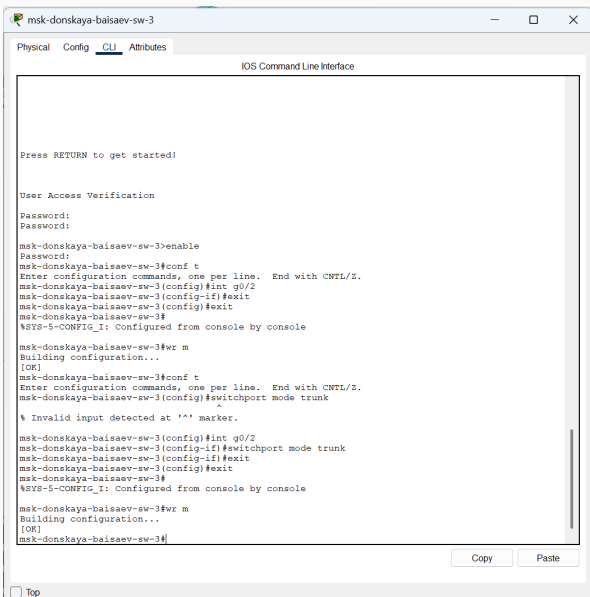
**Figure 1:** Открытие проекта lab\_PT-09.pkt.

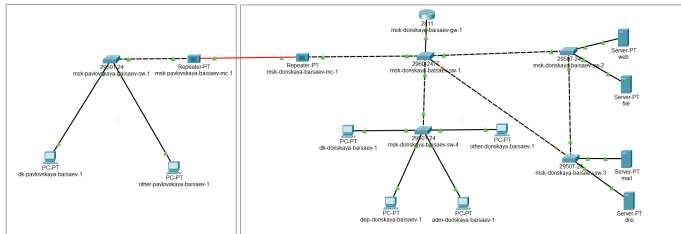
# Резервное соединение



**Figure 2:** Формирование резервного соединения между коммутаторами msk-donskaya-baisaev-sw-1 и msk-donskaya-baisaev-sw-3 (замена соединения между коммутаторами).

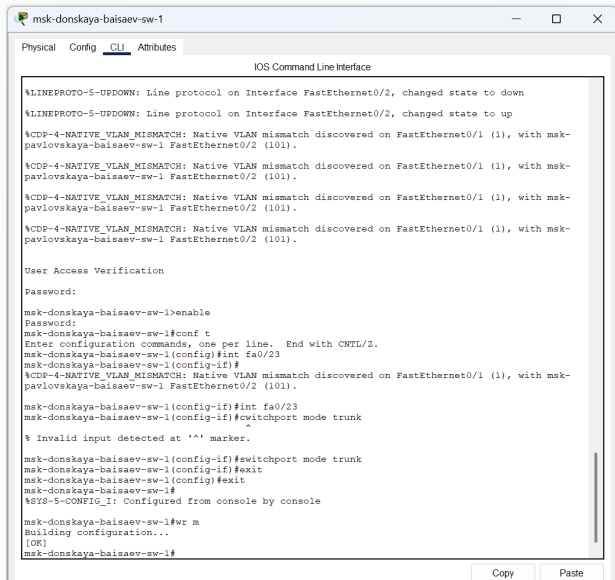
# Настройка порта





**Figure 4:** Соединение между коммутаторами msk-donskaya-baisaev-sw-1 и msk-donskaya-baisaev-sw-4 через интерфейсы Fa0/23.

# Активация (транковый режим)



The screenshot shows a terminal window titled "msk-donskaya-baisaev-sw-1" with tabs for Physical, Config, CLI (selected), and Attributes. The main area displays the "IOS Command Line Interface". The output shows several warnings about line protocol and CDP mismatches. The user enters "enable" and "configure terminal". They then enter "interface fa0/23" and "switchport mode trunk". A warning about an invalid input is shown. Finally, they enter "switchport mode trunk" again, exit configuration mode, and the system confirms the configuration.

```
msk-donskaya-baisaev-sw-1>enable
Password:
msk-donskaya-baisaev-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-baisaev-sw-1(config)#int fa0/23
msk-donskaya-baisaev-sw-1(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with msk-pavlovskaya-baisaev-sw-1 FastEthernet0/2 (101).
msk-donskaya-baisaev-sw-1(config-if)#int fa0/23
msk-donskaya-baisaev-sw-1(config-if)#cswitchport mode trunk
% Invalid input detected at '^' marker.
msk-donskaya-baisaev-sw-1(config-if)#switchport mode trunk
msk-donskaya-baisaev-sw-1(config-if)#exit
msk-donskaya-baisaev-sw-1(config)#exit
msk-donskaya-baisaev-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-baisaev-sw-1#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-1#
```

Copy Paste

# Активация (транковый режим)



The screenshot shows a Cisco IOS Command Line Interface window titled "msk-donskaya-baisaev-sw-4". The window has tabs for "Physical", "Config", "CLI", and "Attributes", with "CLI" selected. The main display area shows the following text:

```
System serial number: FHK061020WC
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-16C4L2-M), Version 12.1(22)EA4, RELEASE SOFTWARE(fcl)
Copyright (c) 1986-2005 by cisco systems, Inc.
Compiled Wed 18-May-05 22:31 by jharirba

Press RETURN to get started!

%LINK-3-UPDOWN: Interface Vlan2, changed state to down
%LINK-5-CHANGED: Interface Vlan2, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/11, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/11, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

User Access Verification

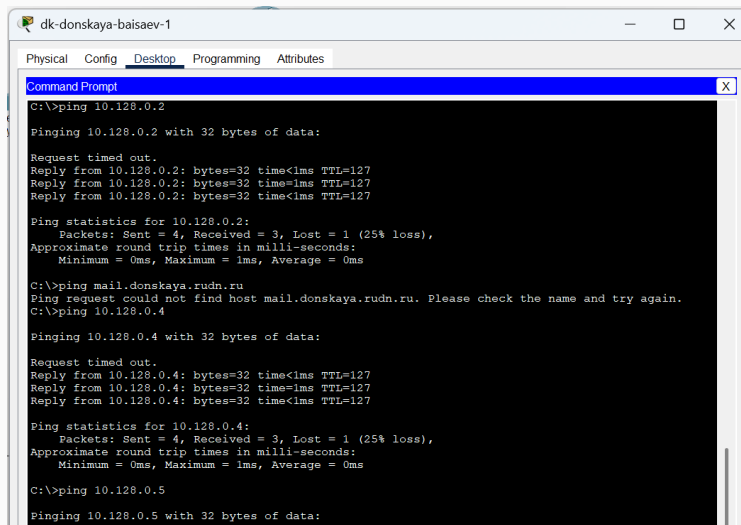
Password:
msk-donskaya-baisaev-sw-4>enable
Password:
msk-donskaya-baisaev-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-baisaev-sw-4(config)#int fa0/23
msk-donskaya-baisaev-sw-4(config-if)#switchport mode trunk
msk-donskaya-baisaev-sw-4(config-if)#exit
msk-donskaya-baisaev-sw-4(config)#exit
msk-donskaya-baisaev-sw-4#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-baisaev-sw-4#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-4#
```

At the bottom of the window, there are "Copy" and "Paste" buttons, and a "Top" button in the bottom left corner.



# Ping mail и web



The screenshot shows a Windows desktop environment. At the top, there is a taskbar with a single icon labeled 'dk-donskaya-baisaev-1'. Below the taskbar, there are several tabs: 'Physical', 'Config', 'Desktop' (which is selected), 'Programming', and 'Attributes'. A 'Command Prompt' window is open, displaying the following text:

```
C:\>ping 10.128.0.2

Pinging 10.128.0.2 with 32 bytes of data:

Request timed out.
Reply from 10.128.0.2: bytes=32 time<1ms TTL=127
Reply from 10.128.0.2: bytes=32 time=1ms TTL=127
Reply from 10.128.0.2: bytes=32 time<1ms TTL=127

Ping statistics for 10.128.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping mail.donskaya.rudn.ru
Ping request could not find host mail.donskaya.rudn.ru. Please check the name and try again.
C:\>ping 10.128.0.4

Pinging 10.128.0.4 with 32 bytes of data:

Request timed out.
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127
Reply from 10.128.0.4: bytes=32 time=1ms TTL=127
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127

Ping statistics for 10.128.0.4:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.128.0.5

Pinging 10.128.0.5 with 32 bytes of data:
```

**Figure 7:** Проверка командой ping серверов mail и web с оконечного устройства dk.donskaya.ru

# Отслеживание пакетов ICMP (DHCP)

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	39.466	--	dep-donskaya-baisaev-1	DHCP
	39.467	dep-donskaya-baisaev-1	msk-donskaya-baisaev-sw-4	DHCP
	39.468	msk-donskaya-baisaev-sw-4	msk-donskaya-baisaev-sw-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-mc-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-3	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-gw-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-2	DHCP
	39.469	--	other-pavlovskaya-baisaev-1	DHCP
	39.470	other-pavlovskaya-baisaev-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.470	msk-donskaya-baisaev-mc-1	msk-pavlovskaya-baisaev-mc-1	DHCP
	39.470	msk-donskaya-baisaev-sw-2	msk-donskaya-baisaev-sw-3	DHCP
	39.471	msk-pavlovskaya-baisaev-mc-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.472	--	dk-pavlovskaya-baisaev-1	DHCP
	39.473	dk-pavlovskaya-baisaev-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.474	msk-pavlovskaya-baisaev-sw-1	msk-pavlovskaya-baisaev-mc-1	DHCP
	39.475	msk-pavlovskaya-baisaev-mc-1	msk-donskaya-baisaev-mc-1	DHCP
	39.476	msk-donskaya-baisaev-mc-1	msk-donskaya-baisaev-sw-1	DHCP
	39.477	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-3	DHCP
	39.477	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-gw-1	DHCP
	39.477	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-2	DHCP
	39.477	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-4	DHCP
	39.478	msk-donskaya-baisaev-sw-2	msk-donskaya-baisaev-sw-3	DHCP

Reset Simulation ☒ Constant Delay

Captured to: 60 003 s

Play Controls

Event List Filters - Visible Events  
DHCP, ICMP

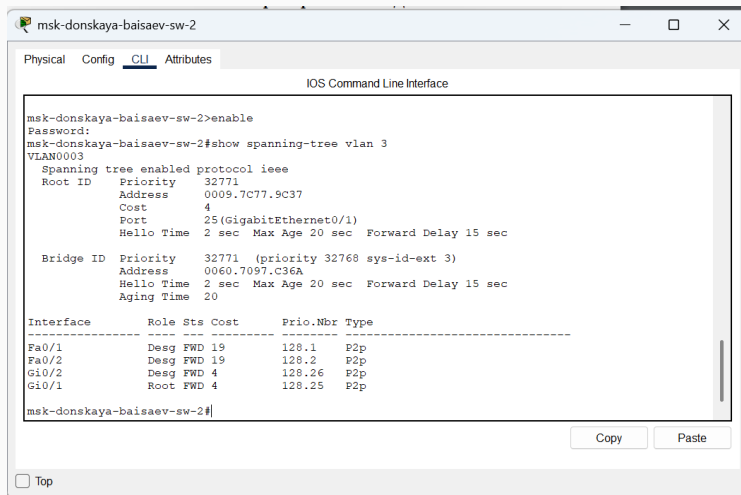
Edit Filters Show All/None

## Отслеживание пакетов ICMP

Simulation Panel				
Event List				
Vis.	Time(sec)	Last Device	At Device	Type
	39.466	--	dep-donskaya-baisaev-1	DHCP
	39.467	dep-donskaya-baisaev-1	msk-donskaya-baisaev-sw-4	DHCP
	39.468	msk-donskaya-baisaev-sw-4	msk-donskaya-baisaev-sw-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-mc-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-3	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-gw-1	DHCP
	39.469	msk-donskaya-baisaev-sw-1	msk-donskaya-baisaev-sw-2	DHCP
	39.469	--	other-pavlovskaya-baisaev-1	DHCP
	39.470	other-pavlovskaya-baisaev-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.470	msk-donskaya-baisaev-mc-1	msk-pavlovskaya-baisaev-mc-1	DHCP
	39.470	msk-donskaya-baisaev-sw-2	msk-donskaya-baisaev-sw-3	DHCP
	39.471	msk-pavlovskaya-baisaev-mc-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.472	--	dk-pavlovskaya-baisaev-1	DHCP
	39.473	dk-pavlovskaya-baisaev-1	msk-pavlovskaya-baisaev-sw-1	DHCP
	39.474	msk-pavlovskaya-baisaev-sw-1	msk-pavlovskaya-baisaev-mc-1	DHCP
	39.475	msk-pavlovskaya-baisaev-mc-1	msk-donskaya-baisaev-mc-1	DHCP

**Figure 9:** Отслеживание пакетов ICMP в режиме симуляции (mail) (движение пакетов происходит через коммутатор msk-donskaya-baisaev-sw-2).

# Просмотр состояния STP



**Figure 10:** Просмотр на коммутаторе msk-donskaya-baisaev-sw-2 состояния протокола STP для vlan 3 (указывается, что данное устройство является корневым (This bridge is<sup>12/24</sup>

# Настройка корневого коммутатора STP

```
msk-donskaya-baisaev-sw-1
Physical Config CLI Attributes
IOS Command Line Interface

msk-donskaya-baisaev-sw-1 con0 is now available

Press RETURN to get started.

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with msk-pavlovskaya-baisaev-sw-1 FastEthernet0/2 (101).

User Access Verification
Password:
msk-donskaya-baisaev-sw-1>enable
Password:
msk-donskaya-baisaev-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-baisaev-sw-1(config)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with msk-pavlovskaya-baisaev-sw-1 FastEthernet0/2 (101).

msk-donskaya-baisaev-sw-1(config)#spanning-tree vlan 3 root primary
msk-donskaya-baisaev-sw-1(config)#exit
msk-donskaya-baisaev-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-baisaev-sw-1#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-1#
```

☐ Top

Copy Paste

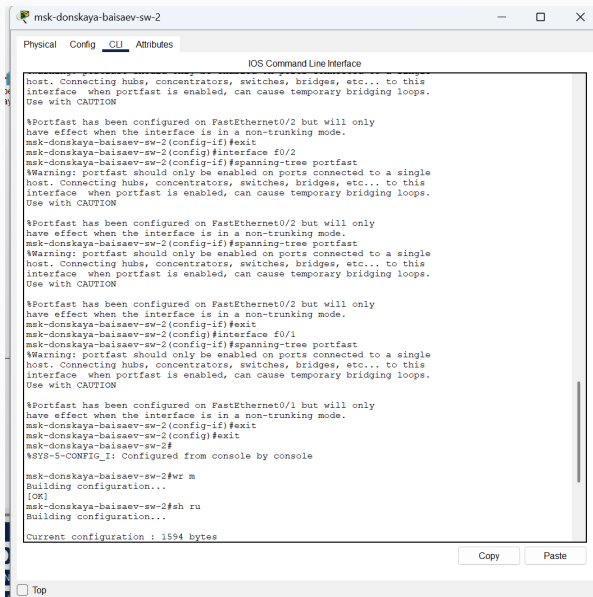
Настройка режима Portfast на интерфейсах коммутатора  
msk-donskaya-baisaev-sw-2.

**Figure 12:** Настройка режима Portfast на интерфейсах коммутатора  
msk-donskaya-baisaev-sw-2.

Настройка режима Portfast на интерфейсах коммутатора  
msk-donskaya-baisaev-sw-3.

**Figure 13:** Настройка режима Portfast на интерфейсах коммутатора  
msk-donskaya-baisaev-sw-3.

# Изучение отказоустойчивости



```
msk-donskaya-baisaev-sw-2
Physical Config CLI Attributes
IOS Command Line Interface

host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-2(config-if)#exit
msk-donskaya-baisaev-sw-2(config)#interface f0/2
msk-donskaya-baisaev-sw-2(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-2(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-2(config-if)#exit
msk-donskaya-baisaev-sw-2(config)#interface f0/1
msk-donskaya-baisaev-sw-2(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-2(config-if)#exit
msk-donskaya-baisaev-sw-2(config)#exit
msk-donskaya-baisaev-sw-2#
%SYS-5-CONFIG_I: Configured from console by console

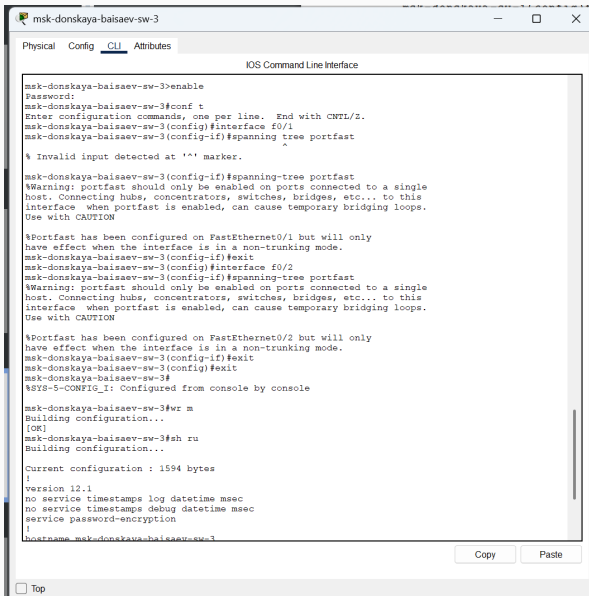
msk-donskaya-baisaev-sw-2#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-2#sh ru
Building configuration...

Current configuration : 1594 bytes
```

☐ Top



# Изучение отказоустойчивости



```
msk-donskaya-baisaev-sw-3>enable
Password:
msk-donskaya-baisaev-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-baisaev-sw-3(config)#interface f0/1
msk-donskaya-baisaev-sw-3(config-if)#spanning tree portfast
^
% Invalid input detected at '^' marker.

msk-donskaya-baisaev-sw-3(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-3(config-if)#exit
msk-donskaya-baisaev-sw-3(config)#interface f0/2
msk-donskaya-baisaev-sw-3(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-baisaev-sw-3(config-if)#exit
msk-donskaya-baisaev-sw-3(config)#exit
msk-donskaya-baisaev-sw-3#
%SYS-5-CONFIG_I: Configured from console by console

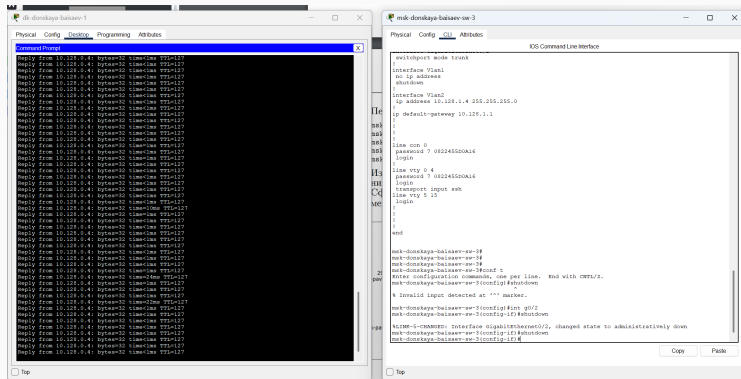
msk-donskaya-baisaev-sw-3#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-3#sh ru
Building configuration...

Current configuration : 1594 bytes
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname msk-donskaya-baisaev-sw-3
```

Copy Paste

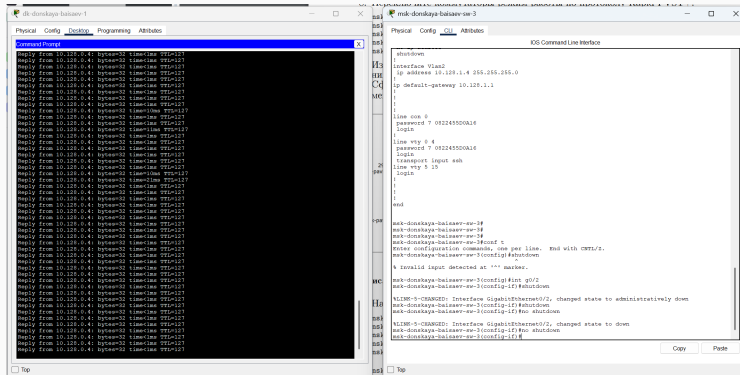
☐ Top

# Переключение в Rapid PVST+



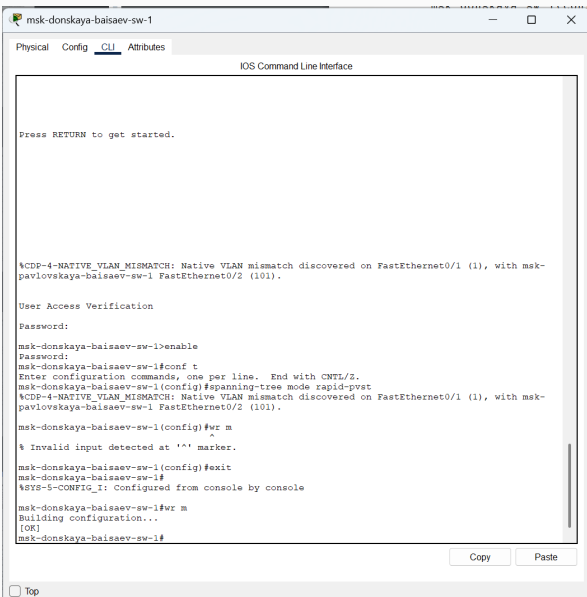
**Figure 16:** Переключение коммутаторов в режим работы по протоколу Rapid PVST+ (на примере msk-donskaya-baisaev-sw-1).

## Изучение отказоустойчивости



**Figure 17:** Изучение отказоустойчивости протокола Rapid PVST+ и времени восстановления соединения при переключении на резервное соединение.

# Изучение отказоустойчивости



```
msk-donskaya-baisaev-sw-1
Physical Config CLI Attributes
IOS Command Line Interface

Press RETURN to get started.

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with msk-pavlovskaya-baisaev-sw-1 FastEthernet0/2 (101).

User Access Verification
Password:

msk-donskaya-baisaev-sw-1>enable
Password:
msk-donskaya-baisaev-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-baisaev-sw-1(config)#spanning-tree mode rapid-pvst
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with msk-pavlovskaya-baisaev-sw-1 FastEthernet0/2 (101).

msk-donskaya-baisaev-sw-1(config)#wr m
^
% Invalid input detected at '^' marker.

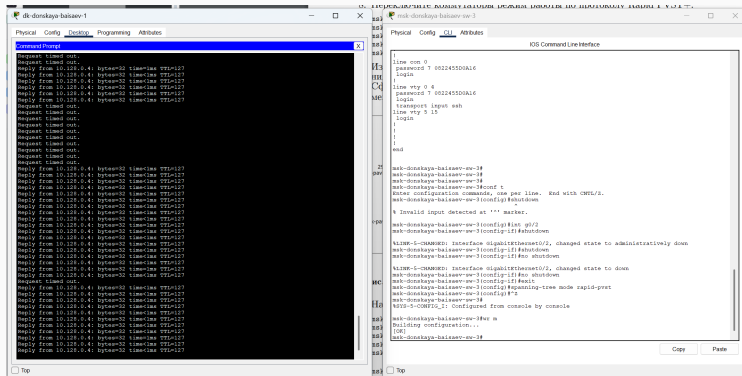
msk-donskaya-baisaev-sw-1(config)#exit
msk-donskaya-baisaev-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-baisaev-sw-1#wr m
Building configuration...
[OK]
msk-donskaya-baisaev-sw-1#
```

Copy Paste

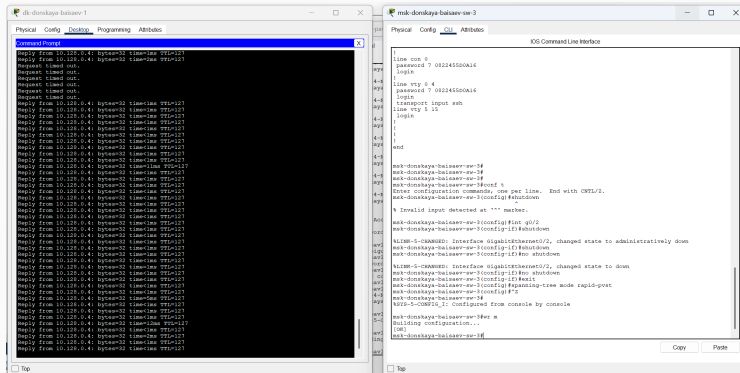
☐ Top

# Агрегированное соединение



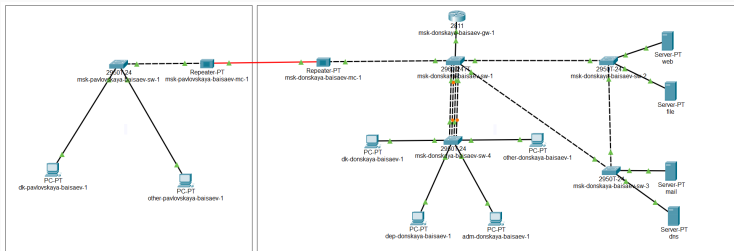
**Figure 19:** Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-baisaev-sw-1 и msk-donskaya-baisaev-sw-4.

# Агрегированное соединение



**Figure 20:** Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-baisaev-sw-1 и msk-donskaya-baisaev-sw-4.

# Агрегированное соединение



**Figure 21:** Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-baisaev-sw-1 и msk-donskaya-baisaev-sw-4.

В ходе выполнения лабораторной работы мы изучили возможности протокола STP и его модификаций по обеспечению отказоустойчивости сети, агрегированию интерфейсов и перераспределению нагрузки между ними.