Manual:CRS1xx/2xx series switches examples

From MikroTik Wiki

Applies to RouterOS: v6.12 +

Contents

Summary

Basic use cases and configuration examples for Cloud Router Switch features.

Warning: This article applies to CRS1xx and CRS2xx series switches and not to CRS3xx series switches. For CRS3xx series devices read the CRS3xx series switches manual.

Management IP Configuration

Untagged

Untagged (VLAN 0) Management IP address has to be assigned to the master-port.

- For RouterOS versions before v6.41:

```
/interface ethernet
set ether3 master-port=ether2
set ether4 master-port=ether2
set ether5 master-port=ether2
/ip address
add address=192.168.88.1/24 interface=ether2 network=192.168.88.0
```

- For RouterOS versions after v6.41:

```
/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether3 hw=yes
add bridge=bridge1 interface=ether4 hw=yes
add bridge=bridge1 interface=ether5 hw=yes
/ip address
add address=192.168.88.1/24 interface=bridge1 network=192.168.88.0
```

If you are intending to use invalid VLAN filtering (which you should), then ports, from which you are going to access the switch, needs to be added to the VLAN table for untagged (VLAN 0) traffic, for example, in case you want to access the switch from **ether2**:

```
/interface ethernet switch vlan
add vlan-id=0 ports=ether2,switch1-cpu
```

Tagged

For tagged VLAN Management IP address add VLAN 99 interface and assign IP address to it. Since the master-port receives all the traffic coming from switch-cpu port, VLAN interface has to be configured on the master-port, in this case "ether2" port. Now from switch-chip point there also has to be VLAN 99 tagging on switch1-cpu port.

- For RouterOS versions before v6.41:

```
/interface vlan
add name=vlan99 vlan-id=99 interface=ether2
/ip address
add address=192.168.88.1/24 interface=vlan99 network=192.168.88.0
```

- For RouterOS versions after v6.41:

```
/interface vlan
add name=vlan99 vlan-id=99 interface=bridge1
/ip address
add address=192.168.88.1/24 interface=vlan99 network=192.168.88.0
```

Specify which ports will need to send out tagged traffic:

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=ether2,ether3,ether4,ether5,switch1-cpu vlan-id=99
```

Specify which ports are allowed to forward the management VLAN:

```
/interface ethernet switch vlan
add ports=ether2,ether3,ether4,ether5,switch1-cpu vlan-id=99 learn=yes
```

After valid VLAN99 configuration unknown/invalid VLAN filtering can be enabled in global switch settings.

```
/interface ethernet switch
set drop-if-invalid-or-src-port-not-member-of-vlan-on-ports=ether2,ether3,ether4,ether5
```

VLAN

Note: It is recommended to get Serial Console cable and test it before configuring VLANs because you may lose access to the CPU and/or the port you are connected to.

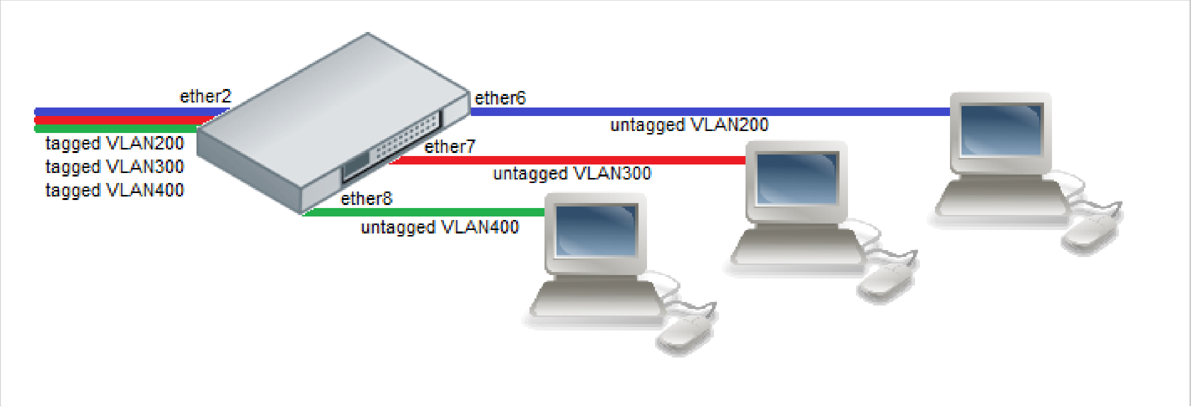
Note: Some changes may take some time to take effect due to already learned MAC addreses. In such cases flushing Unicast Forwarding Database can help: `/interface ethernet switch unicast-fdb flush`

Warning: Multiple master-port/bridge configuration is designed as fast and simple port isolation solution, but it limits part of VLAN functionality supported by CRS switch-chip. For advanced configurations use one master-port/bridge within CRS switch chip for all ports, configure VLANs and isolate port groups with port isolation profile configuration.

Port Based VLAN

Note: For CRS3xx series devices you must use bridge VLAN filtering, you can read more about it in the Bridge VLAN Filtering section.

Example 1 (Trunk and Access ports)



Port Based VLAN 1

- Choose a master port and enslave the ports you need to be in the same switch group.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Add initial VLAN assignments (PVID) to VLAN access ports.

```
/interface ethernet switch ingress-vlan-translation
add ports=ether6 customer-vid=0 new-customer-vid=200 sa-learning=yes
add ports=ether7 customer-vid=0 new-customer-vid=300 sa-learning=yes
add ports=ether8 customer-vid=0 new-customer-vid=400 sa-learning=yes
```

- Add VLAN 200, VLAN 300 and VLAN 400 tagging on ether2 port to create it as VLAN trunk port. Egress-VLAN-Tag entry is mandatory for every VLAN to make VLAN access ports work. If VLAN trunk port has not been chosen yet, Egress-VLAN-Tag entry has to be added with `tagged-ports=""`.

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=ether2 vlan-id=200
add tagged-ports=ether2 vlan-id=300
add tagged-ports=ether2 vlan-id=400
```

- VLAN membership definitions in the VLAN table are required for proper isolation. Adding entries with VLAN id and ports makes that VLAN traffic valid on those ports.

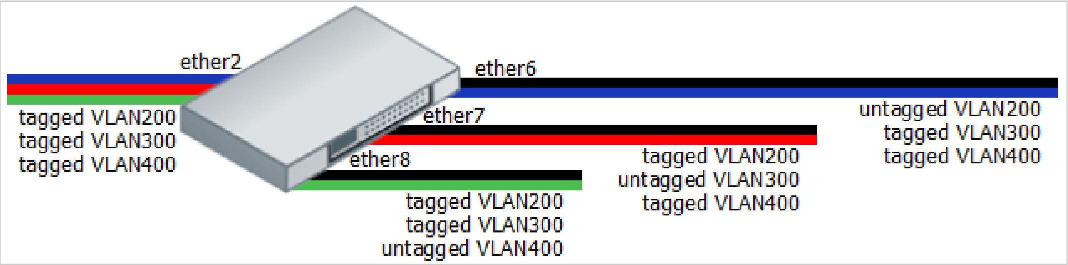
```
/interface ethernet switch vlan
add ports=ether2,ether6 vlan-id=200 learn=yes
add ports=ether2,ether7 vlan-id=300 learn=yes
add ports=ether2,ether8 vlan-id=400 learn=yes
```

- After valid VLAN configuration unknown/invalid VLAN forwarding can be disabled in global switch settings.

```
/interface ethernet switch
set drop-if-invalid-or-src-port-not-member-of-vlan-on-ports=ether2,ether6,ether7,ether8
```

Note: It is possible to use the built-in switch chip and the CPU at the same time to create a Switch-Router setup, where a device acts as a switch and as a router at the same time. You can find a configuration example in the CRS-Router guide.

Example 2 (Trunk and Hybrid ports)



Port Based VLAN 2

- Create a group of switched ports.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Add initial VLAN assignments (PVID) for untagged traffic on ether6, ether7, ether8 ports.

```
/interface ethernet switch ingress-vlan-translation
add ports=ether6 customer-vid=0 new-customer-vid=200 sa-learning=yes
add ports=ether7 customer-vid=0 new-customer-vid=300 sa-learning=yes
add ports=ether8 customer-vid=0 new-customer-vid=400 sa-learning=yes
```

- Add VLAN 200, VLAN 300 and VLAN 400 tagging on ports according to diagram. The `tagged-ports` option allow multiple values to support tagging on many ports.

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=ether2,ether7,ether8 vlan-id=200
add tagged-ports=ether2,ether6,ether8 vlan-id=300
add tagged-ports=ether2,ether6,ether7 vlan-id=400
```

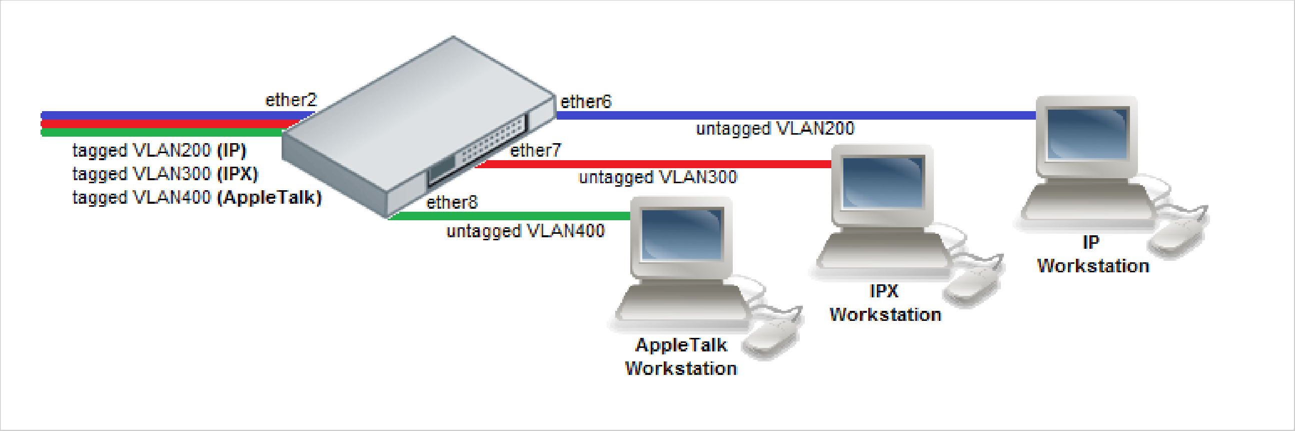
- VLAN membership definitions in the VLAN table are required for proper isolation. Adding entries with VLAN id and ports makes that VLAN traffic valid on those ports.

```
/interface ethernet switch vlan
add ports=ether2,ether6,ether7,ether8 vlan-id=200 learn=yes
add ports=ether2,ether6,ether7,ether8 vlan-id=300 learn=yes
add ports=ether2,ether6,ether7,ether8 vlan-id=400 learn=yes
```

- Unknown VLANs should be disabled after valid VLAN membership configuration.

```
/interface ethernet switch
set drop-if-invalid-or-src-port-not-member-of-vlan-on-ports=ether2,ether6,ether7,ether8
```

Protocol Based VLAN



Protocol Based VLAN

- Create a group of switched ports.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Set VLAN for IP and ARP protocols

```
/interface ethernet switch protocol-based-vlan
add port=ether2 protocol=arp set-customer-vid-for=all new-customer-vid=0
add port=ether6 protocol=arp set-customer-vid-for=all new-customer-vid=200
add port=ether2 protocol=ip set-customer-vid-for=all new-customer-vid=0
add port=ether6 protocol=ip set-customer-vid-for=all new-customer-vid=200
```

- Set VLAN for IPX protocol

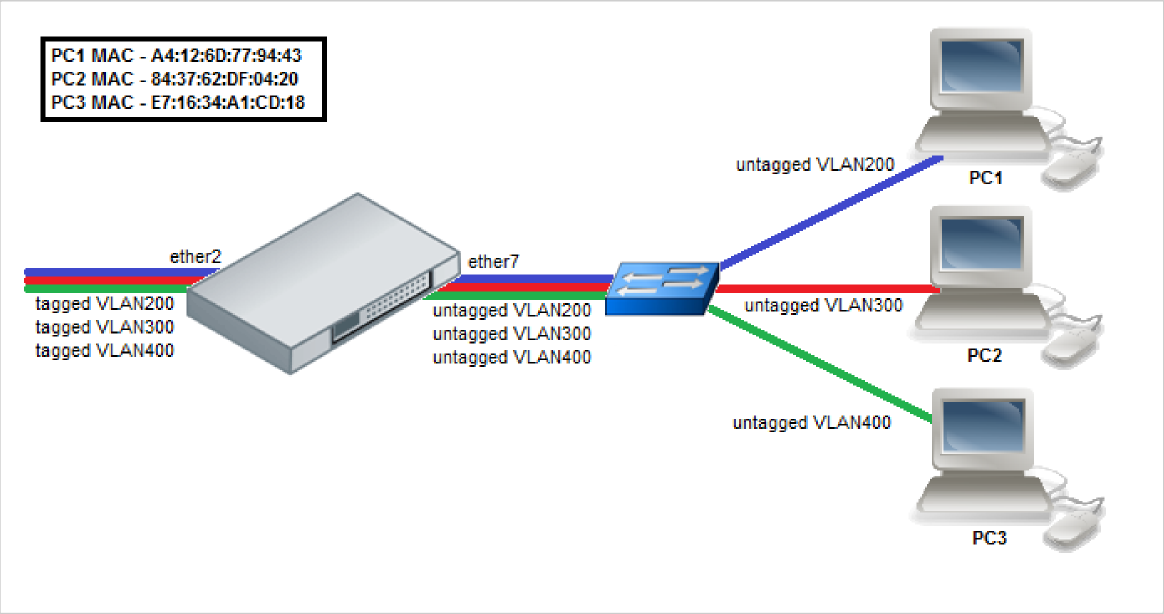
```
/interface ethernet switch protocol-based-vlan
add port=ether2 protocol=ipx set-customer-vid-for=all new-customer-vid=0
add port=ether7 protocol=ipx set-customer-vid-for=all new-customer-vid=300
```

- Set VLAN for AppleTalk AARP and AppleTalk DDP protocols

```
/interface ethernet switch protocol-based-vlan
add port=ether2 protocol=0x80F3 set-customer-vid-for=all new-customer-vid=0
add port=ether8 protocol=0x80F3 set-customer-vid-for=all new-customer-vid=400
add port=ether2 protocol=0x809B set-customer-vid-for=all new-customer-vid=0
add port=ether8 protocol=0x809B set-customer-vid-for=all new-customer-vid=400
```

MAC Based VLAN

Warning: Internally all MAC addresses in MAC based VLANs are hashed, certain MAC addresses can have the same hash, which will prevent a MAC address being loaded in to the switch chip if the hash matches with a hash from a MAC address that has been already loaded, for this reason it is recommended to use Port bases VLANs in combination with MAC based VLANs. This is a hardware limitation.



MAC Based VLAN

- Create a group of switched ports.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether7 master-port=ether2
```

```
# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
```

- Enable MAC based VLAN translation on access port.

```
/interface ethernet switch port
set ether7 allow-fdb-based-vlan-translate=yes
```

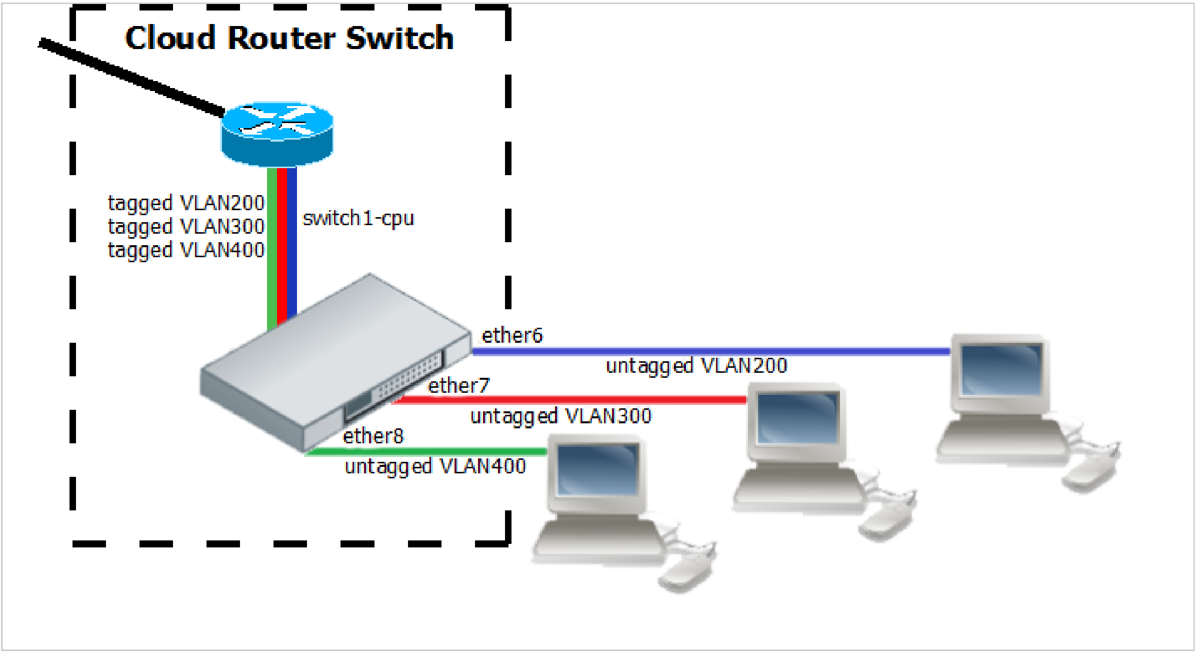
- Add MAC-to-VLAN mapping entries in MAC based VLAN table.

```
/interface ethernet switch mac-based-vlan
add src-mac=A4:12:6D:77:94:43 new-customer-vid=200
add src-mac=84:37:62:DF:04:20 new-customer-vid=300
add src-mac=E7:16:34:A1:CD:18 new-customer-vid=400
```

- Add VLAN 200, VLAN 300 and VLAN 400 tagging on ether2 port to create it as VLAN trunk port.

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=ether2 vlan-id=200
add tagged-ports=ether2 vlan-id=300
add tagged-ports=ether2 vlan-id=400
```

InterVLAN Routing



InterVLAN Routing

InterVLAN routing configuration consists of two main parts – VLAN tagging in switch-chip and routing in RouterOS. This configuration can be used in many applications by combining it with DHCP server, Hotspot, PPP and other features for each VLAN. Additionally this example covers blocking of unwanted other VLAN traffic on ports.

- Create a group of switched ports.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2
```

```
# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Set VLAN tagging on CPU port for all VLANs to make packets tagged before they are routed and add ingress VLAN translation rules to ensure correct VLAN id assignment is done on access ports.

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=switch1-cpu vlan-id=200
add tagged-ports=switch1-cpu vlan-id=300
add tagged-ports=switch1-cpu vlan-id=400

/interface ethernet switch ingress-vlan-translation
add ports=ether6 customer-vid=0 new-customer-vid=200 sa-learning=yes
add ports=ether7 customer-vid=0 new-customer-vid=300 sa-learning=yes
add ports=ether8 customer-vid=0 new-customer-vid=400 sa-learning=yes
```

- For routing add VLAN interfaces on master-port (bridge) because it connects with CPU port and add IP addresses to created VLAN interfaces. In this example three 192.168.x.1 addresses are added to vlan200, vlan300 and vlan400 interfaces.

```
# pre-v6.41 master-port configuration
/interface vlan
add name=vlan200 interface=ether2 vlan-id=200
add name=vlan300 interface=ether2 vlan-id=300
add name=vlan400 interface=ether2 vlan-id=400
/ip address
add address=192.168.20.1/24 interface=vlan200
add address=192.168.30.1/24 interface=vlan300
add address=192.168.40.1/24 interface=vlan400

# post-v6.41 bridge hw-offload configuration
/interface vlan
add name=vlan200 interface=bridge1 vlan-id=200
add name=vlan300 interface=bridge1 vlan-id=300
add name=vlan400 interface=bridge1 vlan-id=400
/ip address
add address=192.168.20.1/24 interface=vlan200
add address=192.168.30.1/24 interface=vlan300
add address=192.168.40.1/24 interface=vlan400
```

Unknown/Invalid VLAN filtering

VLAN membership is defined in the VLAN table. Adding entries with VLAN id and ports makes that VLAN traffic valid on those ports. After valid VLAN configuration unknown/invalid VLAN forwarding can be disabled in global switch settings. This VLAN filtering configuration example applies to InterVLAN Routing setup.

```
/interface ethernet switch vlan
add ports=switch1-cpu,ether6 vlan-id=200 learn=yes
add ports=switch1-cpu,ether7 vlan-id=300 learn=yes
add ports=switch1-cpu,ether8 vlan-id=400 learn=yes
```

- Option 1: disable invalid VLAN forwarding on specific ports:

```
/interface ethernet switch
set drop-if-invalid-or-src-port-not-member-of-vlan-on-ports=ether2,ether6,ether7,ether8
```

- Option 2: disable invalid VLAN forwarding on all ports:

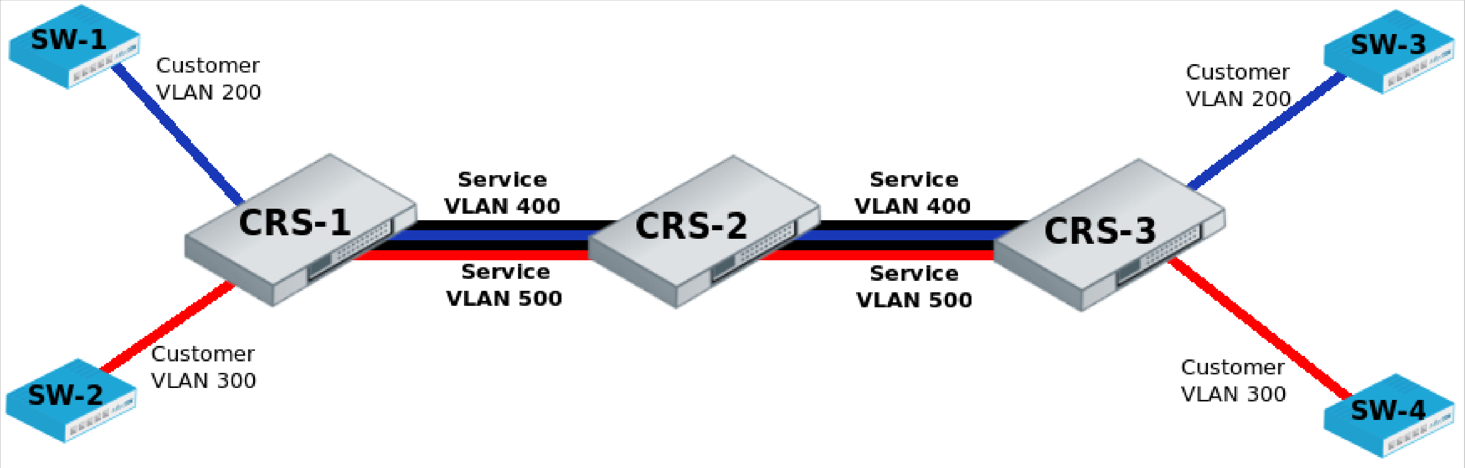
```
/interface ethernet switch
set forward-unknown-vlan=no
```

Warning: Using multiple master-ports/bridges on a single switch chip with enabled invalid VLAN filtering can cause unexpected behaviour. You should always use a single master-port/bridge configuration whenever using VLAN filtering. If port isolation is required, then port isolation feature should be used instead of using multiple master-ports/bridges.

VLAN Tunneling (Q-in-Q)

This example covers typical VLAN tunneling use case where service provider devices add another VLAN tag for independent forwarding in the mean time allowing customers to use their own VLANs.

Note: This example contains only Service VLAN tagging part.
It is recommended to additionally set Unknown/Invalid VLAN filtering configuration on ports.



Q-in-Q VLAN

CRS-1:The first switch on the edge of service provider network has to properly indentify traffic from customer VLAN id on port and assign new service VLAN id with ingress VLAN translation rules.

VLAN trunk port configuration for service provider VLAN tags is in the same *egress-vlan-tag* table.

The main difference from basic Port Based VLAN configuration is that CRS switch-chip has to be set to do forwarding according to service (*outer*) VLAN id instead of customer (*inner*) VLAN id.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether2 master-port=ether1
set ether9 master-port=ether1

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether1 hw=yes
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether9 hw=yes

/interface ethernet switch ingress-vlan-translation
add customer-vid=200 new-service-vid=400 ports=ether1 sa-learning=yes
add customer-vid=300 new-service-vid=500 ports=ether2 sa-learning=yes

/interface ethernet switch egress-vlan-tag
add tagged-ports=ether9 vlan-id=400
add tagged-ports=ether9 vlan-id=500

/interface ethernet switch
set bridge-type=service-vid-used-as-lookup-vid
```

CRS-2: The second switch in the service provider network require only switched ports using `master-port` and `bridge-type` configured to do forwarding according to service (*outer*) VLAN id instead of customer (*inner*) VLAN id.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether10 master-port=ether9

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether9 hw=yes
add bridge=bridge1 interface=ether10 hw=yes

/interface ethernet switch
set bridge-type=service-vid-used-as-lookup-vid
```

CRS-3: The third switch has similar configuration to CRS-1:

- Ports in a switch group using `master-port`;
- Ingress VLAN translation rules to define new service VLAN assingments on ports;
- `tagged-ports` for service provider VLAN trunks;
- CRS switch-chip set to use service VLAN id in switching lookup.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether4 master-port=ether3
set ether10 master-port=ether3

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether3 hw=yes
add bridge=bridge1 interface=ether4 hw=yes
add bridge=bridge1 interface=ether10 hw=yes

/interface ethernet switch ingress-vlan-translation
add customer-vid=200 new-service-vid=400 ports=ether3 sa-learning=yes
add customer-vid=300 new-service-vid=500 ports=ether4 sa-learning=yes

/interface ethernet switch egress-vlan-tag
add tagged-ports=ether10 vlan-id=400
add tagged-ports=ether10 vlan-id=500

/interface ethernet switch
set bridge-type=service-vid-used-as-lookup-vid
```

CVID Stacking

It is possible to use CRS1xx/CRS2xx series switches for CVID Stacking setups. CRS1xx/CRS2xx series switches are capable of VLAN filtering based on the outer tag of tagged packets that have two CVID tags (double CVID tag), these switches are also capable of adding another CVID tag on top of an existing CVID tag (CVID Stacking). For example, in a setup where **ether1** is receiving tagged packets with CVID 10, but it is required that **ether2** sends out these packets with another tag CVID 20 (VLAN10 inside VLAN20) while filtering out any other VLANs, the following must be configured:

- Switch together **ether1** and **ether2**:

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether2 master-port=ether1

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether1 hw=yes
add bridge=bridge1 interface=ether2 hw=yes
```

- Set the switch to filter VLANs based on service tag (0x88a8):

```
/interface ethernet switch
set bridge-type=service-vid-used-as-lookup-vid
```

- Add a service tag SVID 20 to packets that have a CVID 10 tag on **ether1**:

```
/interface ethernet switch ingress-vlan-translation
add customer-vid=10 new-service-vid=20 ports=ether1
```

- Specify **ether2** as the tagged/trunk port for SVID 20:

```
/interface ethernet switch egress-vlan-tag
add tagged-ports=ether2 vlan-id=20
```

- Allow **ether1** and **ether2** to forward SVID 20:

```
/interface ethernet switch vlan
add ports=ether1,ether2 vlan-id=20
```

- Override the SVID EtherType (0x88a8) to CVID EtherType (0x8100) on **ether2**:

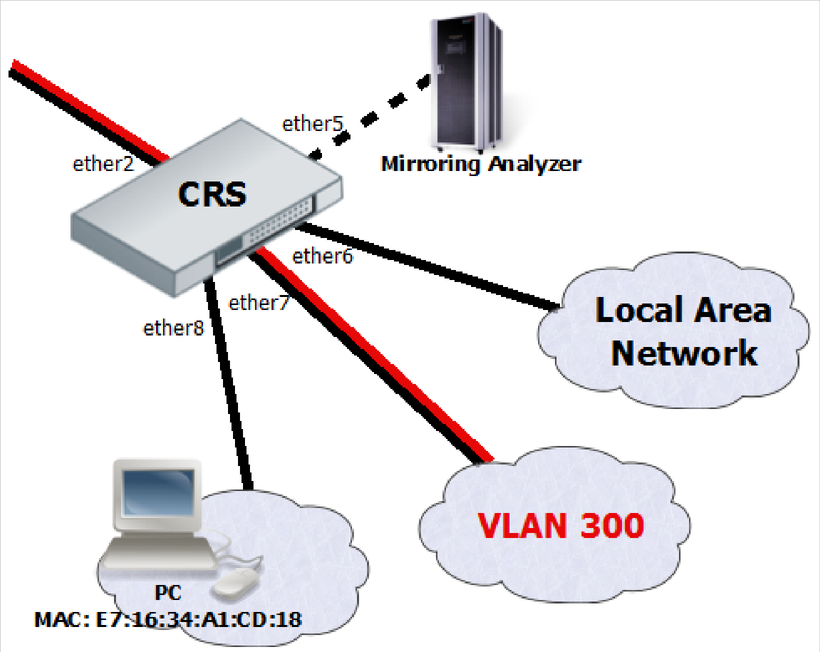
```
/interface ethernet switch port
set ether2 egress-service-tpid-override=0x8100 ingress-service-tpid-override=0x8100
```

- Enable invalid VLAN filtering

```
/interface ethernet switch
set drop-if-invalid-or-src-port-not-member-of-vlan-on-ports=ether1,ether2
```

Note: Since the switch is set to look up VLAN ID based on service tag, which is overridden with a different EtherType, then VLAN filtering is only done on the outer tag of a packet, the inner tag is not checked.

Mirroring



Mirroring

The Cloud Router Switches support three types of mirroring. Port based mirroring can be applied to any of switch-chip ports, VLAN based mirroring works for all specified VLANs regardless switch-chip ports and MAC based mirroring copies traffic sent or received from specific device reachable from the port configured in Unicast Forwarding Database.

Port Based Mirroring

The first configuration sets ether5 port as a mirror0 analyzer port for both ingress and egress mirroring, mirrored traffic will be sent to this port. Port based ingress and egress mirroring is enabled from ether6 port.

```
/interface ethernet switch
set ingress-mirror0=ether5 egress-mirror0=ether5

/interface ethernet switch port
set ether6 ingress-mirror-to=mirror0 egress-mirror-to=mirror0
```

VLAN Based Mirroring

The second example requires ports to be switched in a group. Mirroring configuration sets ether5 port as a mirror0 analyzer port and sets mirror0 port to be used when mirroring from VLAN occurs. VLAN table entry enables mirroring only for VLAN 300 traffic between ether2 and ether7 ports.

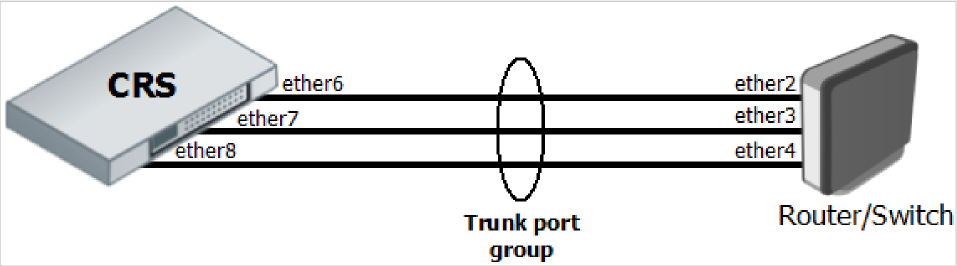
```
# pre-v6.41 master-port configuration

/interface ethernet
set ether7 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether7 hw=yes

/interface ethernet switch
set ingress-mirror0=ether5 vlan-uses=mirror0

/interface ethernet switch vlan
add ports=ether2,ether7 vlan-id=300 learn=yes ingress-mirror=yes
```

MAC Based Mirroring

The third configuration also requires ports to be switched in a group. Mirroring configuration sets ether5 port as a mirror0 analyzer port and sets mirror0 port to be used when mirroring from Unicast Forwarding database occurs. The entry from Unicast Forwarding database enables mirroring for packets with source or destination MAC address E7:16:34:A1:CD:18 from ether8 port.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether8 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether8 hw=yes

/interface ethernet switch
set ingress-mirror0=ether5 fdb-uses=mirror0

/interface ethernet switch unicast-fdb
add port=ether8 mirror=yes svl=yes mac-address=E7:16:34:A1:CD:18
```

Trunking



Trunking

The Trunking in the Cloud Router Switches provides static link aggregation groups with hardware automatic failover and load balancing. IEEE802.3ad and IEEE802.1ax compatible Link Aggregation Control Protocol is not supported yet. Up to 8 Trunk groups are supported with up to 8 Trunk member ports per Trunk group.

- Configuration requires a group of switched ports and an entry in the Trunk table.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no  protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes

/interface ethernet switch trunk
add name=trunk1 member-ports=ether6,ether7,ether8
```

- This example also shows proper bonding configuration in RouterOS on the other end.

```
/interface bonding
add name=bonding1 slaves=ether2,ether3,ether4 mode=balance-xor transmit-hash-policy=layer-2-and-3 \
link-monitoring=mii mii-interval=100ms
```

Note: You can find a working example for trunking and port based VLANs at CRS VLANs with Trunks page.

Limited MAC Access per Port

Disabling MAC learning and configuring static MAC addresses gives ability to control what exact devices can communicate to CRS1xx/2xx switches and through them.

Configuration requires a group of switched ports, disabled MAC learning on those ports and static UFDB entries.

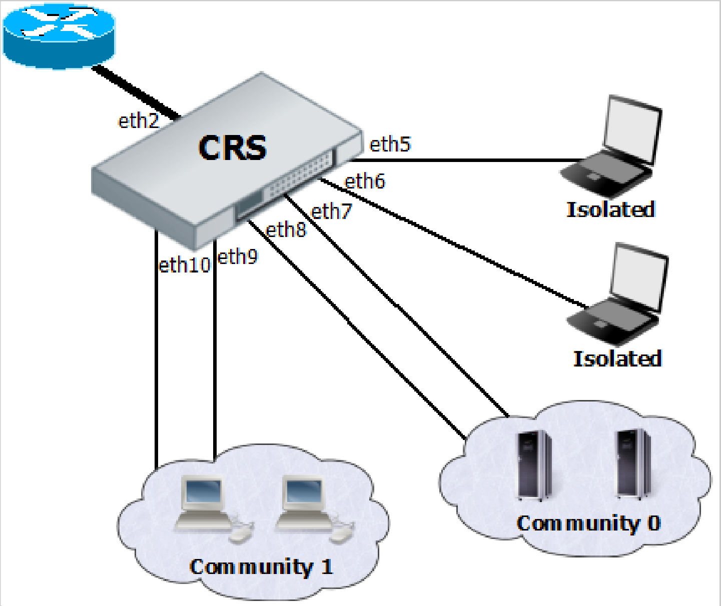
```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes

/interface ethernet switch port
set ether6 learn-override=no
set ether7 learn-override=no

/interface ethernet switch unicast-fdb
add mac-address=4C:5E:0C:00:00:01 port=ether6 svl=yes
add mac-address=D4:CA:6D:00:00:02 port=ether7 svl=yes
```

CRS1xx/2xx switches also allow to learn one dynamic MAC per port to ensure only one end user device is connected no matter of its MAC address.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes

/interface ethernet switch port
set ether6 learn-limit=1
set ether7 learn-limit=1
```

Isolation

Port Level Isolation



Port Level Isolation

Port-level isolation is often used for Private VLAN, where:

- One or multiple uplink ports are shared among all users for accessing gateway or router.
- Port group Isolated Ports is for guest users. Communication is through the uplink ports only.
- Port group Community 0 is for department A. Communication is allowed between the group members and through uplink ports.
- Port group Community X is for department X. Communication is allowed between the group members and through uplink ports.

The Cloud Router Switches use port-level isolation profiles for Private VLAN implementation:

- Uplink ports – Port-level isolation profile 0
- Isolated ports – Port-level isolation profile 1
- Community 0 ports - Port-level isolation profile 2
- Community X (X <= 30) ports - Port-level isolation profile X

This example requires a group of switched ports. Assume that all ports used in this example are in one switch group configured with master-port setting.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether6 master-port=ether2
set ether7 master-port=ether2
set ether8 master-port=ether2
set ether9 master-port=ether2
set ether10 master-port=ether2

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
add bridge=bridge1 interface=ether9 hw=yes
add bridge=bridge1 interface=ether10 hw=yes
```

The first part of port isolation configuration is setting the Uplink port – set port profile to 0 for ether2.

```
/interface ethernet switch port
set ether2 isolation-leakage-profile-override=0
```

Then continue with setting isolation profile 1 to all isolated ports and adding the communication port for port isolation profile 1.

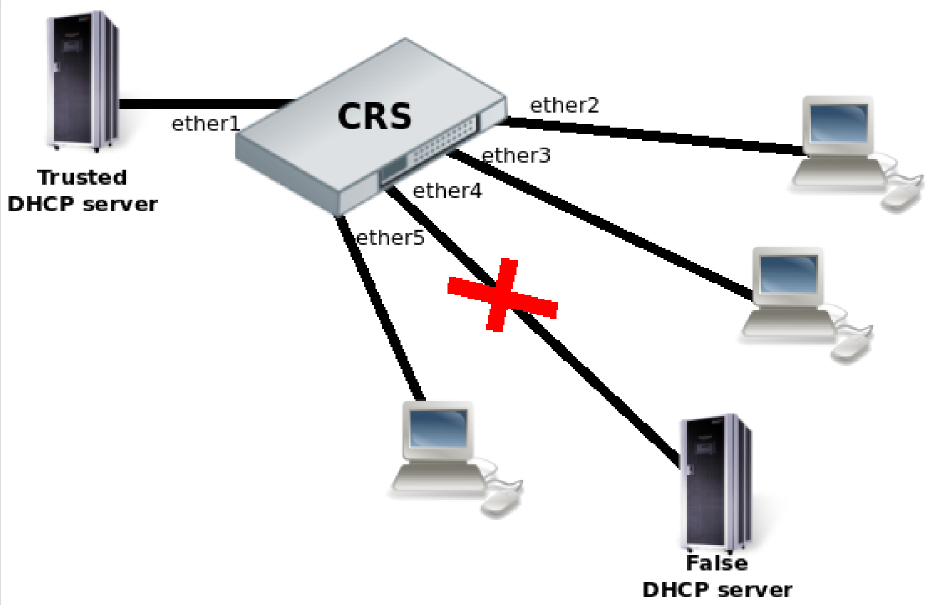
```
/interface ethernet switch port
set ether5 isolation-leakage-profile-override=1
set ether6 isolation-leakage-profile-override=1

/interface ethernet switch port-isolation
add port-profile=1 ports=ether2 type=dst
```

Configuration to set Community 2 and Community 3 ports is similar.

```
/interface ethernet switch port
set ether7 isolation-leakage-profile-override=2
set ether8 isolation-leakage-profile-override=2

/interface ethernet switch port-isolation
add port-profile=2 ports=ether2,ether7,ether8 type=dst
```

```
/interface ethernet switch port
set ether9 isolation-leakage-profile-override=3
set ether10 isolation-leakage-profile-override=3

/interface ethernet switch port-isolation
add port-profile=3 ports=ether2,ether9,ether10 type=dst
```

Protocol Level Isolation



Protocol Level Isolation

Protocol level isolation on CRS switches can be used to enchance network security. For example, restricting DHCP traffic between the users and allowing it only to trusted DHCP server port can prevent security risks like DHCP spoofing attack. The following example shows how to configure it on CRS.

- Choose a master port and enslave the ports you need to be within the same switch group.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether2 master-port=ether1
set ether3 master-port=ether1
set ether4 master-port=ether1
set ether5 master-port=ether1

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether1 hw=yes
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether3 hw=yes
add bridge=bridge1 interface=ether4 hw=yes
add bridge=bridge1 interface=ether5 hw=yes
```

- Set the same Community port profile for all DHCP client ports. Community port profile numbers are from 2 to 30.

```
/interface ethernet switch port
set ether2 isolation-leakage-profile-override=2
set ether3 isolation-leakage-profile-override=2
set ether4 isolation-leakage-profile-override=2
set ether5 isolation-leakage-profile-override=2
```

- And configure port isolation/leakage profile for selected Community (2) to allow DHCP traffic destined only to port where the trusted DHCP server is located. `registration-status` and `traffic-type` properties have to be set empty in order to apply restriction only for DHCP protocol.

```
/interface ethernet switch port-isolation
add port-profile=2 protocol-type=dhcpv4 type=dst forwarding-type=bridged ports=ether1 \
registration-status="" traffic-type=""
```

Quality of Service (QoS)

QoS configuration schemes

MAC based traffic scheduling and shaping: [MAC address in UFDB] -> [QoS Group] -> [Priority] -> [Queue] -> [Shaper]

VLAN based traffic scheduling and shaping: [VLAN id in VLAN table] -> [QoS Group] -> [Priority] -> [Queue] -> [Shaper]

Protocol based traffic scheduling and shaping: [Protocol in Protocol VLAN table] -> [QoS Group] -> [Priority] -> [Queue] -> [Shaper]

PCP/DEI based traffic scheduling and shaping: [Switch port PCP/DEI mapping] -> [Priority] -> [Queue] -> [Shaper]

DSCP based traffic scheduling and shaping: [QoS DSCP mapping] -> [Priority] -> [Queue] -> [Shaper]

MAC based traffic scheduling using internal Priority

In Strict Priority scheduling mode, the highest priority queue is served first. The queue number represents the priority and the queue with highest queue number has the highest priority. Traffic is transmitted from highest priority queue until the queue is empty, and then moves to the next highest priority queue, and so on. If no congestion is present on the egress port, packet is transmitted as soon as it is received. If congestion occurs on the port where high priority traffics keep coming, the lower priority queues starve.

On all CRS switches the scheme where MAC based egress traffic scheduling is done according to internal Priority would be following: [MAC address] -> [QoS Group] -> [Priority] -> [Queue];
In this example host1 (E7:16:34:00:00:01) and host2 (E7:16:34:00:00:02) will have higher priority 1 and the rest of the hosts will have lower priority 0 for transmited traffic on port ether7. Note that CRS has maximum 8 queues per port.

- Create a group of ports for switching.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether7 master-port=ether6
set ether8 master-port=ether6

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Create QoS group for use in UFDB.

```
/interface ethernet switch qos-group
add name=group1 priority=1
```

- Add UFDB entries to match specific MACs on ether7 and apply QoS group1

```
/interface ethernet switch unicast-fdb
add mac-address=E7:16:34:00:00:01 port=ether7 qos-group=group1 svl=yes
add mac-address=E7:16:34:00:00:02 port=ether7 qos-group=group1 svl=yes
```

- Configure ether7 port queues to work according Strict Priority and QoS scheme only for destination address.

```
/interface ethernet switch port
set ether7 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-prior\
    ity:0,strict-priority:0,strict-priority:0,strict-priority:0" priority-to-queue=0:0,1:1 \
    qos-scheme-precedence=da-based
```

MAC based traffic shaping using internal Priority

The scheme where MAC based traffic shaping is done according to internal Priority would be following: [MAC address] -> [QoS Group] -> [Priority] -> [Queue] -> [Shaper];
In this example unlimited traffic will have priority 0 and limited traffic will have priority 1 with the bandwidth limit 10Mbit. Note that CRS has maximum 8 queues per port.

- Create a group of ports for switching.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether7 master-port=ether6
set ether8 master-port=ether6

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Create QoS group for use in UFDB.

```
/interface ethernet switch qos-group
add name=group1 priority=1
```

- Add UFDB entry to match specific MAC on ether8 and apply QoS group1

```
/interface ethernet switch unicast-fdb
add mac-address=E7:16:34:A1:CD:18 port=ether8 qos-group=group1 svl=yes
```

- Configure ether8 port queues to work according Strict Priority and QoS scheme only for destination address.

```
/interface ethernet switch port
set ether8 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-prior\
    ity:0,strict-priority:0,strict-priority:0,strict-priority:0" priority-to-queue=0:0,1:1 \
    qos-scheme-precedence=da-based
```

- Apply bandwidth limit for queue1 on ether8.

```
/interface ethernet switch shaper
add port=ether8 rate=10M target=queue1
```

If CRS switch supports Access Control List, this configuration would be simplier.

```
/interface ethernet switch acl policer
add name=policer1 yellow-burst=100k yellow-rate=10M

/interface ethernet switch acl
add mac-dst-address=E7:16:34:A1:CD:18 policer=policer1
```

VLAN based traffic scheduling + shaping using internal Priorities

Best practice is to assign lower internal QoS Priority for traffic limited by shaper to make it also less important in Strict Priority scheduler. (higher priority should be more important and unlimited)

In this example:
Switch port ether6 is using shaper to limit the traffic that comes from ether7 and ether8.
When link has reached its capacity, the traffic with the highest priority will be sent out first.
VLAN10 -> QoS group0 = lowest priority
VLAN20 -> QoS group1 = normal priority
VLAN30 -> QoS group2 = highest priority

- Create a group of ports for switching.

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether7 master-port=ether6
set ether8 master-port=ether6

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether6 hw=yes
add bridge=bridge1 interface=ether7 hw=yes
add bridge=bridge1 interface=ether8 hw=yes
```

- Create QoS groups for use in VLAN table.

```
/interface ethernet switch qos-group
add name=group0 priority=0
add name=group1 priority=1
add name=group2 priority=2
```

- Add VLAN entries to apply QoS groups for certain VLANs.

```
/interface ethernet switch vlan
add ports=ether6,ether7,ether8 qos-group=group0 vlan-id=10
add ports=ether6,ether7,ether8 qos-group=group1 vlan-id=20
add ports=ether6,ether7,ether8 qos-group=group2 vlan-id=30
```

- Configure ether6, ether7, ether8 port queues to work according Strict Priority and QoS scheme only for VLAN based QoS.

```
/interface ethernet switch port
set ether6 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-prior\
    ity:0,strict-priority:0,strict-priority:0,strict-priority:0" priority-to-queue=0:0,1:1,2:2 \
    qos-scheme-precedence=vlan-based
set ether7 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-prior\
    ity:0,strict-priority:0,strict-priority:0,strict-priority:0" priority-to-queue=0:0,1:1,2:2 \
    qos-scheme-precedence=vlan-based
set ether8 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-prior\
    ity:0,strict-priority:0,strict-priority:0,strict-priority:0" priority-to-queue=0:0,1:1,2:2 \
    qos-scheme-precedence=vlan-based
```

- Apply bandwidth limit on ether6.

```
/interface ethernet switch shaper
add port=ether6 rate=10M
```

PCP based traffic scheduling

By default CRS1xx/CRS2xx series devices will ignore the PCP/CoS/802.1p value and forward packets based on FIFO (First-In-First-Out) manner. When the device's internal queue is not full, then packets are in FIFO manner, but as soon as a queue is filled, then higher priority traffic can be sent out first. Lets consider a scenario when **ether1** and **ether2** is forwarding data to **ether3**, but when **ether3** is congested, then packets are going to be scheduled, we can configure the switch to hold lowest priority packets until all higher priority packets are sent out, this is a very common scenario for VoIP type setups, where some traffic needs to be prioritized.

- To achieve such a behaviour, switch together **ether1**, **ether2** and **ether3** ports:

```
# pre-v6.41 master-port configuration

/interface ethernet
set ether2 master-port=ether1
set ether3 master-port=ether1

# post-v6.41 bridge hw-offload configuration

/interface bridge
add name=bridge1 igmp-snooping=no protocol-mode=none
/interface bridge port
add bridge=bridge1 interface=ether1 hw=yes
add bridge=bridge1 interface=ether2 hw=yes
add bridge=bridge1 interface=ether3 hw=yes
```

- Enable **Strict Policy** for each internal queue on each port:

```
/interface ethernet switch port
set ether1,ether2,ether3 per-queue-scheduling="strict-priority:0,strict-priority:0,strict-priority:0,strict-priority:0,strict-p
```

- Map each PCP value to an internal priority value, for convenience reasons simply map PCP to an internal priority 1-to-1:

```
/interface ethernet switch port
set ether1,ether2,ether3 pcp-based-qos-priority-mapping=0:0,1:1,2:2,3:3,4:4,5:5,6:6,7:7
```

- Since the switch will empty the largest queue first and you need the highest priority to be served first, then you can assign this internal priority to a queue 1-to-1:

```
/interface ethernet switch port
set ether1,ether2,ether3 priority-to-queue=0:0,1:1,2:2,3:3,4:4,5:5,6:6,7:7
```

- Finally, set each switch port to schedule packets based on the PCP value:

```
/interface ethernet switch port
set ether1,ether2,ether3 qos-scheme-precedence=pcp-based
```

Bandwidth Limiting

Both Ingress Port policer and Shaper provide bandwidth limiting features for CRS switches.

- Ingress Port Policer sets RX limit on port:

```
/interface ethernet switch ingress-port-policer
add port=ether5 meter-unit=bit rate=10M
```

- Shaper sets TX limit on port:

```
/interface ethernet switch shaper
add port=ether5 meter-unit=bit rate=10M
```

Traffic Storm Control

The same Ingress Port policer also can be used for the traffic storm control to prevent disruptions on Layer 2 ports caused by broadcast, multicast or unicast traffic storms.

- Broadcast storm control example on ether5 port with 500 packet limit per second:

```
/interface ethernet switch ingress-port-policer
add port=ether5 rate=500 meter-unit=packet packet-types=broadcast
```

- Example with multiple packet types which includes ARP and ND protocols and unregistered multicast traffic. Unregistered multicast is traffic which is not defined in Multicast Forwarding database.

```
/interface ethernet switch ingress-port-policer
add port=ether5 rate=5k meter-unit=packet packet-types=broadcast,arp-or-nd,unregistered-multicast
```

Spanning Tree Protocol

Starting from RouterOS v6.38 Cloud Router Switches support Spanning Tree Protocols on ports configured for switching by hardware switch chip. To enable this feature create RouterOS bridge interface and add the master-port to it.

- Create a group of switched ports

```
/interface ethernet
set ether2 master-port=ether1
set ether3 master-port=ether1
set ether4 master-port=ether1
```

- Create a bridge interface and add the master-port to it

```
/interface bridge add name=bridge1 protocol=rstp

/interface bridge port add bridge=bridge1 interface=ether1
```

- Slave ports are dynamically added to the bridge only to show STP status. Forwarding through switched ports still are handled by hardware switch chip.

```
[admin@MikroTik] > /interface bridge port print
Flags: X - disabled, I - inactive, D - dynamic
 #    INTERFACE           BRIDGE           PRIORITY  PATH-COST    HORIZON
 0    ether1              bridge1              0x80        10       none
 1 ID ether2              bridge1              0x80        10       none
 2  D ether3              bridge1              0x80        10       none
 3  D ether4              bridge1              0x80        10       none
```

```
[admin@MikroTik] > /interface bridge port monitor [find]
                    status: in-bridge       in-bridge     in-bridge       in-bridge
               port-number: 1               2             3               4
                      role: designated-port disabled-port designated-port backup-port
                 edge-port: yes             no            no              no
       edge-port-discovery: yes             yes           yes             yes
       point-to-point-port: no              no            no              no
              external-fdb: no              no            no              no
              sending-rstp: yes             yes           yes             yes
                  learning: yes             no            yes             no
                forwarding: yes             no            yes             no
            root-path-cost:                                               10
         designated-bridge:                                               0x8000.D4:CA:6D:1E:66:9A
           designated-cost:                                               0
    designated-port-number:                                               3
```

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- This page was last edited on 10 July 2018, at 15:51.