5

Virtual LAN

-

-

-

1 –

(VLAN)

,

.

VLAN,

.

VLAN .

, VLAN,

.

.   ,

VLAN.

VLAN   ,

.

,

(   )   ,

VLAN. VLAN   ,

,   .

VLAN

– VLAN   ,

•

– VLAN   MAC,

•

– VLAN   (tag-based), IEEE 802.1q

•

VLAN   VLAN

. VLAN   MAC   MAC-

-        ,   VLAN   VLAN

-                .   MAC

Ethernet,   VLAN.

-VLAN

-

-VLAN

-                    VLAN   2-   ,

2. VLAN

2 – VLAN

3 – VLAN

:

• PVID

• Acceptable Frame Type – :   ,
  .

• VLAN Trunking –   ,   VLAN

,   .   ,

          -                    ,   VLAN,

               «   »   .

          VLAN Trunking.

                         VLAN   .

• Ingress check –   ,

VLAN ID,   .

• GVRP –   VLAN

                         .   ,

          ,   .

• Port Isolation –   ,

                         .

          (CPU)   .

CLI
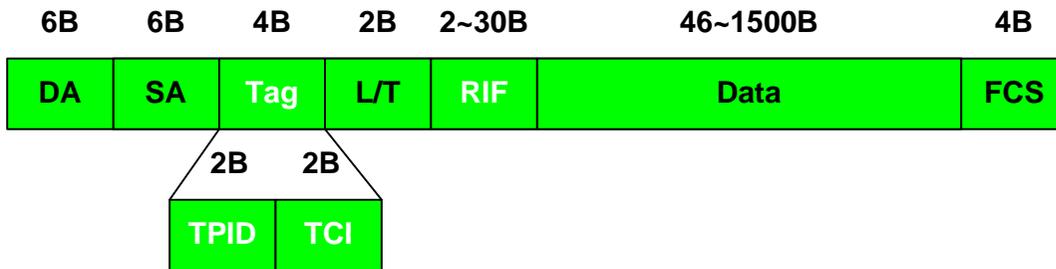
interface port-channel <port-list> pvid <1-4094>

interface port-channel <port-list> ingress-check

interface port-channel <port-list> gvrp

interface port-channel <port-list> frame-type <all|tagged|untagged>

interface port-channel <port-list> name <port-name-string>

interface port-channel <port-list> vlan-trunking

interface port-channel <port-list> flow-control

VLAN

802.3/Ethernet Frame

6B	6B	2B	46~1500B	4B
DA	SA	L/T	Data	FCS

802.3/Ethernet Tagged Frame

6B	6B	4B	2B	2~30B	46~1500B	4B
DA	SA	Tag	L/T	RIF	Data	FCS

2B	2B
TPID	TCI

4 –   Ethernet   VLAN

RIF: Routing Information Field (optional).

IEEE   802.1Q

Ethernet,   VLAN   .

IEEE   802.1p

,   ,

IEEE 802.1Q.

Ethernet   4   . TPID (Tag Protocol Identifier) 2
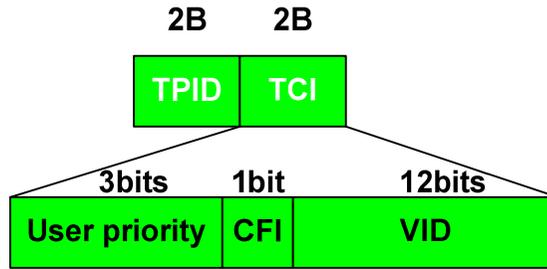
,   Ethernet

VLAN   TCI (Tag Control Information),   .

Ethernet

,

Ethernet   .   ,

.

IEEE   802.1p,

802.1Q,

.   802.1p

,

.

2B   2B

```
       TPID   TCI
```

```
     3bits      1bit        12bits
   User priority  CFI        VID
```

5 –

TPID: , 802.1Q TPID = 8100

User Priority: 8   802.1P   QoS

(Quality of Service)

CFI: Canonical Format Indicator,   0   Ethernet

VID: VLAN ID, 4096 VLAN   802.1Q

VLAN

TPID: TPID

802.1Q   8100   16 / .

EtherType   8100,   IEEE

802.1Q/802.1p.

TCI   :

Priority: TCI   .
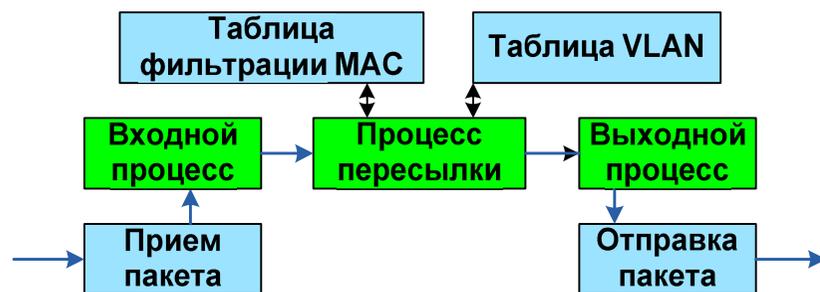
(2^3) . IEEE 802.1P   3

.

CFI: Canonical Format Indicator   ,
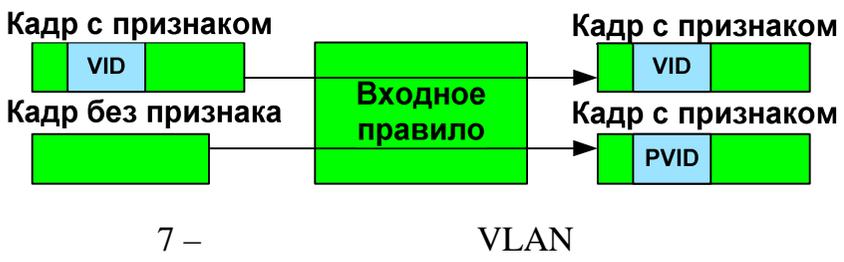
0   Ethernet. CFI   ,

, Ethernet, Token Ring.

1. Ethernet

CFI 1, untagged .

VID: VLAN ID VLAN,

802.1Q. 12 4096

(2^{12}) VLAN- . 4096 , VID 0 4095 (FFF)

, VLAN,

4094. VID = 0 ,

VLAN, . VID = 4095

.

802.1Q Tag VLAN:

- VLAN VID

- VLAN

VLAN-aware

- , VLAN

VLAN-unaware

- , VLAN

VID .

, VLAN,

.

VLAN

.

6 – 802.1Q

:

–   .   ,

,   ,

.

(   ):

–

VLAN   MAC.

:

–   ,   VLAN   .   ,

VLAN-Unaware,   .

Кадр с признаком   **Кадр с признаком**

| | VID | |

Кадр без признака

Входное правило

Кадр с признаком

| | PVID | |

7 –   VLAN

VLAN

,   .

-

-              PVID

-                              PVID

- Port   VLAN   ID

VLAN.

.

,   .

,   ,

:

-

-   ,

PVID   .   VID

PVID (Port VID). PVID

(VID=0),   .

VLAN
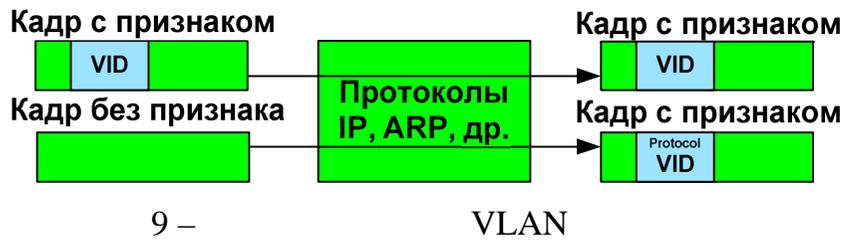
8 –   VLAN

Port:

Ethernet-type: type   Ethernet.

VID: VLAN ID,

Priority: ,

9 –   VLAN

           ,   4

      ,   VLAN,

        .

Таблица MAC

Port	MAC address	Aging
2	00:A0:C5:11:11:11	0
2	00:A0:C5:22:22:22	20
3	00:A0:C5:33:33:33	30
10	00:A0:C5:44:44:44	100

Таблица VLAN

VID	Egress Port	Register	Tag
1	2	Static	Untag
1	3	Dynamic	Tag
100	3	Static	Untag
100	10	Dynamic	Tag

10 –   MAC   VLAN

           :

- MAC

- VID

         :

-        MAC: , MAC   ,

-       VLAN: SVLAN + DVLAN

-          VLAN: VLAN ID, VLAN   (

),

           .

    :   MAC   VLAN.

            MAC,

       VLAN.

    ,   VID.

VLAN,

. (Static VLAN

SVLAN) (Dynamic VLAN

DVLAN). SVLAN .

DVLAN GVRP,

.

SVLAN

VLAN

- Fixed: VLAN

- Forbidden:

VLAN

- Normal : GVRP VLAN

- VID3 : Port 3(Fixed)

- VID4 : Port 2(Forbidden), Port 3(Fixed)

- VID5 : Port 1(Normal)

Таблица SVLAN

VID	Port	Ad Control	Tag
3	3	Fixed	Tag
4	2	Fixed	Untag
5	1	Normal	Tag
6	1	Normal	Untag

11 – SVLAN

SVLAN :

VID: VLAN ID

Port:

Ad Control: , : forbidden, fixed

normal.

Forbidden: VLAN.

Fixed: VLAN.

Normal: ,

VLAN DVLAN GVRP.

Egress Tag Control ( ):

. tag,

, Untag, .

Ad Control = Forbidden, Egress Tag Control = none.

VLAN

VLAN:

- :

- :

GVRP

GVRP:

- VLAN VLAN-aware

-VLAN

Static VLAN , ,

( ).

		Port Number												Elapsed Time	Status
Index	VID	2	4	6	8	10	12	14	16	18	20	22	24		
		1	3	5	7	9	11	13	15	17	19	21	23		
1	1	U	U	U	U	U	U	U	U	U	U	U	U	0:02:10	Static
		U	U	U	U	U	U	U	U	U	U	U	U		
2	100	-	-	-	-	-	-	-	-	-	-	-	-	0:02:10	Static
		-	-	-	-	-	-	-	-	-	-	-	-		

VLAN Status — The Number Of VLAN = 2 — VLAN Port Setting — Static VLAN

Static VLAN — VLAN Status

ACTIVE	☑
Name	test
VLAN Group ID	100

Port	Control			Tagging
*	Normal ▼			☑ Tx Tagging
1	⦿ Normal	○ Fixed	○ Forbidden	☑ Tx Tagging
2	⦿ Normal	○ Fixed	○ Forbidden	☑ Tx Tagging

12 – Static VLAN

VLAN   Static   VLAN.

, VID

VLAN:

- Fixed –   VLAN;

- Forbidden –   ,
     VLAN;

- Normal –   ,   VLAN,
     ,   VLAN

     GVRP.   normal   GVRP

     forbidden.

   Tx Tagging   ,

        .   VLAN

                                .   ,

        forbidden   VLAN ID=200,

                          200.

         200   .
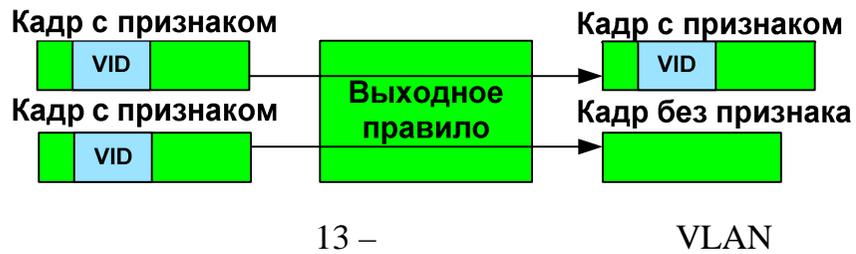
CLI

vlan <1-4094> name <name-str> vlan <1-4094> normal <port-list>

vlan <1-4094> fixed <port-list>

vlan <1-4094> forbidden <port-list>

vlan <1-4094> untagged <port-list>

vlan <1-4094> inactive vlan <1-4094> help

vlan <1-4094> no fixed <port-list>

vlan <1-4094> no forbidden <port-list>

vlan <1-4094> no untagged <port-list>

vlan <1-4094> no inactive

      Dynamic VLAN

GVRP,   .

GVRP   GARP VLAN Registration Protocol, GVRP –
                    VLAN   .

              ,   802.1Q VLAN   –

Switch-1   Switch-2.   SVLAN   ,
                                                    DVLAN   .

GVRP   VLAN
                                          .

Кадр с признаком   Кадр с признаком
[| VID |]   [| VID |]
                          ┌──────────┐
Кадр с признаком   │ Выходное │   Кадр без признака
[| VID |]   │ правило │   [   ]
                          └──────────┘

                          13 –   VLAN

        VLAN-aware

         -

        VLAN-unaware

         -

    VLAN   .

          .

      Egress Tag Control (   )   .
      GARP Timer –   VLAN.
                                  : Join, Leave   Leave All.

(   ),   .

          Join

          VLAN,   «Leaving»

      Leave   ,

      Join.   -   VLAN   (

),   Leave,

VLAN   .   ,

Leave All   ,
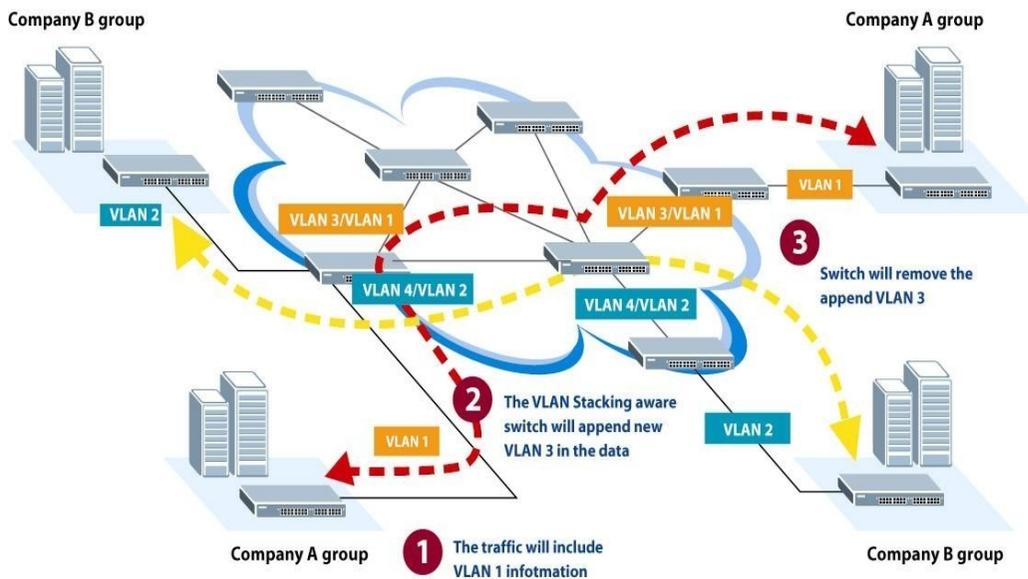
Leave All.   Leave All

«Leaving»,   Join

.

VLAN.

VLAN Stacking

14 –   VLAN

VLAN

(VLAN Stacking),   ,

VLAN.   VLAN

,

.

«   » –   ,

VLAN.

VLAN Stacking

Active	☐
SP TPID	◉ 0x8100 ▼
	○ Others [____] (Hex)

Port	Role	SPVID	Priority
1	Access Port ▼	1	0 ▼
2	Access Port ▼	1	0 ▼
3	Access Port ▼	1	0 ▼
4	Access Port ▼	1	0 ▼
5	Access Port ▼	1	0 ▼
6	Access Port ▼	1	0 ▼
7	Access Port ▼	1	0 ▼
8	Access Port ▼	1	0 ▼
9	Access Port ▼	1	0 ▼
10	Access Port ▼	1	0 ▼
11	Access Port ▼	1	0 ▼
12	Access Port ▼	1	0 ▼

15 –   VLAN

(Port Role):

Access Port –   «   »

,   (   )   .

.

Tunnel Port –   .

,   Access Port,

,   (TPID)   SP TPID

(Service Provider's TPID),   .

CLI
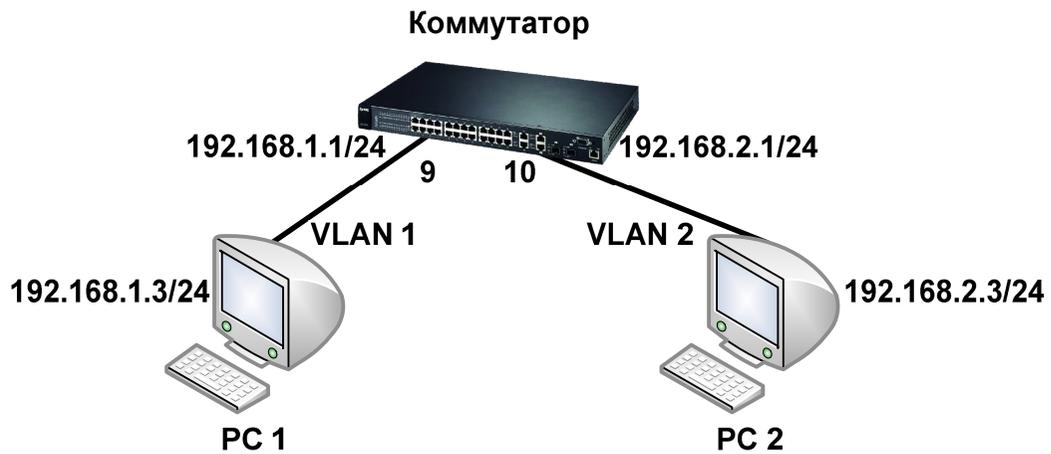
vlan-stacking <cr>

vlan-stacking <SPTPID>

interface port-channel <port-list> vlan-stacking role <normal | access | tunnel>

interface port-channel <port-list> vlan-stacking SPVID <1-4094>

interface port-channel <port-list> vlan-stacking priority <0-7>

Коммутатор

192.168.1.1/24   192.168.2.1/24

9   10

VLAN 1   VLAN 2

192.168.1.3/24   192.168.2.3/24

PC 1   PC 2

16 –   IP-

1.   Advanced Application > VLAN > Static VLAN,

    Active   .

    Name **second**

    VLAN Group ID **2**

    9 forbidden Tx Tagging –   .

    10 fixed Tx Tagging –   .

2.   Add.

3.   (   )   VLAN VID 1.

4.   10   forbidden,   Add.

5.   Advanced Application > VLAN > VLAN Port Setting.

5.   PVID **2**   **10**.

6. IP-   192.168.1.1/24   .

7.   Basic Setting > IP Setup,
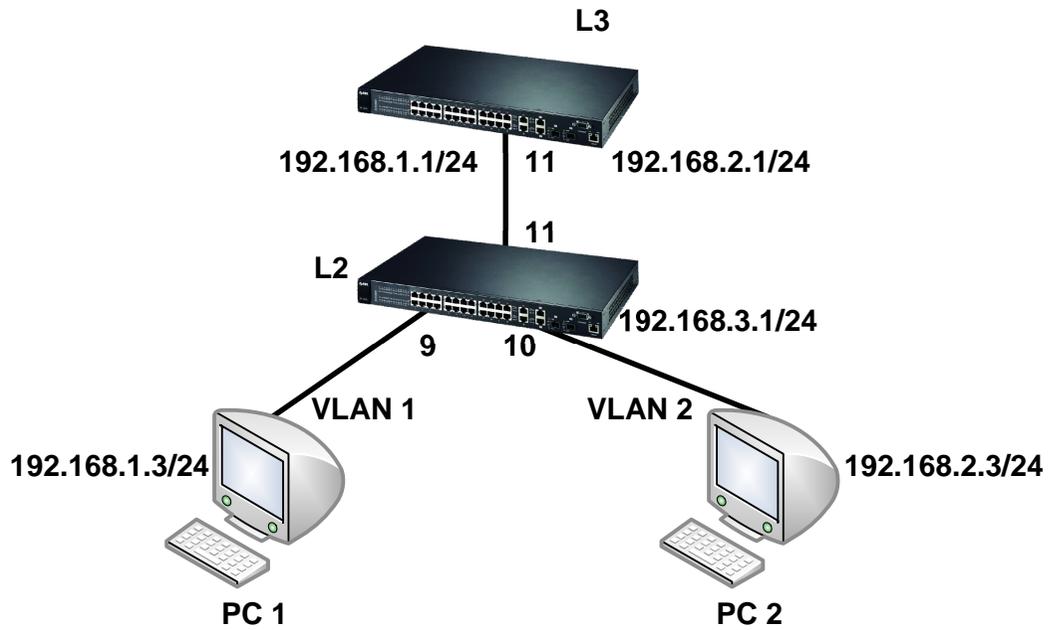
    IP Address **192.168.2.1**

    IP Subnet Mask **255.255.255.0**

    VID **2**

8.   Add.

9.   PC2   192.168.2.3,   255.255.255.0   192.168.2.1.

10.   PC1   192.168.1.3,   255.255.255.0   192.168.1.1.

11.   PC1   PC2   ping.

L3

192.168.1.1/24   **11**   **192.168.2.1/24**

11

L2

192.168.3.1/24

9   **10**

VLAN 1   **VLAN 2**

192.168.1.3/24   **192.168.2.3/24**

PC 1   **PC 2**

17 –   IP-

1.   3

                2   .

2.   2   VLAN   :

VLAN 1

9 fixed Tx Tagging –   .

10 forbidden Tx Tagging –   .

11 fixed Tx Tagging –   .

VLAN 2

9 forbidden Tx Tagging –   .

10 fixed Tx Tagging –   .

11 fixed Tx Tagging –   .

3. VLAN Port Setup 9 PVID=1, 10
PVID=2.

4. 3 VLAN :

VLAN 1 11 fixed Tx Tagging – .

VLAN 2 11 fixed Tx Tagging – .

5. PC1 PC2 ping.