

A graphic on the left side of the slide showing a network topology. It consists of several nodes (circles) connected by lines. Some nodes are highlighted in red, while others are grey or blue. The background is a solid blue color with faint, light blue geometric patterns.

L2-коммутация в Mikrotik RB/CRS

it•lab
system integrator

Who am I?

Алексей Чобан

- Опыт работы с сетями – 14 лет
- Опыт работы с Mikrotik – 13 лет
- Сертифицирован Mikrotik, Cisco
- Тренер Mikrotik с 2009 года



- системный интегратор

(Mikrotik, Cisco, VoIP, Billing, IPTV, Linux/FreeBSD, high load, soft. development, монтаж сетей)

- 5 специалистов Mikrotik
MTCNA/MTCRE/MTCWE/MTCTCE/MTCUME
- 2 специалиста Cisco
- 2 VoIP-инженера
- 2 *nix-админа
- 2 программиста

Предлагаемое оборудование и решения

- Поставка Mikrotik, Cisco
 - Поставка антенн
 - Поставка VoIP/TDM-оборудования
 - Поставка IPTV-оборудования
 - Поставка серверов Cisco, HP
 - Поставка и программирование SFP/SFP+/XFP
-
- Курсы Mikrotik (MTCNA, MTCRE, MTCWE, MTCUME, MTCTCE)
 - Кабельные работы
 - Монтаж и настройка LAN, WiFi
 - Корпоративные сети и сети VPN
 - Решения для операторов связи (Billing, VoIP, LNP, IPTV)
 - IP PBX, Call Centers, Asterisk
 - Виртуализация (VMware, Xen, Proxmox), кластеры
 - WEB-программирование, внедрение CRM, e-archive
 - Гибридные решения (VoIP + CRM)



Лотерея от IT-LAB

1. Заполните анкету – получите презент (USB-флешка, блокнот) и возможность выиграть RB260GS
2. Сфотографируйтесь на фоне плаката IT-LAB
Выложите на FB с хештегом #ITLAB_MUM2015
Лайкните FB-страницу IT-LAB
Наберите наибольшее кол-во лайков и получите CRS125-24G-1S-IN



Содержание

- L2-switching (коммутация) в Mikrotik
- Switch-chip в RouterBOARD.
- Обзор линейки CRS
- Преимущества и недостатки
- Feature requests

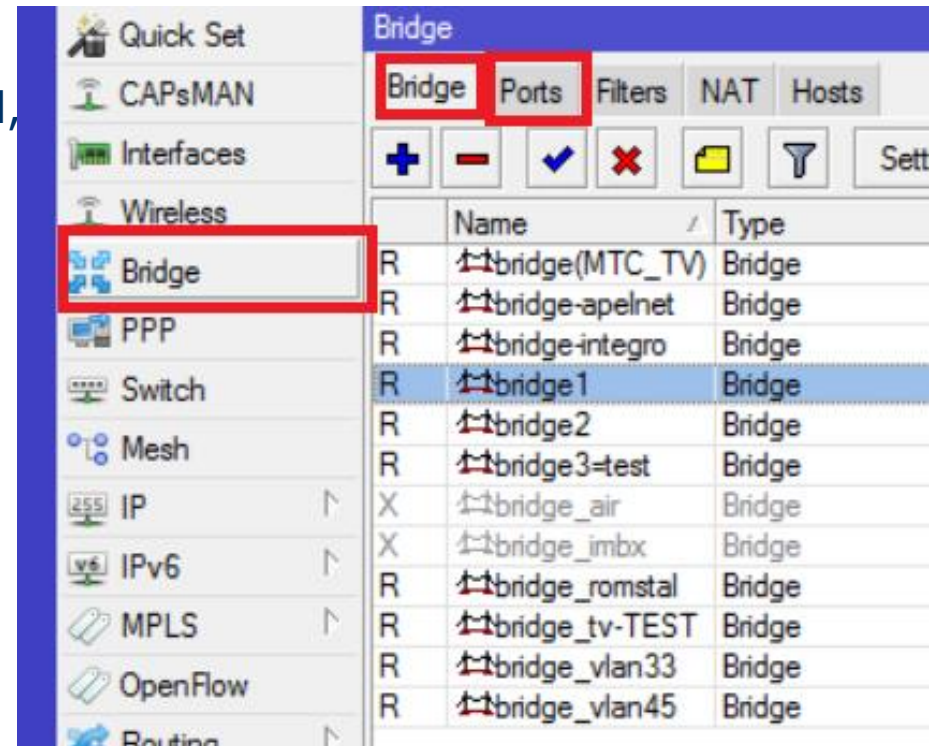
L2-коммутация

- Осуществляется на втором уровне модели OSI – Layer 2
- Единица адресации – MAC-адрес, 48 бит,
01-02-03-04-05-06
- Устройства – коммутаторы
- Порты – 5,8,16,24,48 и т.д.
- Управляемые (managed) и неуправляемые (unmanaged)
- Производители – Cisco, HP, D-Link, TP-Link и т.д.
- Функции – switching (forwarding), VLAN, port security, L2/L3 filtering, STP, mirroring, IGMP snooping, QoS etc.



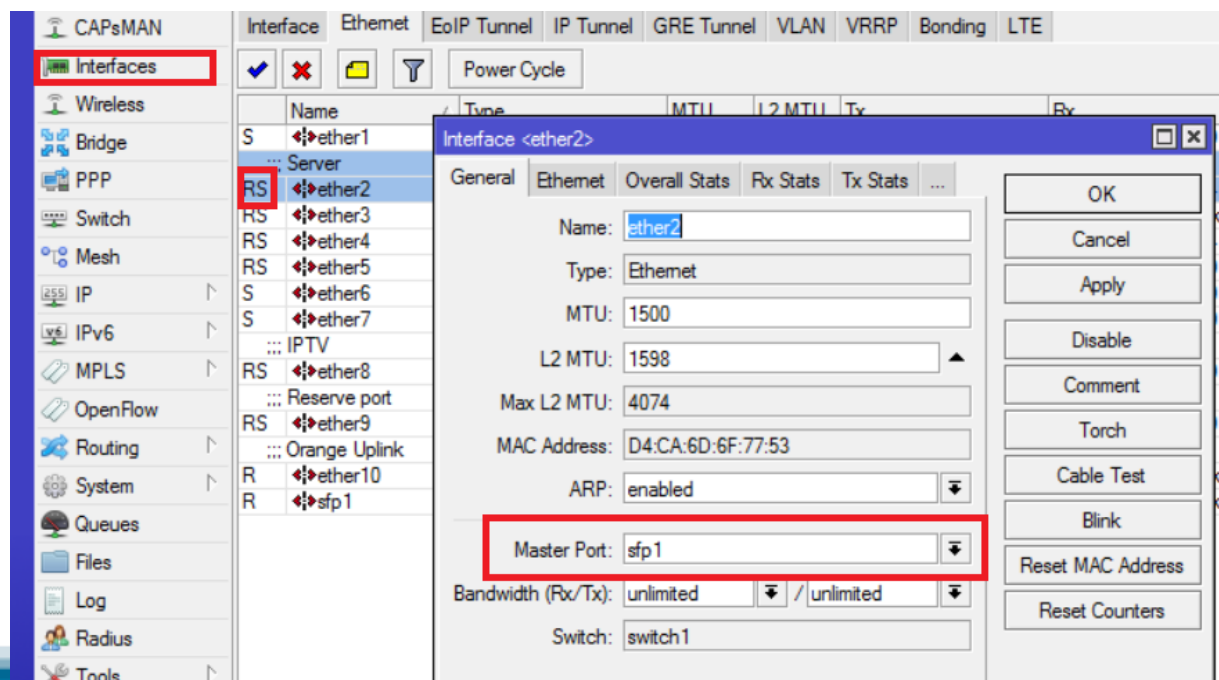
L2-коммутация в Mikrotik

- Software bridging
 - Реализуется средствами ОС
 - Позволяет объединять разнотипные интерфейсы (Ethernet, Wireless, Tunnel)
 - Использует CPU => ограничение в производительности
 - Богатый функционал (L2/L3 firewall, NAT, STP, fast path)



L2-коммутация в Mikrotik

- Hardware bridging
 - Реализуется в «железе» – с помощью спец. микросхемы – switch-chip (asic)
 - Работает только на однотипных интерфейсах – Ethernet, 100Mbps, 1Gbps
 - CPU не задействуется => работает быстро, wire speed
 - Ограниченный функционал
 - Master, slave - интерфейсы

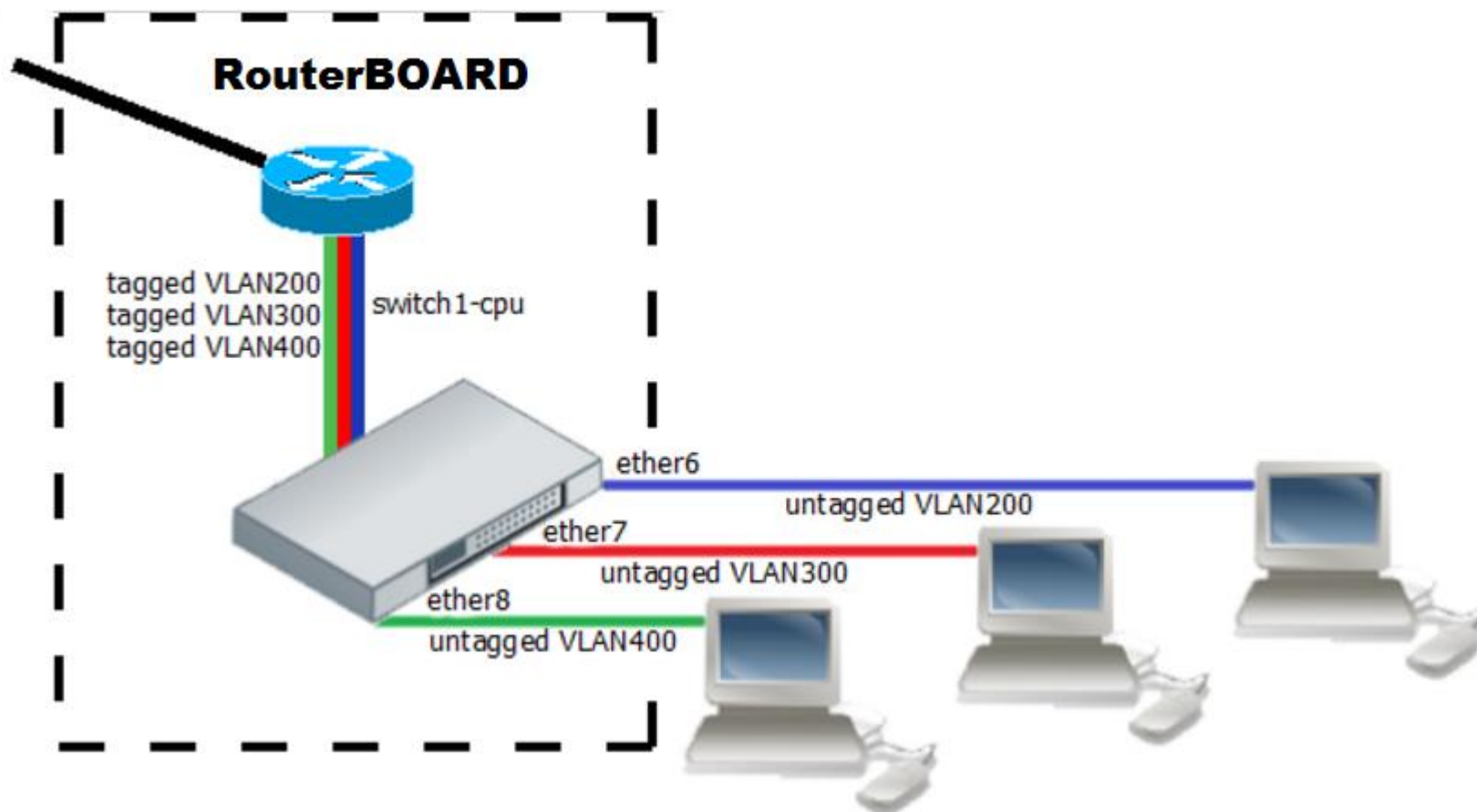


Типы switch-chip в RouterBOARD

Feature	QCA8337	Atheros8327	Atheros8316
Port Switching	yes	yes	yes
Port Mirroring	yes	yes	yes
Host table	2048 entries	2048 entries	2048 entries
Vlan table	4096 entries	4096 entries	4096 entries
Rule table	92 rules	92 rules	32 rules

Feature	Atheros8227	Atheros7240	ICPlus175D	Other
Port Switching	yes	yes	yes	yes
Port Mirroring	yes	yes	yes	no
Host table	1024 entries	2048 entries	no	no
Vlan table	4096 entries	16 entries	no	no
Rule table	no	no	no	no

Принцип работы switch-chip



Модели RB с switch-chip

- RB4xx, RB7xx, RB9xx
- RB2011, RB3011
- RB850Gx2
- RB1100, RB1200
- CCR1009
- В CCR1016/1036/1072 – нет!!!

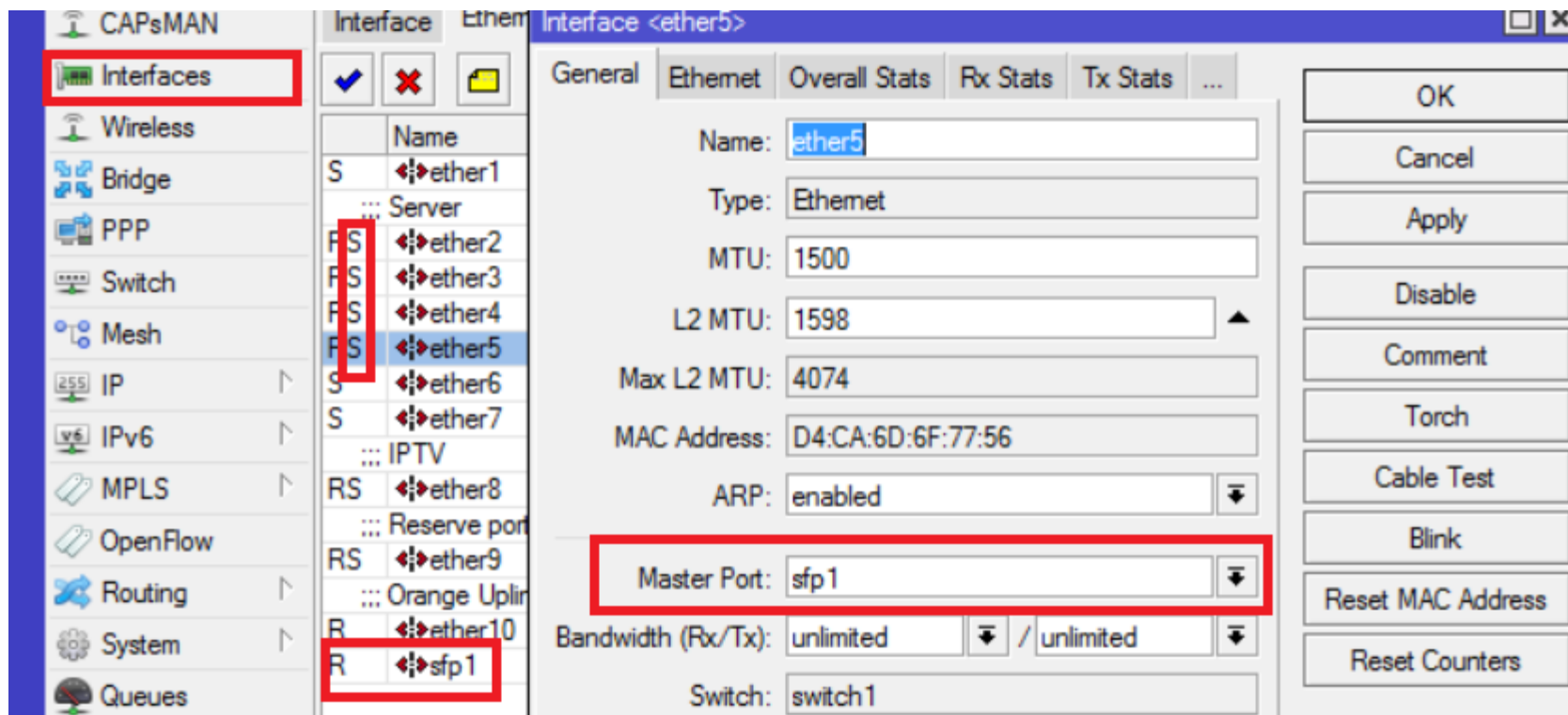


- Подробности - http://wiki.mikrotik.com/wiki/Manual:Switch_Chip_Features



Настройка switch-chip

- Выберите master-интерфейс
- Привяжите к нему slave-интерфейсы



Настройка switch-chip

- На одном RB можно быть несколько чипов – RB2011, RB3011, RB1100

The screenshot shows the Mikrotik WinBox interface. On the left is a sidebar with various configuration categories: PPP, Switch (highlighted with a red box), Mesh, IP, IPv6, MPLS, OpenFlow, Routing, System, Queues, Files, Log, Radius, Tools, and New Terminal. The main window displays the 'Switch' configuration page. At the top, there are tabs for 'Switch', 'Port', 'Host', 'VLAN', and 'Rule'. Below these is a table with columns: Name, Type, Mirror Source, and Mirror Target. The table contains two entries: 'switch1' with type 'Atheros 8327' and 'switch2' with type 'Atheros 8227'. A modal dialog box titled 'Switch <switch1>' is open in the foreground, showing configuration fields for 'Name' (switch1), 'Type' (Atheros 8327), 'Mirror Source', and 'Mirror Target'. It also includes a checkbox for 'Switch All Ports' and buttons for 'OK', 'Cancel', and 'Apply'. The status bar at the bottom of the main window indicates '2 items (1 selected)'.

Name	Type	Mirror Source	Mirror Target
switch1	Atheros 8327		
switch2	Atheros 8227		

Настройка switch-chip

- Настройка портов (VLAN mode, VLAN header, PVID)
- Switch CPU port – для чего?

The screenshot displays a network configuration window titled "Switch" with a tabbed interface (Switch, Port, Host, VLAN, Rule). The "Switch" tab is active, showing a table of switch ports. The "Port" tab is also visible, showing a configuration dialog for "ether2".

Switch Port Configuration Dialog:

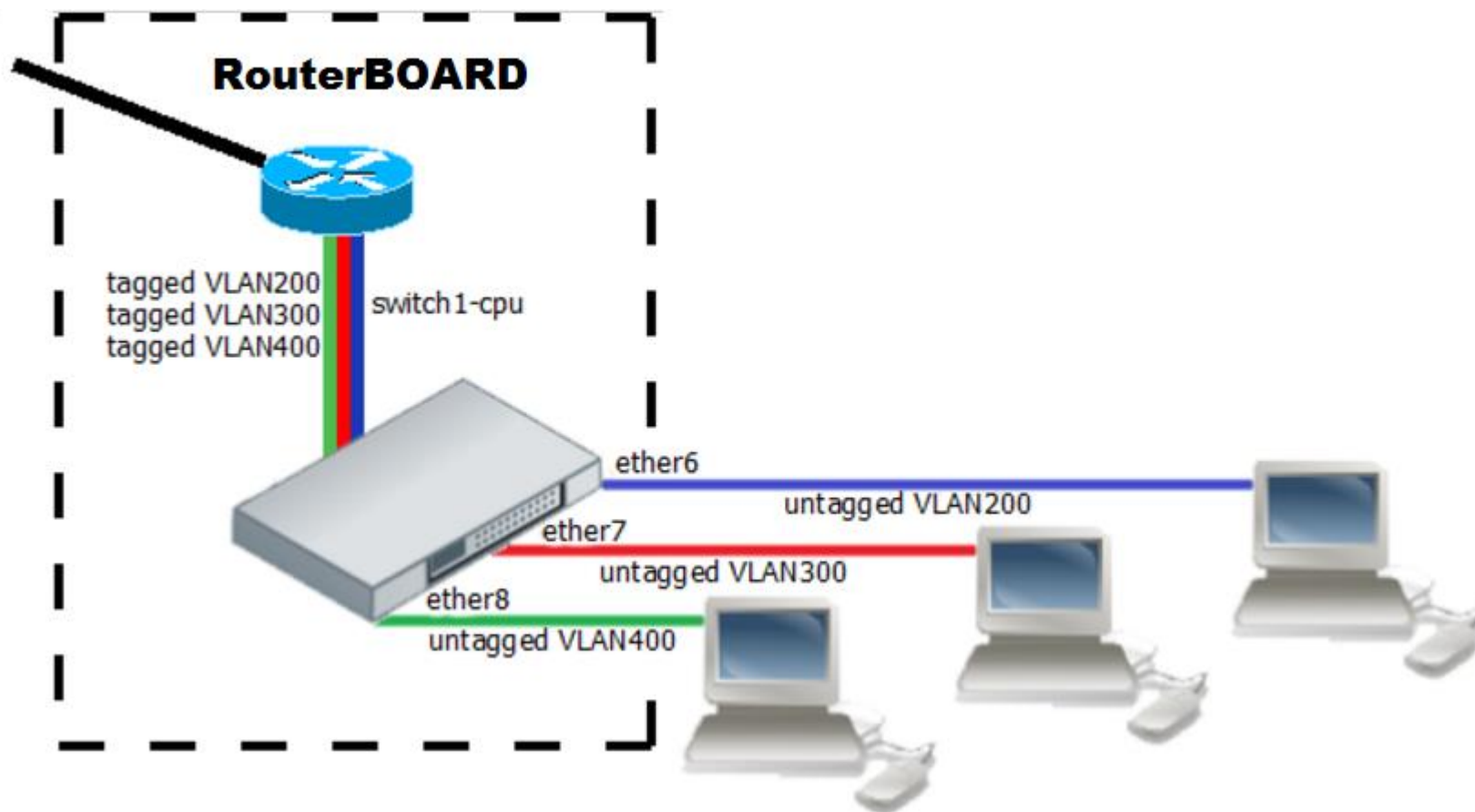
- Name: ether2
- Switch: switch1
- VLAN Mode: secure
- VLAN Header: add if missing
- Default VLAN ID: (empty)

Switch Port Table:

Name	Switch	VLAN Mode	VLAN Header
ether10	switch2	disabled	leave as is
ether6	switch2	disabled	leave as is
ether7	switch2	disabled	leave as is
ether8	switch2	disabled	leave as is
ether9	switch2	disabled	leave as is
switch2 cpu	switch2	disabled	leave as is
ether1	switch1	fallback	leave as is
ether2	switch1	secure	add if missing
ether3	switch1	fallback	leave as is
ether4	switch1	fallback	leave as is
ether5	switch1	fallback	leave as is
sfp1	switch1	secure	add if missing
switch1 cpu	switch1	secure	add if missing

13 items (1 selected)

Принцип работы switch-chip



Настройка switch-chip

- Создание VLAN и привязка к портам

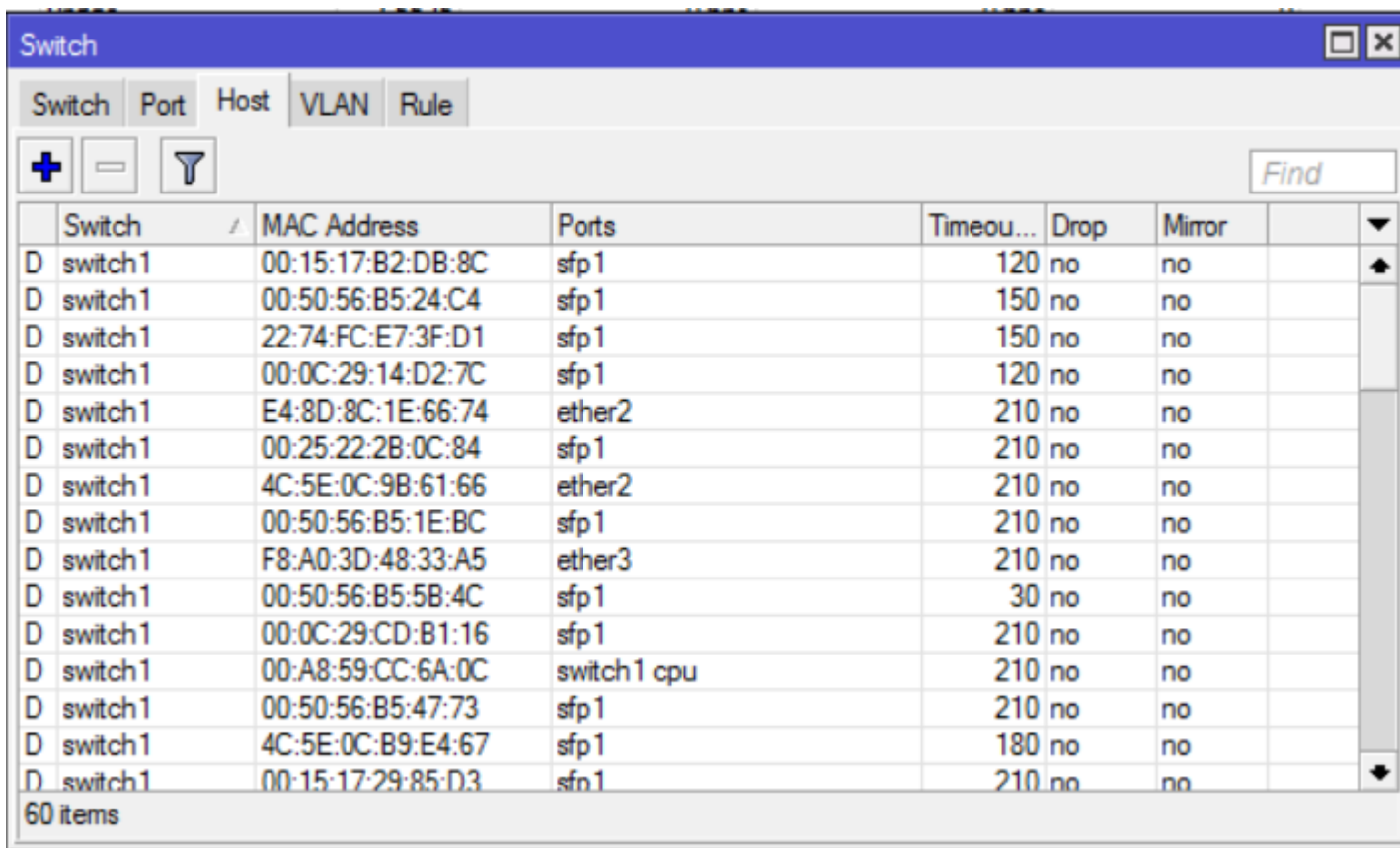
The screenshot displays a network configuration window titled "Switch" with tabs for Switch, Port, Host, VLAN, and Rule. The "VLAN" tab is active, showing a table of VLAN configurations. The first row is selected, showing VLAN ID 20 on switch1 with ports ether2, ether4, ether3, sfp1, and switch1 cpu. A modal dialog titled "Switch VLAN <20>" is open, allowing configuration for this specific VLAN. It shows the switch as "switch1", the VLAN ID as "20", and a list of ports: ether2, ether4, ether3, sfp1, and switch1 cpu. There are buttons for OK, Cancel, Apply, Disable, Copy, and Remove. An "Independent Learning" checkbox is present and unchecked. The status "enabled" is shown at the bottom of the dialog.

Switch	VLAN ID	Ports
switch1	20	ether2, ether4, ether3, sfp1, switch1 cpu
switch1	33	ether2, sfp1
switch1	40	ether2, sfp1
switch1	45	ether2, sfp1
switch1	30	ether2, sfp1, ether1, ether5

5 items (1 selected)

Настройка switch-chip

- MAC-таблица (не путать с ARP-таблицей) – заполняется динамически
- Можно добавлять статические записи



Switch	MAC Address	Ports	Timeout	Drop	Mirror
D switch1	00:15:17:B2:DB:8C	sfp1	120	no	no
D switch1	00:50:56:B5:24:C4	sfp1	150	no	no
D switch1	22:74:FC:E7:3F:D1	sfp1	150	no	no
D switch1	00:0C:29:14:D2:7C	sfp1	120	no	no
D switch1	E4:8D:8C:1E:66:74	ether2	210	no	no
D switch1	00:25:22:2B:0C:84	sfp1	210	no	no
D switch1	4C:5E:0C:9B:61:66	ether2	210	no	no
D switch1	00:50:56:B5:1E:BC	sfp1	210	no	no
D switch1	F8:A0:3D:48:33:A5	ether3	210	no	no
D switch1	00:50:56:B5:5B:4C	sfp1	30	no	no
D switch1	00:0C:29:CD:B1:16	sfp1	210	no	no
D switch1	00:A8:59:CC:6A:0C	switch1 cpu	210	no	no
D switch1	00:50:56:B5:47:73	sfp1	210	no	no
D switch1	4C:5E:0C:B9:E4:67	sfp1	180	no	no
D switch1	00:15:17:29:85:D3	sfp1	210	no	no

60 items

Настройка switch-chip

- L2/L3/L4 - фильтрация
- Нет функции DROP (есть в других чипах)

Switch

Switch Port Host VLAN Rule

New Switch Rule

Match Action

Switch: switch1

Ports:

Src. MAC Address:

Dst. MAC Address:

MAC Protocol:

VLAN

IP

IP 6

OK

Cancel

Apply

Disable

Copy

Remove

Switch

Switch Port Host VLAN Rule

New Switch Rule

Match Action

☐ Copy To CPU

☐ Redirect To CPU

☐ Mirror

☐ Set New Dst. Ports

New Dst. Ports:

New VLAN ID:

New VLAN Priority:

OK

Cancel

Apply

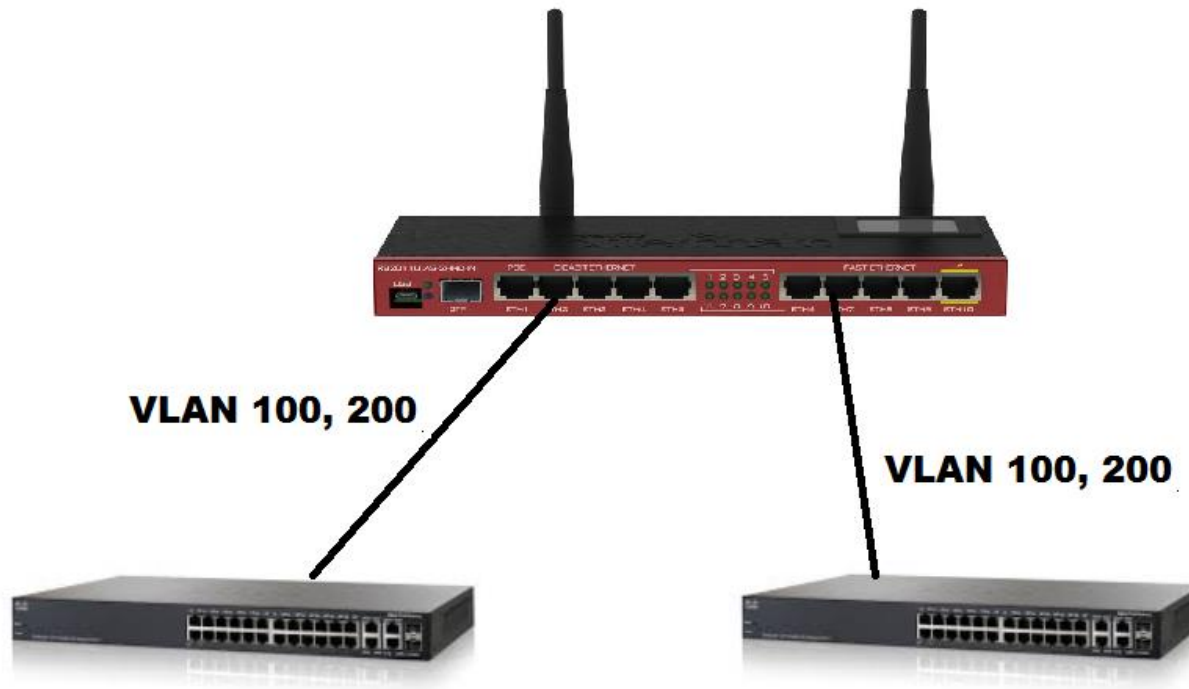
Disable

Copy

Remove

Применение switch-chip

- Коммутация wire speed с поддержкой VLAN - быстрее, чем на software bridge (как реализуется?)
- Найдите ошибку в схеме



Производительность switch-chip

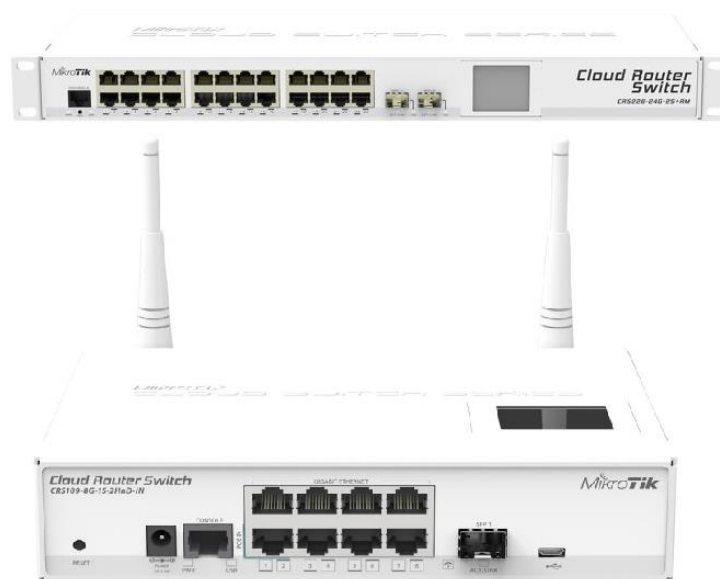
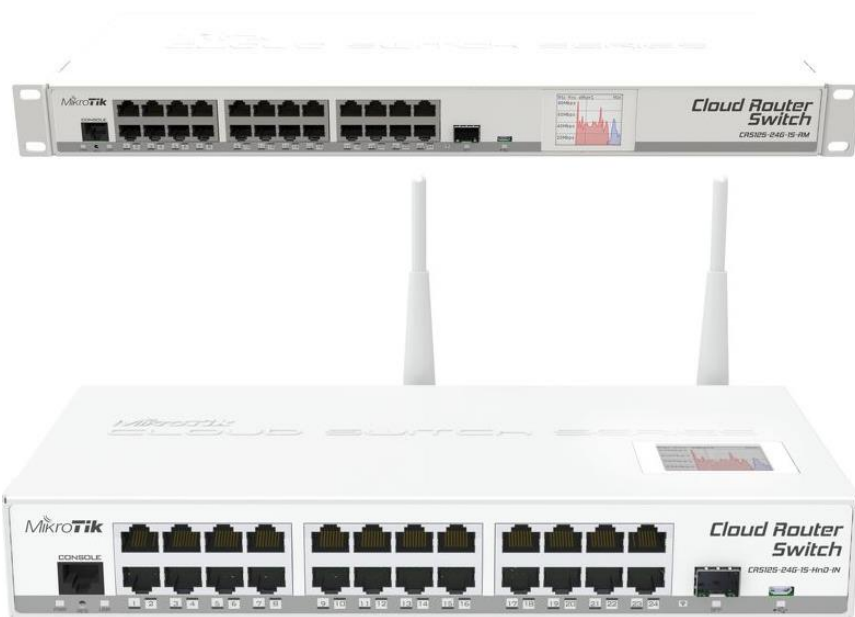
Uptime: 1d 05:02:51 CPU: 8% ☒ Hide Pa

Interface List

Interface	Ethernet	EoIP Tunnel	IP Tunnel	GRE Tunnel	VLAN	VRRP	Bonding	LTE
+	-	✓	✗	📄	🔍			
	Name	Type	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	
R	bridge-local	Bridge	1598	0 bps	0 bps	0	0	
R	ether1	Ethernet	1598	960.3 Mbps	961.3 Mbps	82 333	82 418	
RS	ether2	Ethernet	1598	960.4 Mbps	960.6 Mbps	82 346	82 360	
RS	ether3	Ethernet	1598	958.2 Mbps	958.2 Mbps	82 383	82 378	
RS	ether4	Ethernet	1598	958.1 Mbps	957.6 Mbps	82 371	82 330	
R	ether5	Ethernet	1598	0 bps	0 bps	0	0	
RS	ether6	Ethernet	1598	0 bps	0 bps	0	0	
RS	ether7	Ethernet	1598	0 bps	0 bps	0	0	
RS	ether8	Ethernet	1598	0 bps	0 bps	0	0	
S	ether9	Ethernet	1598	0 bps	0 bps	0	0	
S	ether10	Ethernet	1598	0 bps	0 bps	0	0	
S	sfp1	Ethernet	1598	0 bps	0 bps	0	0	
R	wlan1	Wireless (Atheros AR...	2290	109.5 kbps	7.9 kbps	11	13	

Cloud Router Switch - CRS

- Новая линейка коммутаторов
- Многопортовый маршрутизатор с продвинутыми функциями L2-коммутатора
- Называть его L3-коммутатором неправильно, так как он не имеет hardware L3 (fast path?).



Cloud Router Switch - CRS

- Каждый порт может работать в режиме коммутатора (switched) или маршрутизатора (routed)
- Полноценный RouterOS
- CPU – 600MHz, RAM – 128Mb => мало для wirespeed routing
- USB, SFP/SFP+
- Power consumption – 15W
- Router + switch + access point в одном корпусе



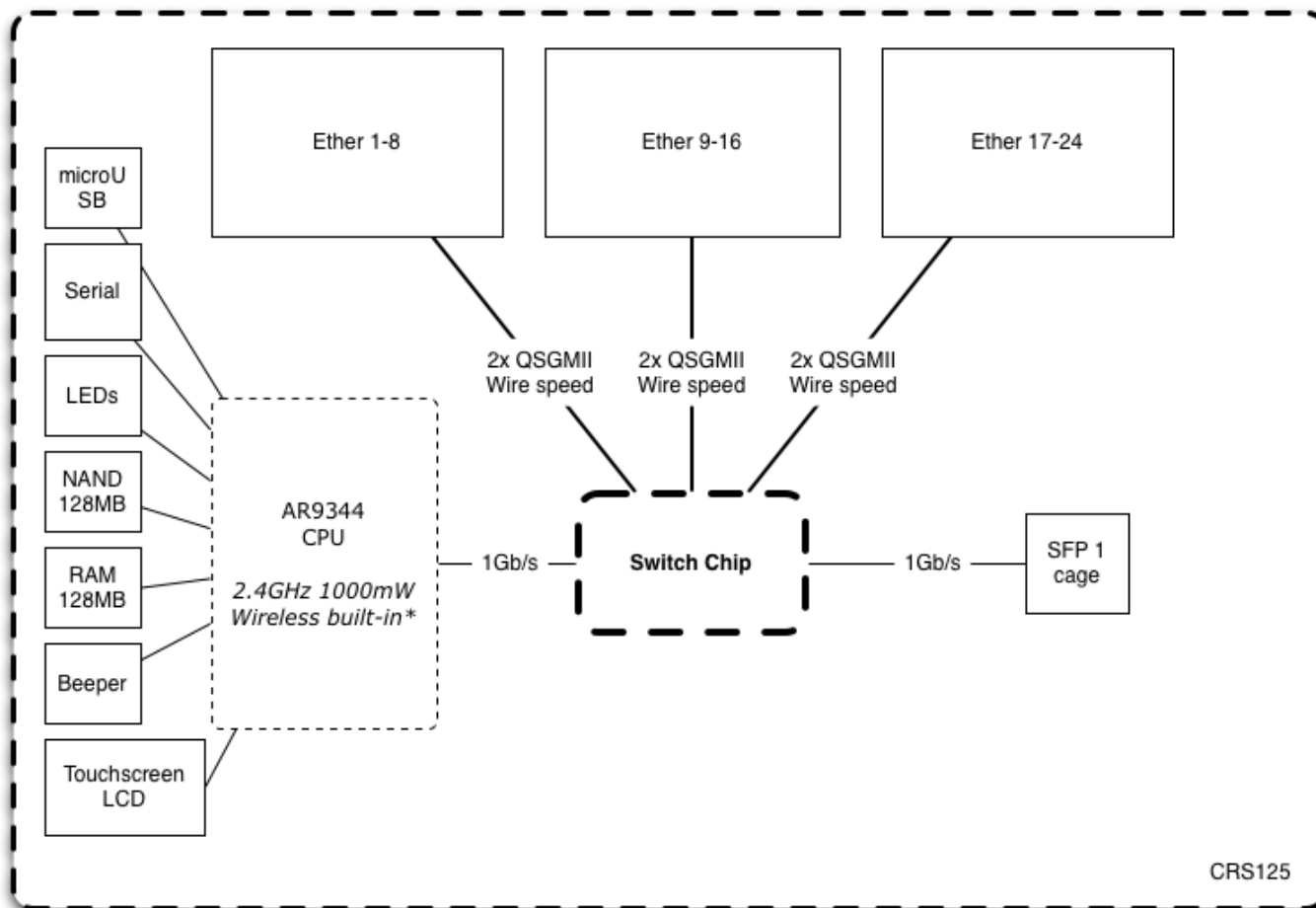
Cloud Router Switch - CRS

- 1Gbps ports, SFP/SFP+
- 16k MAC address table
- 4k active VLANs (!!!!!)
- Q-in-Q
- Port isolation
- Mirroring
- ACL (L2, L3)
- QoS (DSCP, VLAN, MAC, etc)
- Trunking on hardware level (static bonding)
- Shaping/scheduling
- Jumbo frames



Cloud Router Switch - CRS

- Принципиальная схема CRS



* - Only on CRS125-24G-1S-2HnD-IN

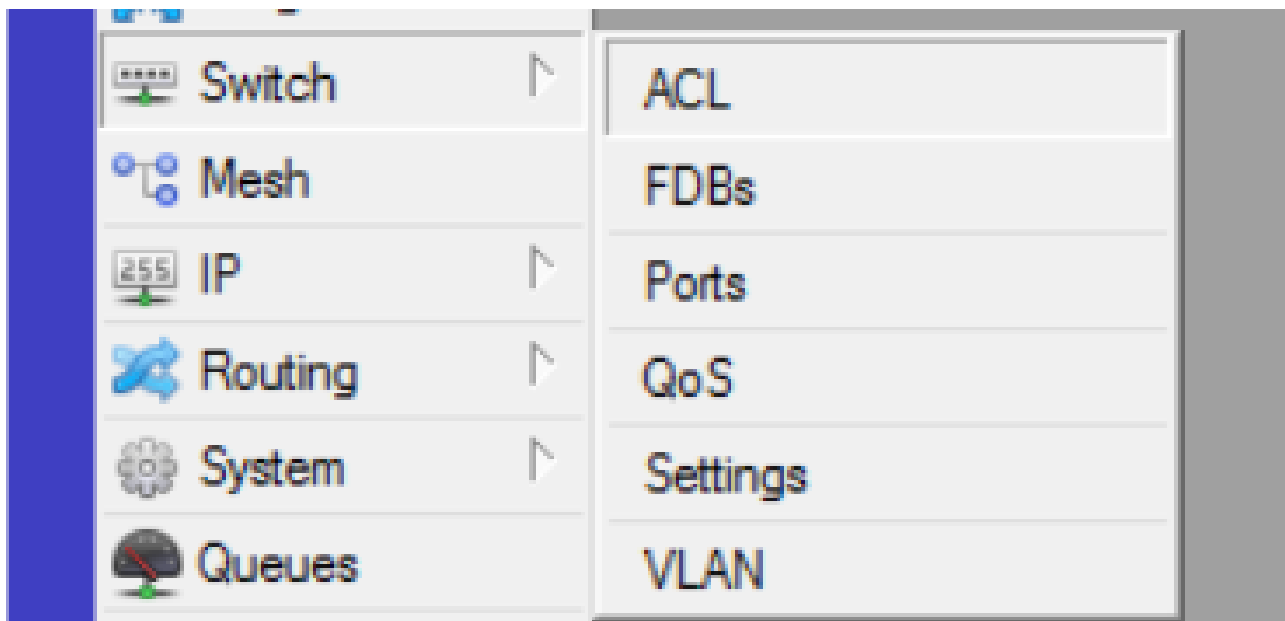
Настройка CRS

- Для включения коммутатора нужно выбрать master/slave-интерфейсы
- Можно создавать несколько switch-групп

Interface List								
Interface Ethernet EoIP Tunnel IP Tunnel GRE Tunnel VLAN VRRP Bonding LTE								
+ - ✓ ✗ [Icon] [Icon]								
	Name	Type	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	
R	ether1-master-local	Ethernet	1588	298.4 kbps	29.9 kbps	29	38	
R	vlan20	VLAN	1584	295.8 kbps	13.1 kbps	28	22	
S	ether2-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether3-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether4-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether5-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether6-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
RS	ether7-slave-local	Ethernet	1588	9.3 kbps	704 bps	13	1	
S	ether8-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether9-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether10-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether11-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether12-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether13-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether14-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether15-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether16-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether17-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether18-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether19-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether20-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether21-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether22-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	ether23-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
... routed								
	ether24-slave-local	Ethernet	1588	0 bps	0 bps	0	0	
S	sfp1-slave-local	Ethernet	1588	0 bps	0 bps	0	0	

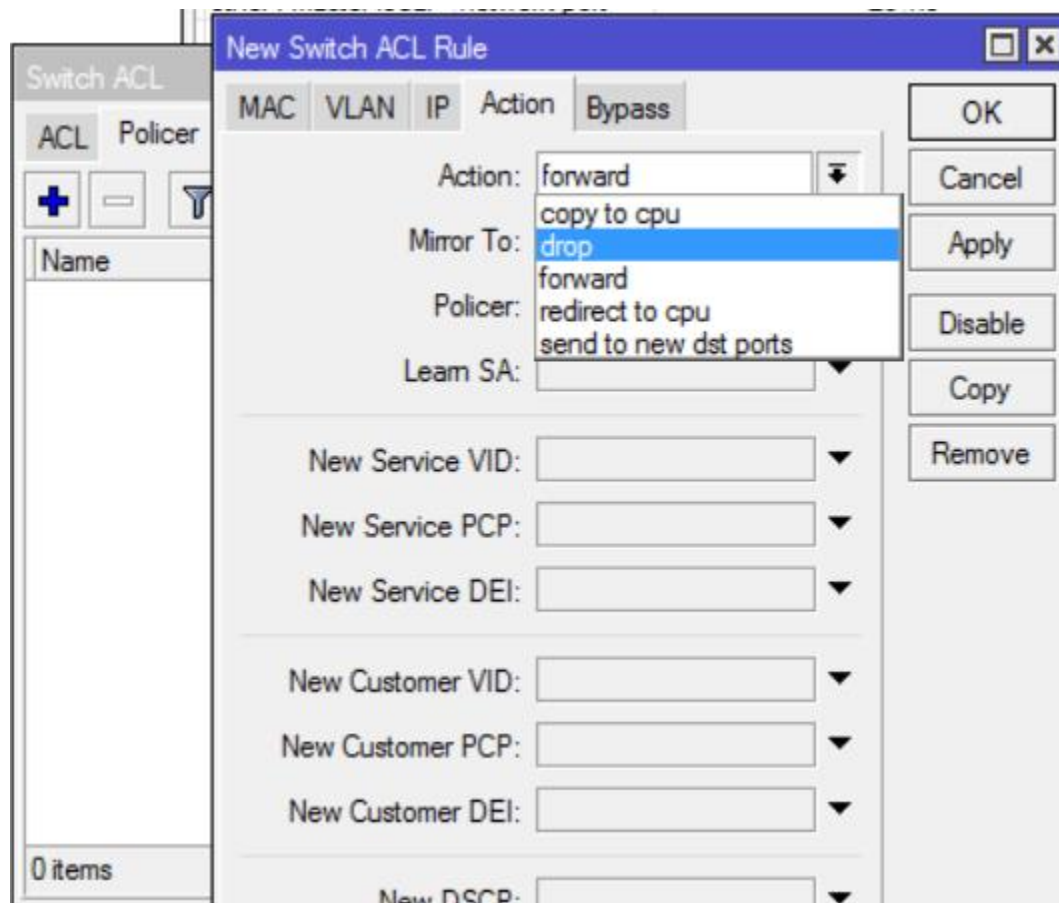
Настройка CRS

- Меню switch – ACL, FDB, Ports, QoS, Settings, VLAN



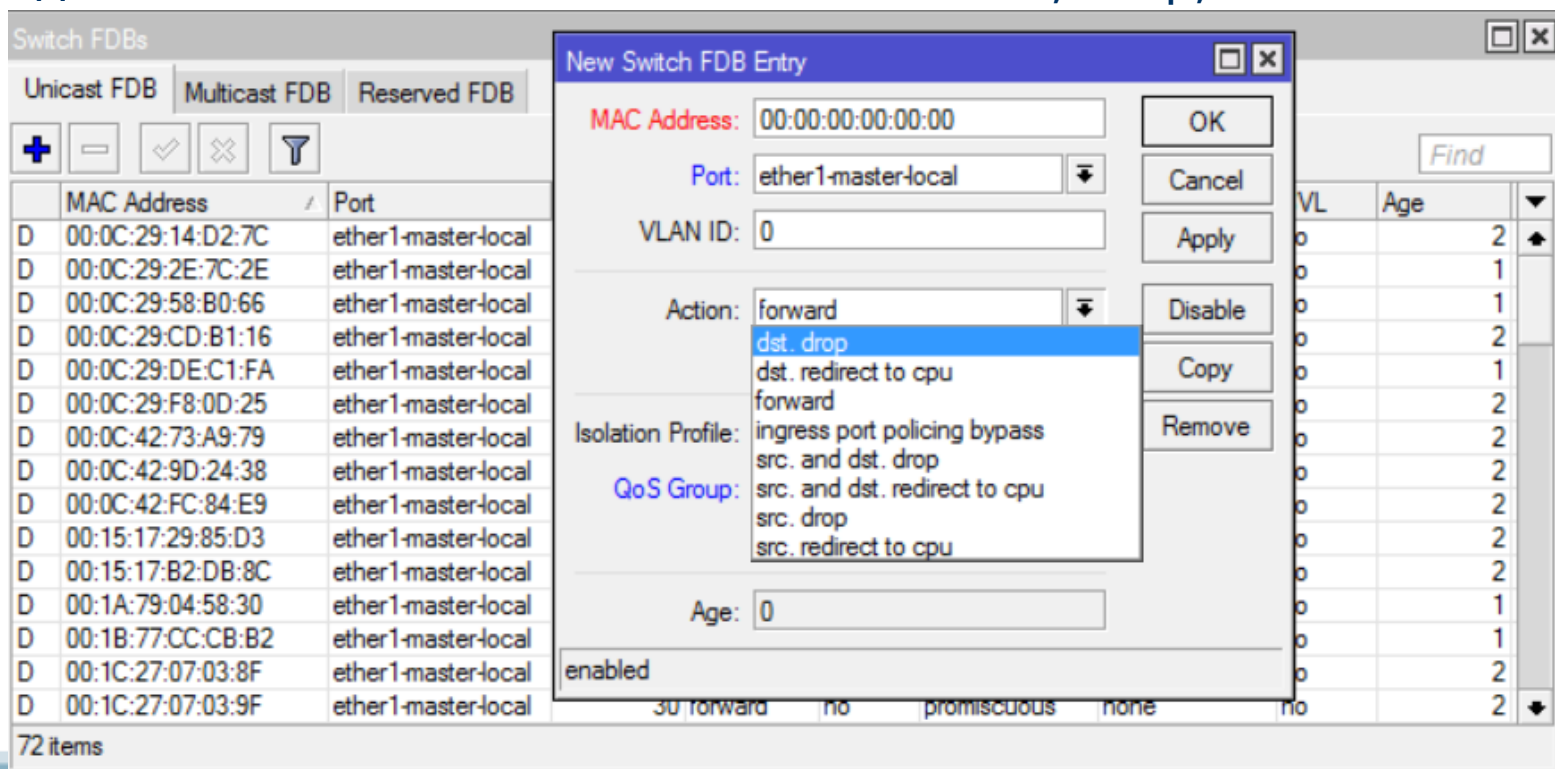
Настройка CRS

- Access Control Lists – MAC,IP, VLAN-based



Настройка CRS

- Forwarding Data Base – FDB
- Unicast/Multicast/Reserved
- MAC-таблица
- Можно добавлять статические записи – forward, drop, etc



Настройка CRS

- Port, trunk, port isolation, port leakage

Switch Ports

Ports Trunk Port Isolation Port Leakage

Y

Name /

ether1-master-local
ether2-slave-local
ether3-slave-local
ether4-slave-local
ether5-slave-local
ether6-slave-local
ether7-slave-local
ether8-slave-local
ether9-slave-local
ether10-slave-local
ether11-slave-local
ether12-slave-local
ether13-slave-local
ether14-slave-local
ether15-slave-local
26 items (1 selected)

Switch Port <ether6-slave-local>

Generic Ingress VLAN Egress VLAN Mirroring QoS Queues TPIDs Counters

Name: ether6-slave-local

VLAN Type: network port

Isolation Profile: 29

Isolation Profile Override:

☒ Learning

Learning Override:

Learning Limit:

☒ Allow Unicast FDB Drop
☐ Allow Unicast Loopback
☐ Allow Multicast Loopback

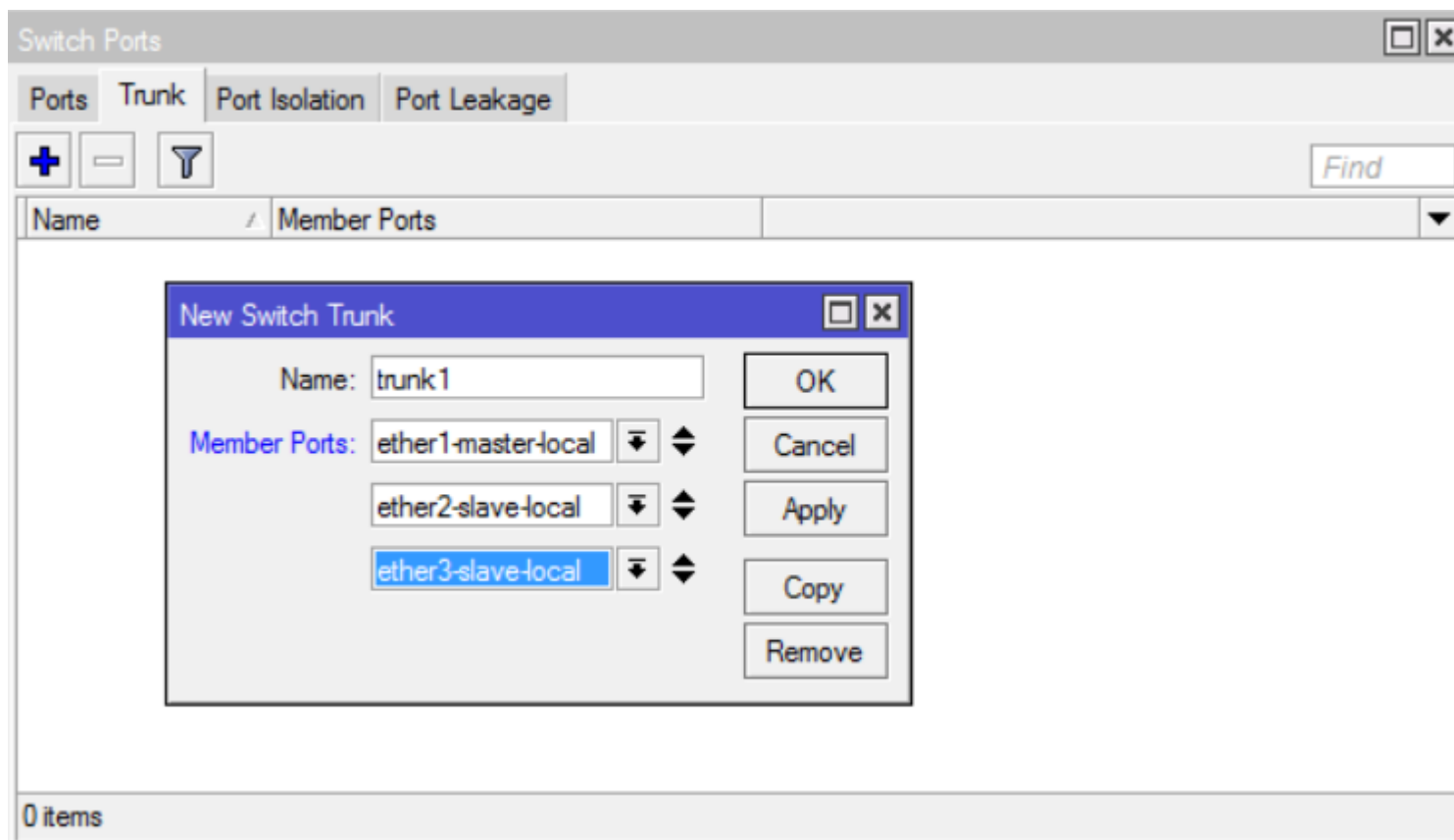
Action On Static Station Move: forward

☐ Drop Secure Static MAC Move
☐ Drop Dynamic MAC Move

OK
Cancel
Apply

Настройка CRS

- Настройка static trunk (bonding), LACP пока не поддерживается
- Реализуется в hardware, в отличие от /interface bonding в ROS



Настройка CRS

- Глобальные настройки свитча
- Модель чипа – QCA 8513L

Switch Settings

Generic | VLAN | Exceptions | Mirror

Type: QCA 8513L

Bridge Type: customer vlan bridge

☒ MAC Level Isolation

☐ Use SVID in 1:1 VLAN Lookup

☒ Use CVID in 1:1 VLAN Lookup

IPv4 Multicast Lookup Mode: dst ip and vid for ipv4

Unicast FDB Timeout: 300 s

OK
Cancel
Apply

Настройка CRS

- Создание и привязка VLAN к портам

Switch VLAN

VLAN | VLAN Tagging | In. VLAN Tran. | Eg. VLAN Tran. | 1:1 VLAN Switching | MAC Based VLAN | Protocol Based VLAN

+ - ✓ ✗ ⏏

	VLAN ID	Ports
	20	ether1-master-local, ether2-slave-local, ether3-slave-local, eth...
	30	ether1-master-local, ether6-slave-local, ether16-slave-local, et...
	33	ether1-master-local, ether19-slave-local
	40	ether1-master-local, ether22-slave-local, ether23-slave-local
	45	ether1-master-local, ether20-slave-local, ether21-slave-local
D	4091	ether21-slave-local, ether22-slave-local, ether23-slave-local, ...
D	4095	ether24-slave-local, switch1-cpu

Switch VLAN <33>

VLAN ID: 33

Ports: ether1-master-local ether19-slave-local

☐ SVL
☒ SA Learning
☐ Flood
☐ Ingress Mirror

QoS Group: none

OK Cancel Apply Disable Copy Remove

Настройка CRS

- Настройка tagged VLAN

Switch VLAN

VLAN VLAN Tagging In. VLAN Tran. Eg. VLAN Tran. 1:1 VLAN Switching MAC Based VLAN Protocol Based VLAN

+ - ✓ ✗ ⏏

	VLAN ID /	Tagged Ports
	20	ether1-master-local, s...
	30	ether1-master-local
	33	ether1-master-local
	40	ether1-master-local
	45	ether1-master-local, et...
D	4091	
D	4095	

Switch Egress Tag VLAN <20>

VLAN ID: 20

Tagged Ports: ether1-master-local ⏴ ⏵

switch1-cpu ⏴ ⏵

OK

Cancel

Apply

Disable

Copy

Remove

enabled

- Настройка PVID

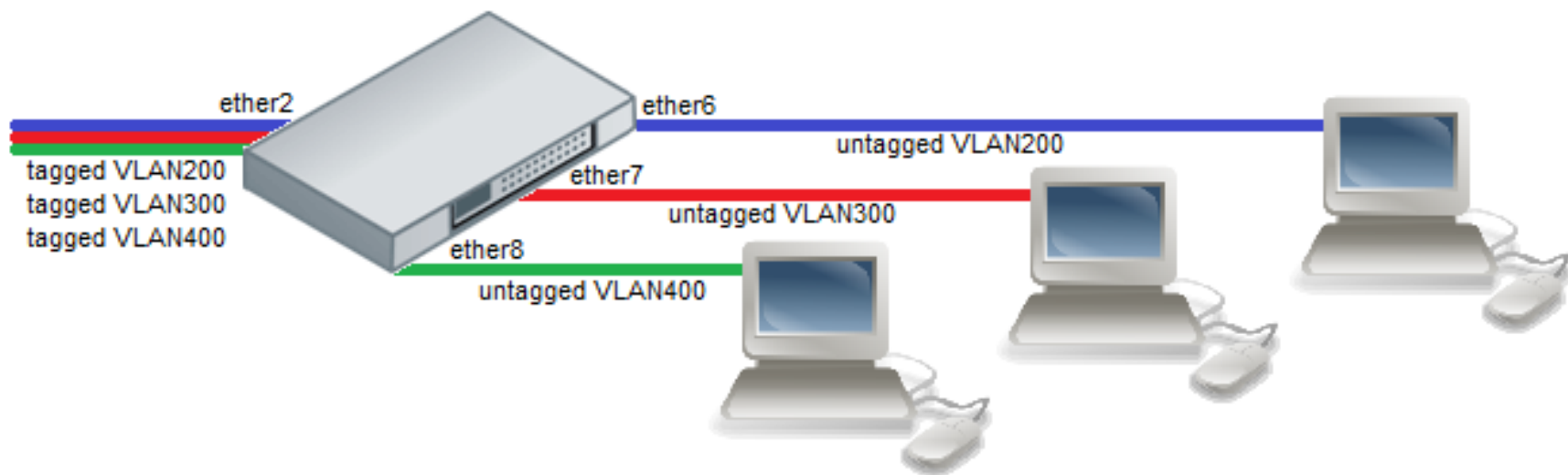
The screenshot shows the "Ingress VLAN Translation" configuration window. The title bar reads "Ingress VLAN Translation <ether16-slave-local, ether6-slave-local, eth...".

- Ports:** A list of three ports: "ether16-slave-local", "ether6-slave-local", and "ether17-slave-local". Each port has up/down arrows next to it.
- Protocol:** A dropdown menu currently set to "any".
- Service VLAN Lookup For:** A dropdown menu currently set to "any".
- Service VID:** An input field.
- Service PCP:** A dropdown menu.
- Service DEI:** A dropdown menu.
- Customer VLAN Lookup For:** A dropdown menu currently set to "any".
- Customer VID:** An input field.
- Customer PCP:** A dropdown menu.
- Customer DEI:** A dropdown menu.
- New Service VID:** An input field.
- New Customer VID:** An input field containing the value "30". This field is highlighted with a red rectangle.
- PCP Propagation:** An unchecked checkbox.
- SA Learning:** An unchecked checkbox.
- Status:** A label at the bottom left indicating "enabled".
- Buttons:** On the right side, there are buttons for "OK", "Cancel", "Apply", "Disable", "Copy", and "Remove".

In the background, a portion of another window titled "Switch VLAN" is visible, showing a table with columns "VLAN", "VLAN Tagging", and "Eg.". The "In. VLAN Tran." tab is selected and highlighted with a red box.

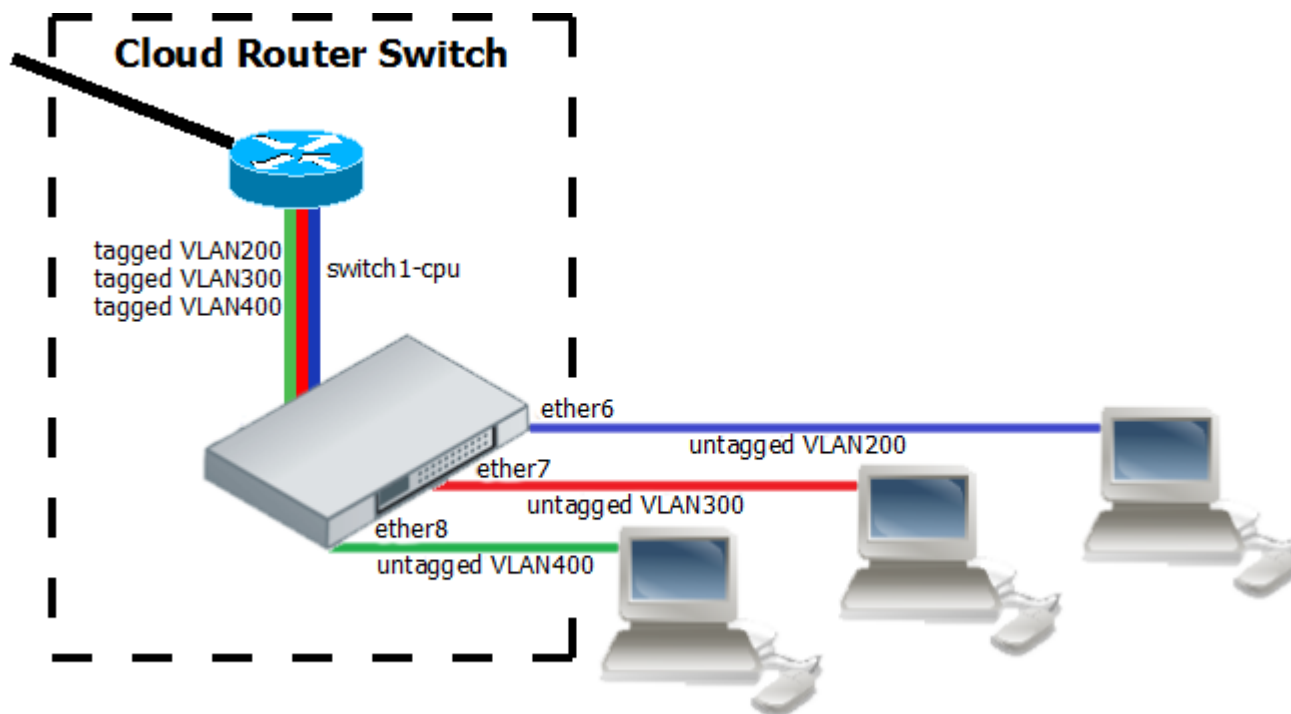
Применение CRS

- Разделение сети на VLAN на уровне доступа (access layer)



Применение CRS

- Inter VLAN routing на одном устройстве



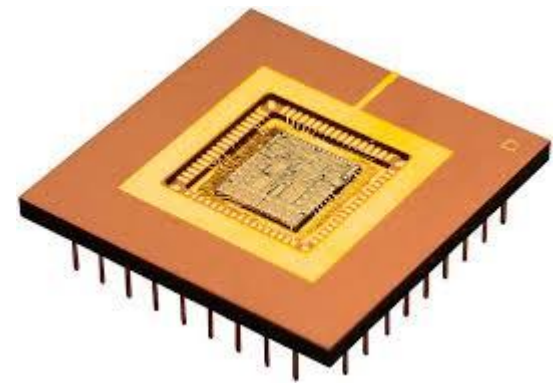
Преимущества и недостатки



- Область применения CRS:
 - 3 устройства в одном (router, switch, AP) в небольших офисах
 - Гигабитный коммутатор уровня доступа или агрегации в небольших и средних организациях
- Крупные организации со сложной структурой и ISP – рано (нет 802.1X, RADIUS, RSTP)
- Плюсы:
 - соотношение цена/функциональность (~250\$)
 - удобство (3 в 1)
- Минусы:
 - Нет IGMP snooping (обещают в ROS 7)
 - Нет loopback detection
 - Нет PoE 48V для VoIP, камер
 - Нет RSTP в «железе»
 - Сложное меню настройки

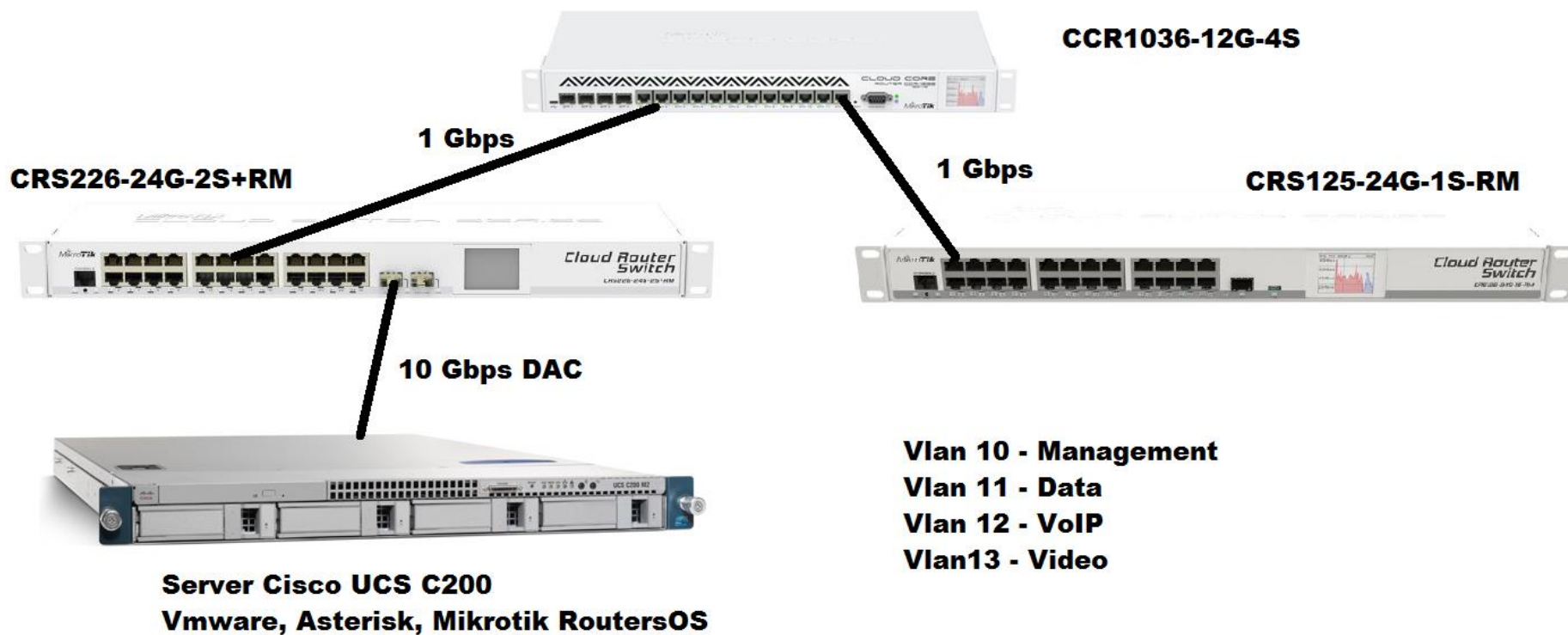
Feature request

- STP (RSTP) in hardware
- IGMP snooping
- Loopback detection
- DHCP Option 82
- Удобное меню
- 48 портов
- Больше SFP
- L3-routing in hardware (at least static) !!!



Загадочный QCA8513L

Демо-стенд IT-LAB



Литература

- <http://routerboard.com/>
- http://wiki.mikrotik.com/wiki/Manual:CRS_examples
- http://wiki.mikrotik.com/wiki/Manual:CRS_features
- http://wiki.mikrotik.com/wiki/Manual:Switch_Chip_Features
- http://wiki.mikrotik.com/wiki/Manual:Fast_Path

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