

About Me

- Steve Discher, from College Station, Texas, USA
- MikroTik Certified Trainer since 2008 and teach RouterOS classes, LearnMikroTik.com and blog at SteveDischer.com
- Operate a wireless distribution company, ISP Supplies
- Author of RouterOS by Example



Congratulations!

28 New MTCNA Engineers



01:00

How to Properly Use the Switching Functions of the CRS Cloud Router Switches

Practice Quiz



This is a:

A. Switch

B. Router

C. All of the above

Practice Quiz



This is a:

A. Switch

B. Router

C. All of the above

CRS Features

Switching Features & Highlights

Features	Description
Forwarding	• Configurable ports for switching or routing • Full non-blocking wirespeed switching • Up to 16k MAC entries in Unicast FDB for Layer 2 unicast forwarding • Up to 1k MAC entries in Multicast FDB for multicast forwarding • Up to 256 MAC entries in Reserved FDB for control and management purposes • All Forwarding Databases support IVL and SVL • Configurable Port based MAC learning limit (max 1024 MACs per port) • Jumbo frame support (CRS1xx: 4064 Bytes; CRS2xx: 9204 Bytes)
Mirroring	• Various types of mirroring: • Port based mirroring • VLAN based mirroring • MAC based mirroring • 2 independent mirroring analyzer ports

Wires speed
switching and jumbo
frame support

Port, VLAN and MAC
based mirroring

CRS Features

Features	Description
VLAN	• Fully compatible with IEEE802.1Q and IEEE802.1ad VLAN • 4k active VLANs • Flexible VLAN assignment: • Port based VLAN • Protocol based VLAN • MAC based VLAN • From any to any VLAN translation and swapping • 1:1 VLAN switching - VLAN to port mapping • VLAN filtering
Port Isolation and Leakage	• Applicable for Private VLAN implementation • 3 port profile types: Promiscuous, Isolated and Community • Up to 28 Community profiles • Leakage profiles allow bypassing egress VLAN filtering

802.1Q and Q in Q
VLANs, up to 4000
VLANs

Port isolation and
leakage

CRS Features

Features	Description
Trunking	• Supports static link aggregation groups • Up to 8 Port Trunk groups • Up to 8 member ports per Port Trunk group • Hardware automatic failover and load balancing
Quality of Service (QoS)	• Flexible QoS classification and assignment: • Port based • MAC based • VLAN based • Protocol based • PCP/DEI based • DSCP based • ACL based • QoS remarking and remapping for QoS domain translation between service provider and client networks • Overriding of each QoS assignment according to the configured priority

Trunking including standards based LAG, Link Aggregation Groups

Layer 2 QOS based on port, MAC, VLAN and many other matchers

CRS Features

Traffic shaping

Features	Description
Shaping and Scheduling	• 8 queues on each physical port • Shaping per port, per queue, per queue group
Access Control List	• Ingress and Egress ACL tables • Up to 512 ACL rules • Classification based on ports, L2, L3, L4 protocol header fields • ACL actions include filtering, forwarding and modifying of the protocol header fields

Ingress and Egress
ACL's

CRS

- Those are the switching features
- Don't forget about RouterOS

Question

True or False: Steve knows how to use all the capabilities of the CRS?

Answer

False. Why? There are three to four features that most people need all the time, the rest are designed to address certain, less common scenarios.

Question

True or False: I can solve most if not all of the switching needs of the average WISP or integrator by learning 3 basic switching setups on the CRS.

Answer

True. We will look at three simple setups that will work for the majority of your applications.

Agenda

1. Why switch, why not just bridge?
2. Background knowledge
3. Examples of setups



Why Use Switching Instead of Bridging?

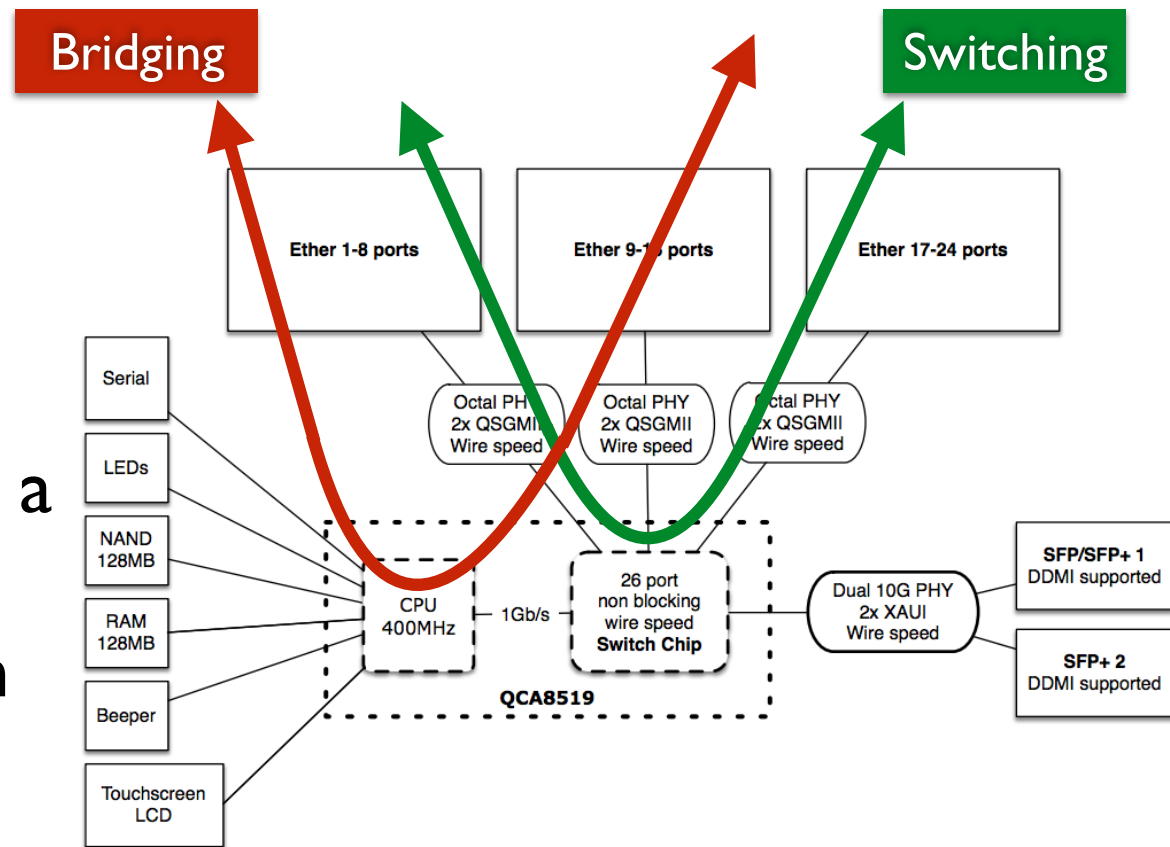
- Bridges are easy, and perfect for joining ports that can not be joined any other way
- Example: Wireless to Ethernet
- Bridges are done in software, resource hit
- Bridges could max out a CPU before the interfaces hit wire speed



How Are Switches Different Than Bridges?

How Are Switches Different Than Bridges?

- Although functionally they are the same, operationally they are very different
- Switching involves using a dedicated switch chip, separate and apart from the Router CPU and processes



Dedicated hardware, not software

CRS226

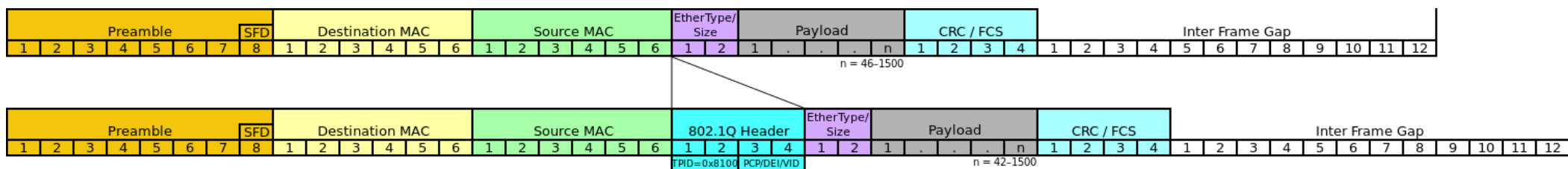


What are VLANs?

- A Virtual LAN (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). -*Wikipedia*
- It is like a virtual switch or switches inside a physical switch

How Are VLANs Done

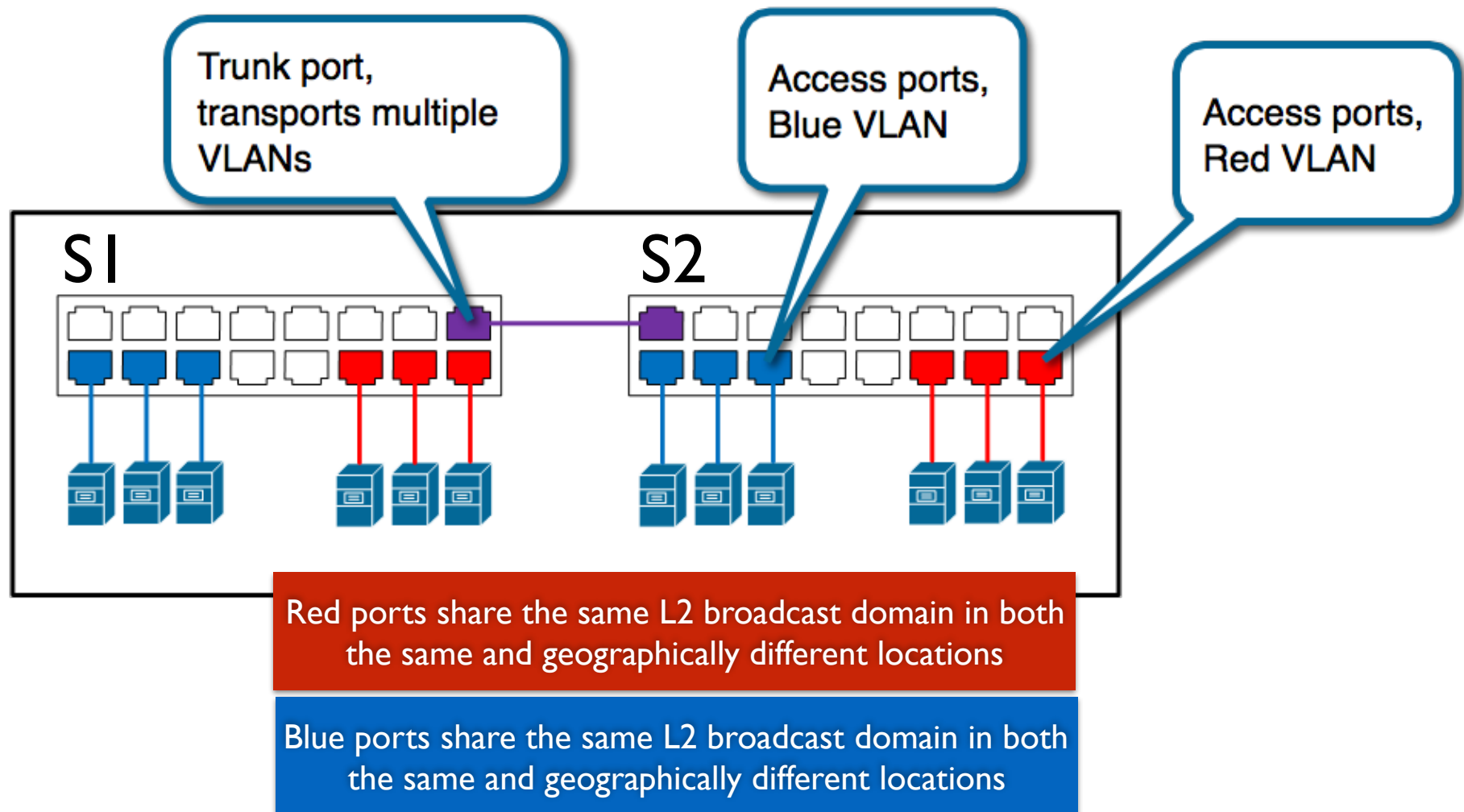
- “Encapsulation” is a misnomer
- 802.1Q does not “encapsulate” the original frame, per se, instead it adds a 32-bit field between the source MAC address and the “EtherType” field of the original frame



VLAN Terms

- **Tagging** - adding the VLAN tag to frames
- **Untagging** - Stripping the VLAN tag
- **Trunk Port** - (not an aggregation group) Allowing various, different frame tags to pass through a switch typically without change
- **Access port** - Receives only frames with a certain tag and strips them before the frames leave the port for non-VLAN aware devices
- **Hybrid port** - Passes some tags intact but strips others

VLANs in Action



School's out!





Application Examples

How can we use these features?

Example 1

- **Basic switch** - Set all or a group of ports to be switched together

Example 2

- **Inter VLAN Routing** - Trunk VLANs to a router port to be presented as VLAN sub-interfaces

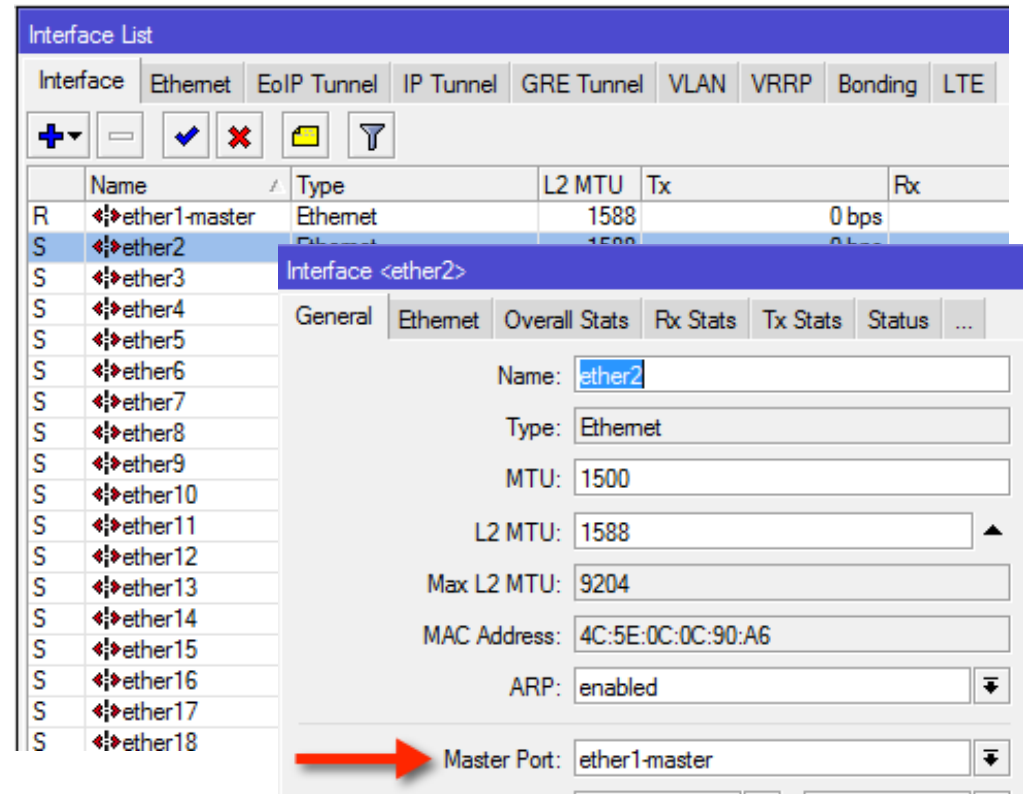
Example 3

- **Port Isolation** - Prevent rogue DHCP servers on a switch

Example 1

Configure a Basic Switch

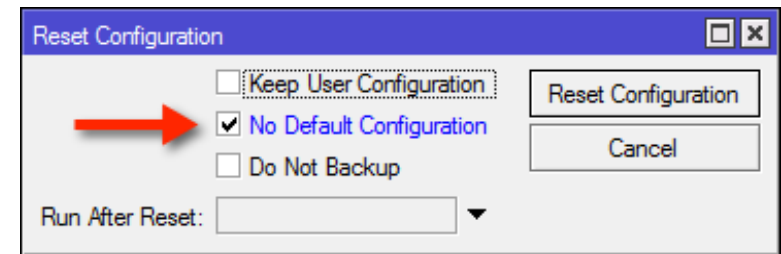
- Using default configuration, all ports are switched with ether1 as the master



Interfaces

Configure a Basic Switch

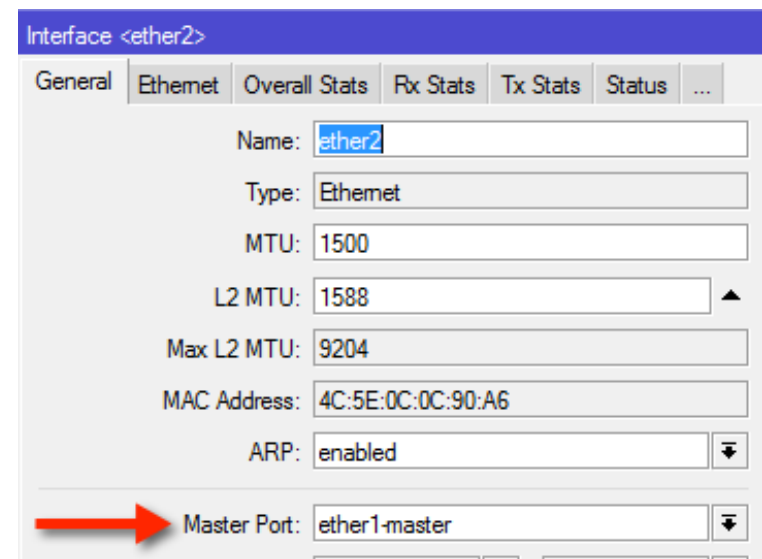
- Without default configuration, you will need to assign ports manually or by using a script
- “No Default Configuration” does just that



System → Reset Configuration

Configure a Basic Switch

- After reset, we can assign interfaces manually or using a script
- Without scripting this can take a while!



Interface <ether2>

General | Ethernet | Overall Stats | Rx Stats | Tx Stats | Status | ...

Name: ether2

Type: Ethernet

MTU: 1500

L2 MTU: 1588 ▲

Max L2 MTU: 9204

MAC Address: 4C:5E:0C:0C:90:A6

ARP: enabled ▼

Master Port: ether1-master ▼

Interfaces

Configure a Basic Switch

- Two scripts to greatly simplify configuration

The screenshot displays the Mikrotik RouterOS interface. At the top, the 'Script List' window shows a table of scripts. Below it, the 'System → Scripts' menu path is visible. At the bottom, two configuration windows are shown side-by-side: 'Script <Clear Ports>' and 'Script <Set Ports>'. Both windows show the same configuration: Name (Clear Ports/Set Ports), Owner (admin), and a Policy with all options (ftp, read, policy, password, sensitive, reboot, write, test, sniff) checked.

Name	Owner	Last Time Started	Run Count
Clear Ports	admin	Jan/02/1970 00:59:11	2
Set Ports	admin	Jan/02/1970 00:58:00	5

System → Scripts

Script <Clear Ports>

Name: Clear Ports

Owner: admin

Policy:

- ☒ ftp
- ☒ read
- ☒ policy
- ☒ password
- ☒ sensitive
- ☒ reboot
- ☒ write
- ☒ test
- ☒ sniff

Script <Set Ports>

Name: Set Ports

Owner: admin

Policy:

- ☒ ftp
- ☒ read
- ☒ policy
- ☒ password
- ☒ sensitive
- ☒ reboot
- ☒ write
- ☒ test
- ☒ sniff

Configure a Basic Switch

```
/system script
add name="Set Ports" owner=admin policy=ftp,reboot,read,write,policy,test,password,sniff,sensitive
source="#\r\
\n#\r\
\n# Set master port\r\
\n# Then set slave port type i.e.: ether or sfp \r\
\n# This is for interfaces not named \93ether\94 like SFP\r\
\n# Then set ports in range form using SlavePortStart and SlavePortStop.\r\
\n:global MasterPort \"ether24\" \r\
\n:global PortType \"ether\" \r\
\n:global SlavePortsStart \"1\" \r\
\n:global SlavePortsStop \"9\" \r\
\n:for i from=\$SlavePortsStart to=\$SlavePortsStop do={\r\
\n/interface ethernet set (\$PortType . \$i) master-port=\$MasterPort\r\
\n}"
add name="Clear Ports" owner=admin policy=ftp,reboot,read,write,policy,test,password,sniff,sensitive
source=\
"/interface ethernet\r\
\nset [find] master=none"
```

Download at <http://wiki.ispsupplies.com>
Search for “script”

Helpful Scripts

Script List

Scripts Jobs Environment

+ - [Folder Icon] [Filter Icon] Run Script

Name	Owner	Last Time Started
Clear Ports	admin	Jan/02/19
Set Ports	admin	Jan/02/19

Script <Clear Ports>

Name: Clear Ports

Owner: admin

Policy:

- ☒ ftp
- ☒ read
- ☒ policy
- ☒ password
- ☒ sensitive
- ☒ reboot
- ☒ write
- ☒ test
- ☒ sniff

Last Time Started:

Run Count: 0

```

/interface ethernet
set [find] master=none
    
```

Script <Set Ports>

Name: Set Ports

Owner: admin

Policy:

- ☒ ftp
- ☒ read
- ☒ policy
- ☒ password
- ☒ sensitive
- ☒ reboot
- ☒ write
- ☒ test
- ☒ sniff

Last Time Started:

Run Count: 0

Source:

```

# Then set slave port type i.e.: ether or sfp
# This is for interfaces not named "ether" like SFP
# Then set ports in range form using SlavePortStart and
SlavePortStop
:global MasterPort "ether1"
:global PortType "ether"
:global SlavePortsStart "2"
:global SlavePortsStop "6"
for i from=$SlavePortsStart to=$SlavePortsStop do={
/interface ethernet set ($PortType . $i) master-port=$MasterPort
    
```

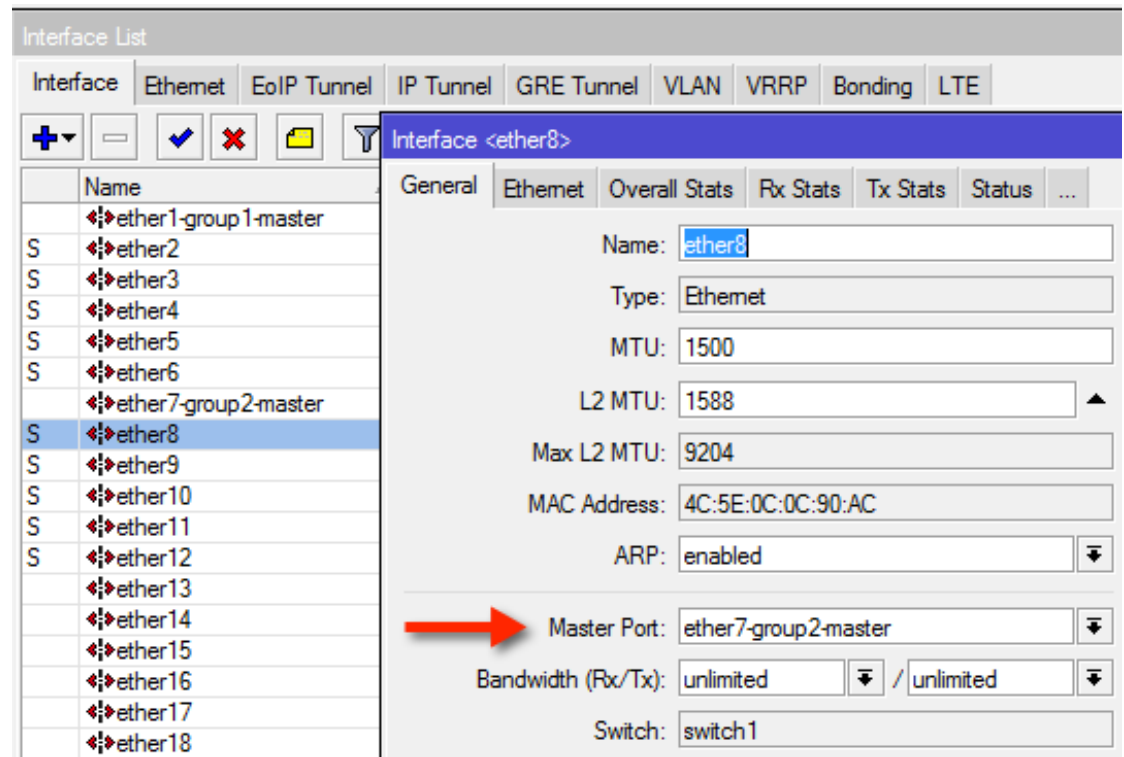
Example 1

Configure a Basic Switch



Result=2 x 6 port switches

That's it!

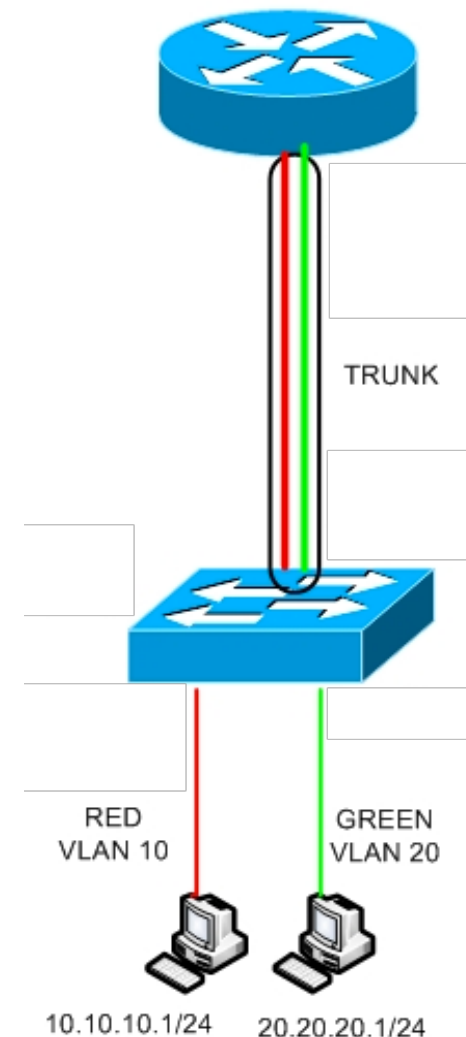


Interfaces

Example 2

Inter VLAN Routing

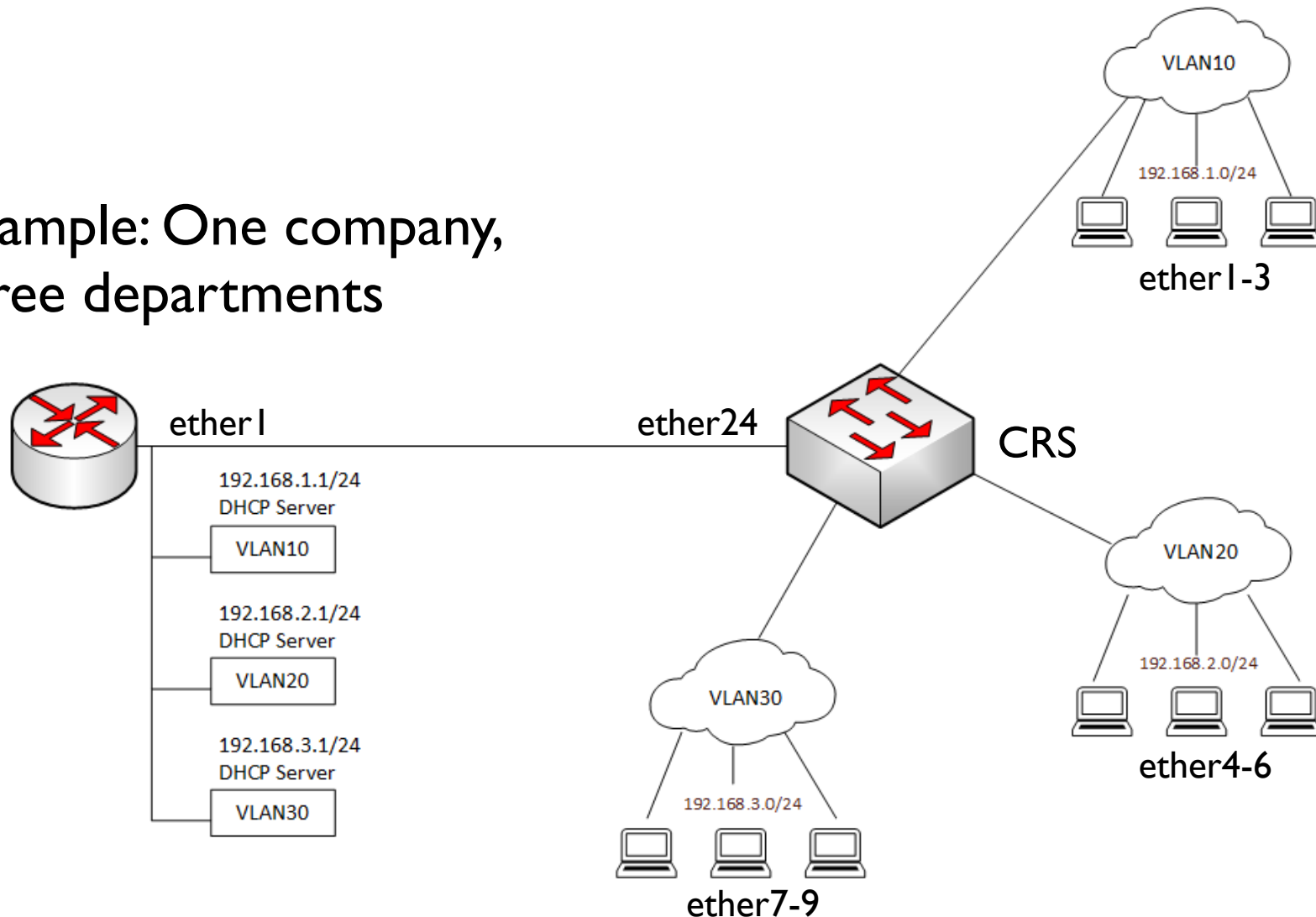
- Common configuration when a router needs many independent ports
- Each switch port appears as a separate virtual interface on the router



Example 2

Inter VLAN Routing

Example: One company,
three departments



Example 2

Inter VLAN Routing

Router Config

Step 1

- Separate routing device apart from CRS
- Router, create three VLAN interfaces subordinate to ether1

Interfaces → VLAN

Interface List

Interface	Ethernet	EoIP Tunnel	IP Tunnel	GRE Tunnel	VLAN	VRRP	Bonding	LTE
+	-	✓	✗	✗	✗	✗	✗	✗
Name	Type	MTU	L2 MTU	Tx	Rx			
vlan10	VLAN	1500	1584		0 bps			
vlan20	VLAN	1500	1584		0 bps			
vlan30	VLAN	1500	1584		0 bps			

Interface <vlan10>

General	Status	Traffic
Name: vlan10		
Type: VLAN		
MTU: 1500		
L2 MTU: 1584		
MAC Address: 4C:5E:0C:0C:90:9A		
ARP: enabled		
VLAN ID: 10		
Interface: ether1-trunk		
☐ Use Service Tag		

Interface <vlan20>

General	Status	Traffic
Name: vlan20		
Type: VLAN		
MTU: 1500		
L2 MTU: 1584		
MAC Address: 4C:5E:0C:0C:90:A5		
ARP: enabled		
VLAN ID: 20		
Interface: ether1-trunk		
☐ Use Service Tag		

Interface <vlan30>

General	Status	Traffic
Name: vlan30		
Type: VLAN		
MTU: 1500		
L2 MTU: 1584		
MAC Address: 4C:5E:0C:0C:90:A5		
ARP: enabled		
VLAN ID: 30		
Interface: ether1-trunk		
☐ Use Service Tag		

Example 2

Inter VLAN Routing

Router Config

Step 2

- Add IP Addresses to each VLAN interface

The screenshot displays the Mikrotik WinBox interface. At the top, the 'Address List' window shows a table with three entries:

Address	Network	Interface
192.168.1.1/24	192.168.1.0	vlan10
192.168.2.1/24	192.168.2.0	vlan20
192.168.3.1/24	192.168.3.0	vlan30

Below the table, three configuration windows are open, each for a different IP address. Red arrows point to the 'OK' and 'Apply' buttons in each window:

- Address <192.168.1.1/24>**: Address: 192.168.1.1/24, Network: 192.168.1.0, Interface: vlan10. Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove.
- Address <192.168.2.1/24>**: Address: 192.168.2.1/24, Network: 192.168.2.0, Interface: vlan20. Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove.
- Address <192.168.3.1/24>**: Address: 192.168.3.1/24, Network: 192.168.3.0, Interface: vlan30. Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove.

Each configuration window also has an 'enabled' checkbox at the bottom, which is checked.

IP → Addresses

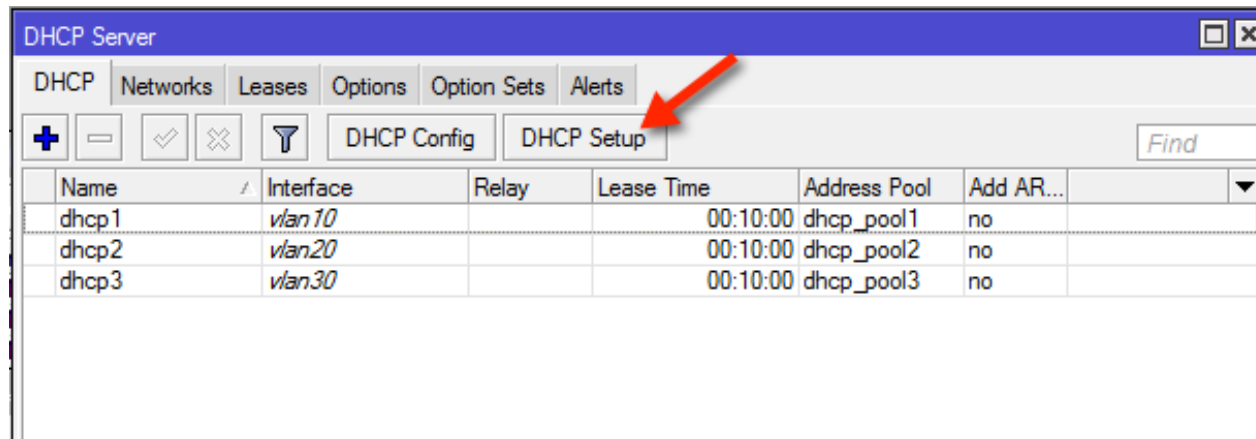
Example 2

Inter VLAN Routing

Router Config

Step 3

- And add DHCP Servers to each VLAN interface using the setup button and accept the defaults



DHCP Server							
DHCP Networks Leases Options Option Sets Alerts							
+ - ✓ ✕ ⚙ Find							
DHCP Config DHCP Setup							
Name	Interface	Relay	Lease Time	Address Pool	Add AR...		
dhcp1	vlan10		00:10:00	dhcp_pool1	no		
dhcp2	vlan20		00:10:00	dhcp_pool2	no		
dhcp3	vlan30		00:10:00	dhcp_pool3	no		

IP → DHCP-Server

Example 2

Inter VLAN Routing

Switch Config

Step 1

- Create a switch port group, ether24 is master, ether1-ether9 are slaves to port 24 using our script “Set Ports”
- 1 switch port group

Interfaces

The screenshot shows the Mikrotik WinBox interface. The top window is the 'Interface List' with tabs for Interface, Ethernet, EoIP Tunnel, IP Tunnel, GRE Tunnel, VLAN, VRRP, Bonding, and LTE. The 'Interface' tab is active, showing a table of interfaces. A red box highlights the first ten interfaces: ether1 through ether10. Below this, the 'Interface <ether1>' configuration window is open, showing the 'General' tab. The 'Name' field is 'ether1', 'Type' is 'Ethernet', 'MTU' is '1500', 'L2 MTU' is '1588', 'Max L2 MTU' is '9204', 'MAC Address' is '4C:5E:0C:0C:90:A5', and 'ARP' is 'enabled'. A red arrow points to the 'Master Port' field, which is set to 'ether24-trunk'. Other fields include 'Bandwidth (Rx/Tx)' set to 'unlimited' and 'Switch' set to 'switch1'. On the right side of the configuration window, there are buttons for OK, Cancel, Apply, Disable, Comment, Torch, Cable Test, Blink, Reset MAC Address, and Reset Counters.

Interface	Type	L2 MTU	Tx	Rx
ether1	Ethernet	1588	0 bps	0 bps
ether2	Ethernet	1588	0 bps	0 bps
ether3	Ethernet	1588	0 bps	0 bps
ether4	Ethernet	1588	0 bps	0 bps
ether5	Ethernet	1588	0 bps	0 bps
ether6	Ethernet	1588	0 bps	0 bps
ether7	Ethernet	1588	0 bps	0 bps
ether8	Ethernet	1588	0 bps	0 bps
ether9	Ethernet	1588	0 bps	0 bps
ether10	Ethernet	1588	0 bps	0 bps

Interface <ether1>

General Ethernet Overall Stats Rx Stats Tx Stats Status ...

Name: ether1

Type: Ethernet

MTU: 1500

L2 MTU: 1588

Max L2 MTU: 9204

MAC Address: 4C:5E:0C:0C:90:A5

ARP: enabled

Master Port: ether24-trunk

Bandwidth (Rx/Tx): unlimited / unlimited

Switch: switch1

OK Cancel Apply Disable Comment Torch Cable Test Blink Reset MAC Address Reset Counters

Example 2

Inter VLAN Routing

Switch Config

Step 2

- Set access ports for each VLAN

Switch → VLAN →
In-VLAN-Tran

The screenshot displays the Mikrotik RouterOS configuration interface for VLANs. The main window shows a table of VLANs with columns for Ports, Protocol, Service VLAN, and Service VID. Below this, three 'Ingress VLAN Translation' windows are open, each corresponding to a different VLAN. Each window has a 'Ports' field with a list of ports (ether1, ether2, ether3 for VLAN 10; ether4, ether5, ether6 for VLAN 20; ether7, ether8, ether9 for VLAN 30) and a 'New Customer VID' field. Red boxes highlight the 'Ports' and 'New Customer VID' fields in each window. Red arrows point from the 'New Customer VID' field in the first window to the 'New Customer VID' field in the second window, and from the second to the third.

VLAN	Eg. VLAN Tag	In. VLAN Tran.	Eg. VLAN Tran.	1:1 VLAN Switching	MAC Based VLAN	Protocol Based VLAN
10	any	any	any	any	any	any
20	any	any	any	any	any	any
30	any	any	any	any	any	any
4095	any	any	any	any	any	any

Ingress VLAN Translation for VLAN 10: Ports: ether1, ether2, ether3; New Customer VID: 10

Ingress VLAN Translation for VLAN 20: Ports: ether4, ether5, ether6; New Customer VID: 20

Ingress VLAN Translation for VLAN 30: Ports: ether7, ether8, ether9; New Customer VID: 30

Example 2

Inter VLAN Routing

Switch Config

Step 3

- Set the trunk port, ether24

Switch VLAN

VLAN	Eg. VLAN Tag	In. VLAN Tran.	Eg. VLAN Tran.	1:1 VLAN Switching	MAC Based VLAN	Protocol Based VLAN
+	-	✓	✗	⌵		
Find						
VLAN ID	Tagged Ports					
10	ether24-trunk					
20	ether24-trunk					
30	ether24-trunk					
D	4095					

Switch Egress Tag VLAN <10>

VLAN ID: 10

Tagged Ports: ether24-trunk

OK Cancel Apply Disable Copy Remove

enabled

Switch Egress Tag VLAN <20>

VLAN ID: 20

Tagged Ports: ether24-trunk

OK Cancel Apply Disable Copy Remove

enabled

Switch Egress Tag VLAN <30>

VLAN ID: 30

Tagged Ports: ether24-trunk

OK Cancel Apply Disable Copy Remove

enabled

Switch → VLAN → Eg-VLAN-Tag

Example 2

Inter VLAN Routing

Switch Config

Step 4

- Add VLAN membership definitions in the VLAN table

That's it!

The screenshot displays the Mikrotik RouterOS configuration interface for VLANs. At the top, the 'Switch VLAN' window shows a table of VLANs. Below this, three sub-windows provide detailed configuration for VLANs 10, 20, and 30. Red boxes and arrows highlight the 'Ports' field in each sub-window, indicating where to add the member ports.

VLAN ID	Ports	SVL	SA Leami...	Flood	Ingress M...
10	ether1, ether2, ether3	no	yes	no	no
20	ether4, ether5, ether6	no	yes	no	no
30	ether7, ether8, ether9	no	yes	no	no
4095	switch1-cpu, ether10, ether11, ...	no	no	no	no

Switch VLAN <10>
VLAN ID: 10
Ports: ether1, ether2, ether3
SA Leaming: ☒
QoS Group: none

Switch VLAN <20>
VLAN ID: 20
Ports: ether4, ether5, ether6
SA Leaming: ☒
QoS Group: none

Switch VLAN <30>
VLAN ID: 30
Ports: ether7, ether8, ether9
SA Leaming: ☒
QoS Group: none

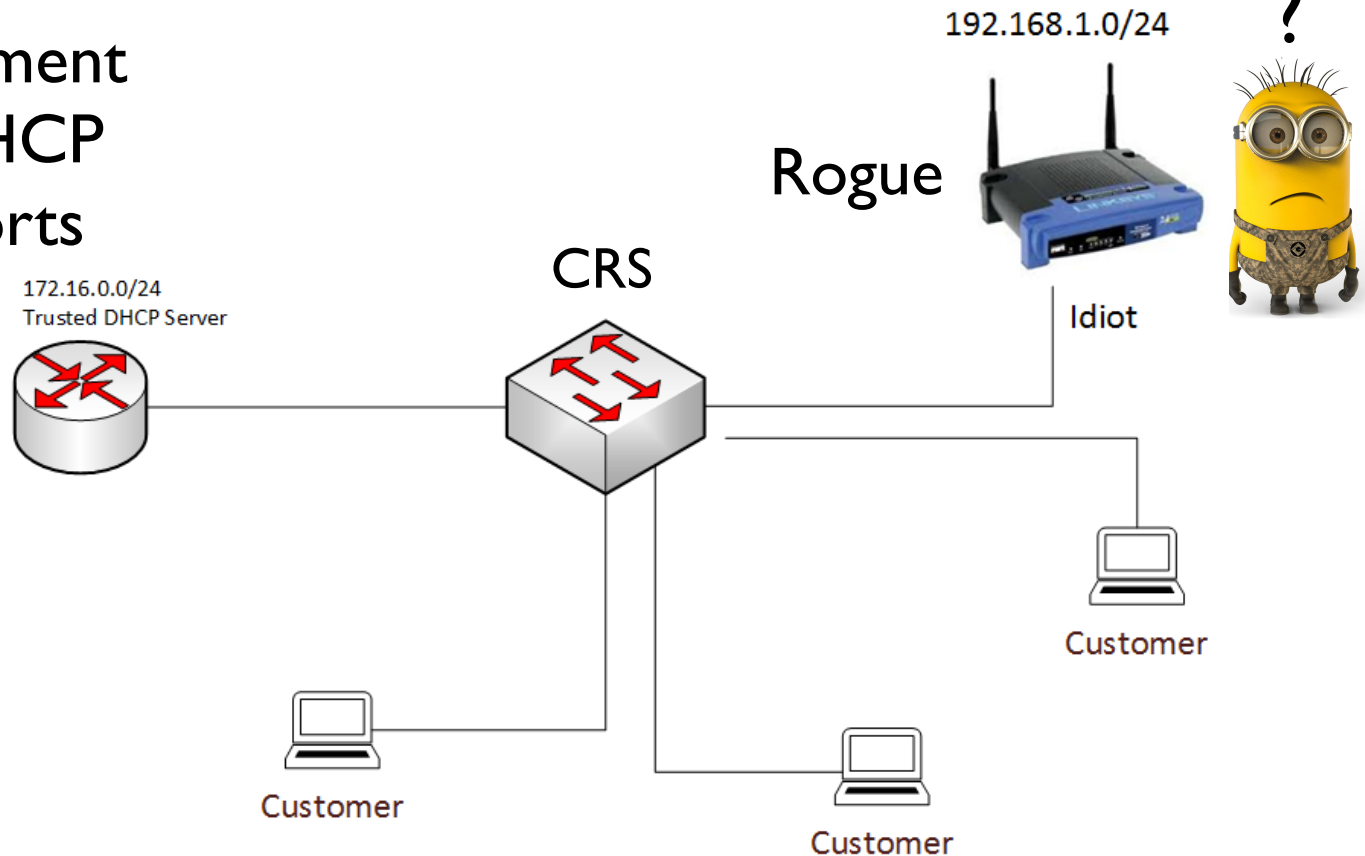
Switch → VLAN → VLAN

Example 3

Example 3

Configure Rogue DHCP Prevention (port level isolation)

Example: MDU, apartment complex, etc., one DHCP server, 9 customer ports



Configure Rogue DHCP Prevention

Step 1

- Create a switch port group, ether24 is master, ether1-ether9 are slaves to port 24 using our script “Set Ports”

Interfaces

The screenshot shows two windows from the Mikrotik RouterOS configuration interface. The top window, titled 'Interface List', displays a table of interfaces. A red box highlights the first ten interfaces, ether1 through ether10, which are all of type 'Ethernet' and have an L2 MTU of 1588. The bottom window, titled 'Interface <ether1>', shows the configuration for the 'ether1' interface. A red arrow points to the 'Master Port' field, which is set to 'ether24-trunk'. Other configuration details include Name: ether1, Type: Ethernet, MTU: 1500, L2 MTU: 1588, Max L2 MTU: 9204, MAC Address: 4C:5E:0C:0C:90:A5, ARP: enabled, Bandwidth (Rx/Tx): unlimited / unlimited, and Switch: switch1.

Interface	Name	Type	L2 MTU	Tx	Rx
S	ether1	Ethernet	1588	0 bps	0 bps
S	ether2	Ethernet	1588	0 bps	0 bps
S	ether3	Ethernet	1588	0 bps	0 bps
S	ether4	Ethernet	1588	0 bps	0 bps
S	ether5	Ethernet	1588	0 bps	0 bps
S	ether6	Ethernet	1588	0 bps	0 bps
S	ether7	Ethernet	1588	0 bps	0 bps
S	ether8	Ethernet	1588	0 bps	0 bps
S	ether9	Ethernet	1588	0 bps	0 bps
S	ether10	Ethernet	1588	0 bps	0 bps

Interface <ether1>

General | Ethernet | Overall Stats | Rx Stats | Tx Stats | Status | ...

Name: ether1

Type: Ethernet

MTU: 1500

L2 MTU: 1588

Max L2 MTU: 9204

MAC Address: 4C:5E:0C:0C:90:A5

ARP: enabled

Master Port: ether24-trunk

Bandwidth (Rx/Tx): unlimited / unlimited

Switch: switch1

OK
Cancel
Apply
Disable
Comment
Torch
Cable Test
Blink
Reset MAC Address
Reset Counters

Configure Rogue DHCP Prevention

Step 2

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

Switch → Ports

The screenshot shows the 'Switch Ports' configuration window in MikroTik WinBox. The 'Ports' tab is selected, showing a list of ports. A red box highlights the 'Isolation Profile' column, which contains values from 2 to 30. A red arrow points from the 'ether22' row to the 'Isolation Profile Override' field in the 'Switch Port <ether1>' configuration window, which is set to 2.

Name	VLAN Type	Isolation Profile	Isolation Profile O...	MAC...	Egress VLAN Mode
ether1	network port	9	2	o	unmodified
ether2	network port	9	2	o	unmodified
ether3	network port	9	2	o	unmodified
ether4	network port	9	2	o	unmodified
ether5	network port	9	2	o	unmodified
ether6	network port	9	2	o	unmodified
ether7	network port	9	2	o	unmodified
ether8	network port	9	2	o	unmodified
ether9	network port	9	2	o	unmodified
ether10	network port	9	2	o	unmodified
ether11	network port	30	no	no	unmodified
ether12	netw				
ether13	netw				
ether14	netw				
ether15	netw				
ether16	netw				
ether17	netw				
ether18	netw				
ether19	netw				
ether20	netw				
ether21	netw				
ether22	netw				
ether23	netw				
ether24-trunk	netw				
sfp-sfpplus1	netw				
sfpplus2	netw				
switch1-cpu	netw				

Switch Port <ether1>

Generic Ingress VLAN Egress VLAN Mirroring QoS Queues TPIDs Counters

Name: ether1

VLAN Type: network port

Isolation Profile: 29

Isolation Profile Override: 2

☒ Leaming

Leaming Override:

Leaming Limit:

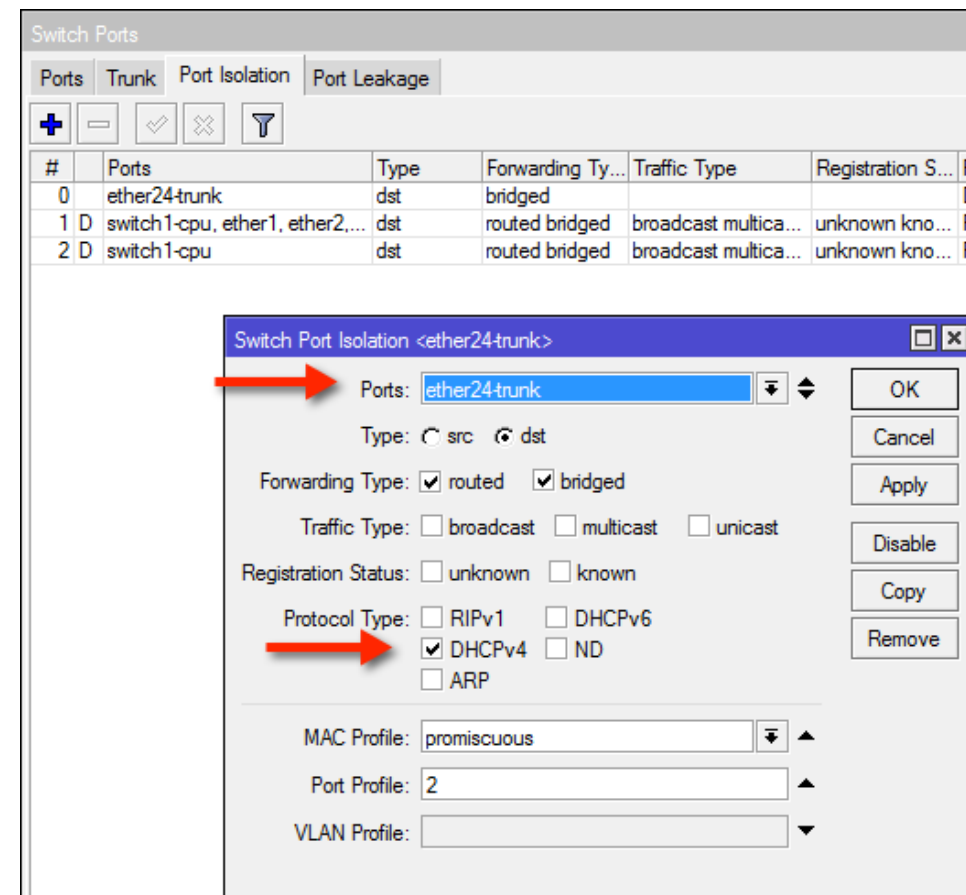
Example 3

Configure Rogue DHCP Prevention

Step 3

- Tell the switch which port is trusted for DHCP server
- Define your profile to match DHCP protocol traffic only, straight from the wiki.

Switch → Port Isolation



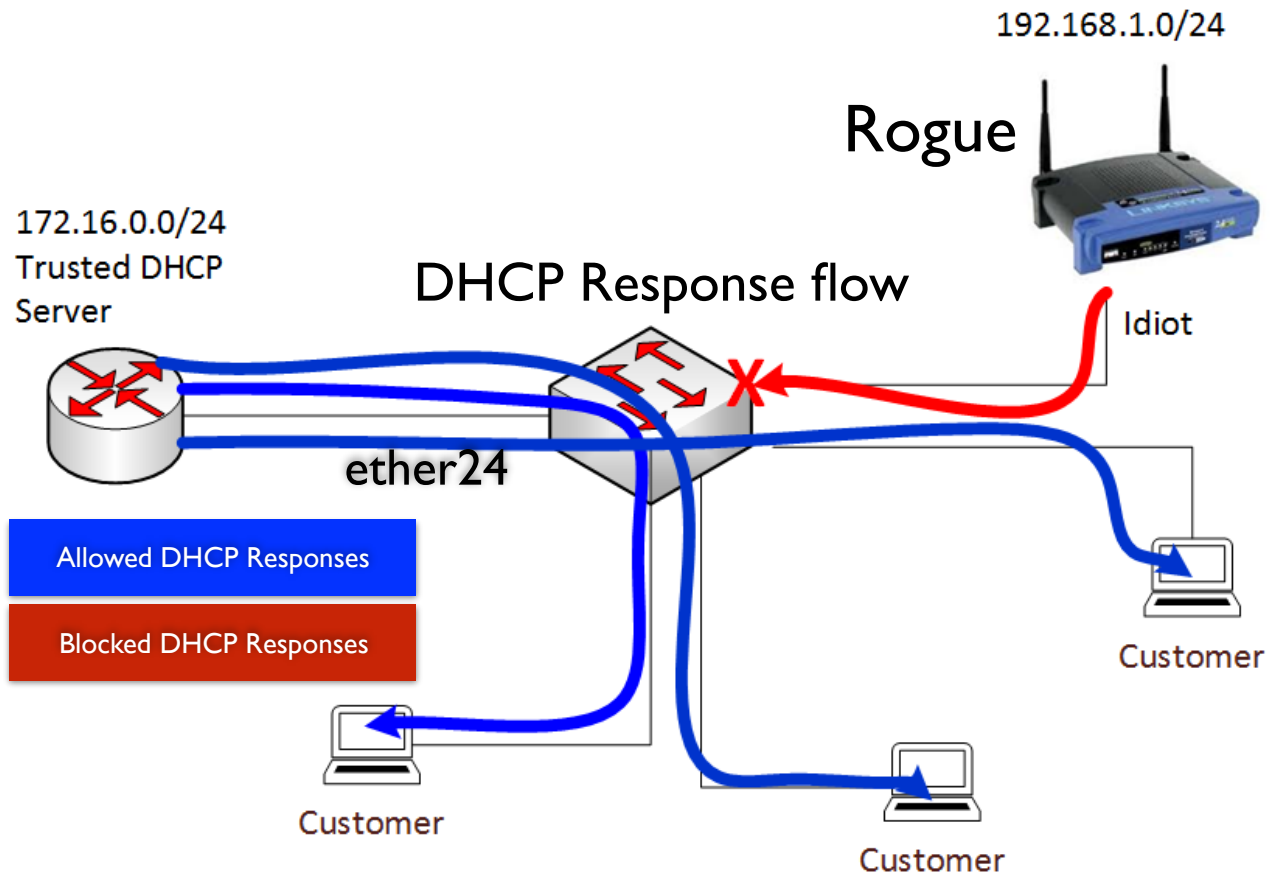
Example 3

Configure Rogue DHCP Prevention

Result: Customers will not see DHCP server responses unless they come from port 24.

All other traffic is allowed.

That's it!



Other Ideas With CRS

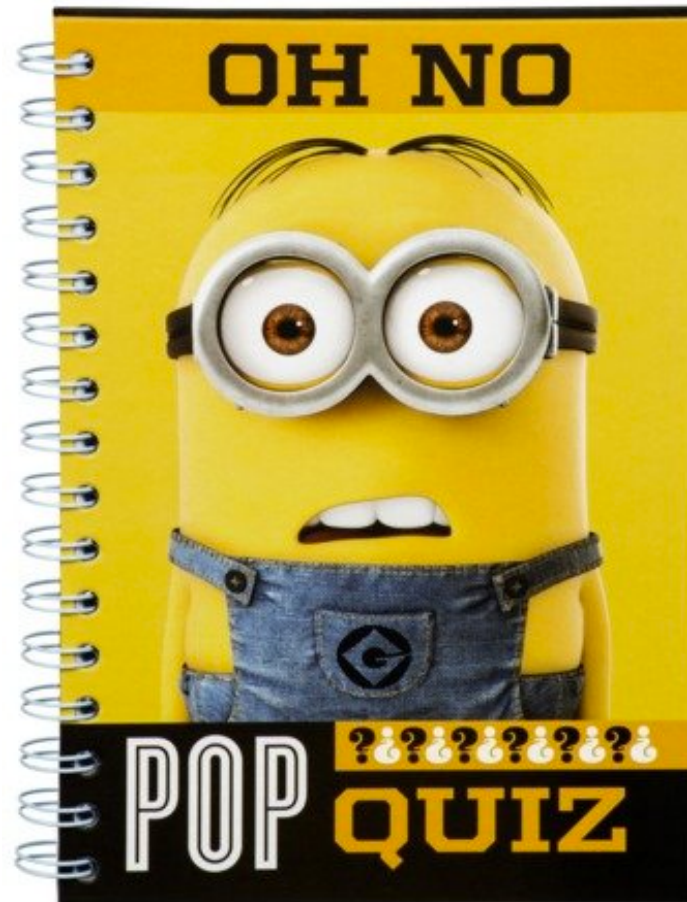
- **MAC based VLAN.** Tag packets as they enter a port based on MAC matcher

Example: All Grandstream phones tag as VLAN 100 based on MAC address pattern matcher

- **Port based bandwidth limiting.** Ensures virus infected hosts do not saturate uplinks.
- **Port based storm control.** Prevent disruptions on Layer 2 ports caused by broadcast, multicast or unicast traffic storms.
- Many other examples at http://wiki.mikrotik.com/wiki/Manual:CRS_examples

Summary

- Stop bridging when you have switching capabilities.
- Don't be overwhelmed by all the features, pick the two or three setups you actually need and learn them.
- Make your networks more efficient by utilizing VLANs and other advanced CRS features



Pop Quiz

- True or **false** - CRS supports various frame sizes up to but not including jumbo frames?
- What is the maximum number of VLANs supported by the CRS? **4000**
- Which is done in software, switching or bridging? **Bridging**
- **True** or false - To configure port level isolation for rogue DHCP server control, we use the Port Isolation feature?
- True or **false** - To configure a basic switch on the CRS using the switch chip, create a bridge interface and add ports to it.

Questions?

MikroTik Maze Winners

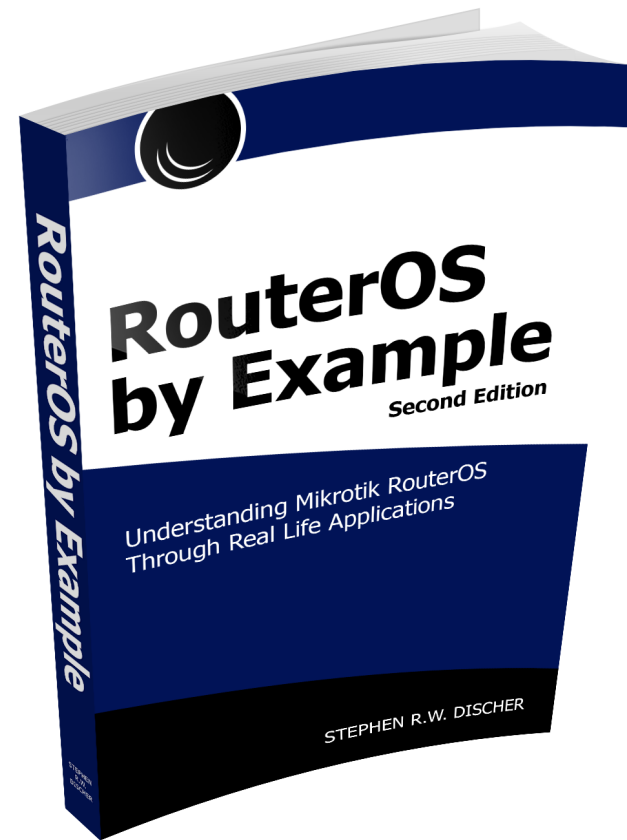
<http://learnmikrotik.com/mazerunner/game.php>

Top 5 Prizes

Come Get a Shirt!

Second Edition

- Updated everything to version 6
- Expanded the examples
- Added significant content for CRS switches
- Currently in edit, shipping beginning of summer 2016
Amazon and ISPSupplies.com



Thank you for playing!

- Try our MikroTik Maze at ISP Supplies table
- Training: MyVWISPTraining.com & LearnMikroTik.com
- Store: ISPSupplies.com
- Blog: SteveDischer.com
- “RouterOS by Example” available from ISP Supplies, Amazon, 2nd Edition early summer
- Configurator: MikroTikConfig.com

