Best Practice - How to Operate VLANs on an Ethernet Bond with Virtual Routers

https://campus.barracuda.com/doc/32624/

This article describes the usage of virtual routers working with ethernet bonds (ethernet bundles) on a VLAN.

The purpose of this article is to exemplify how to build a configuration that facilitates sending traffic over a VLAN which is handled by virtual routers and which is channeled over a bond interface on the CGF. This article also considers a switch that is connected to the CGF via the bond and that forwards the traffic to clients on a LAN.

The article is intended to help understand the underlying concept and to be a supportive example to create a similar setup of any higher complexity.

Before You Begin

- You should be familiar with the concept of virtual routers. For more information on virtual routing and forwarding, see Virtual Routing and Forwarding (VRF).
- The network setup described in this article also refers to a switch that must be connected to the CGF. Ensure that your switch supports the configuration of ethernet bonds with an **Active-Backup** setup.

Scenario

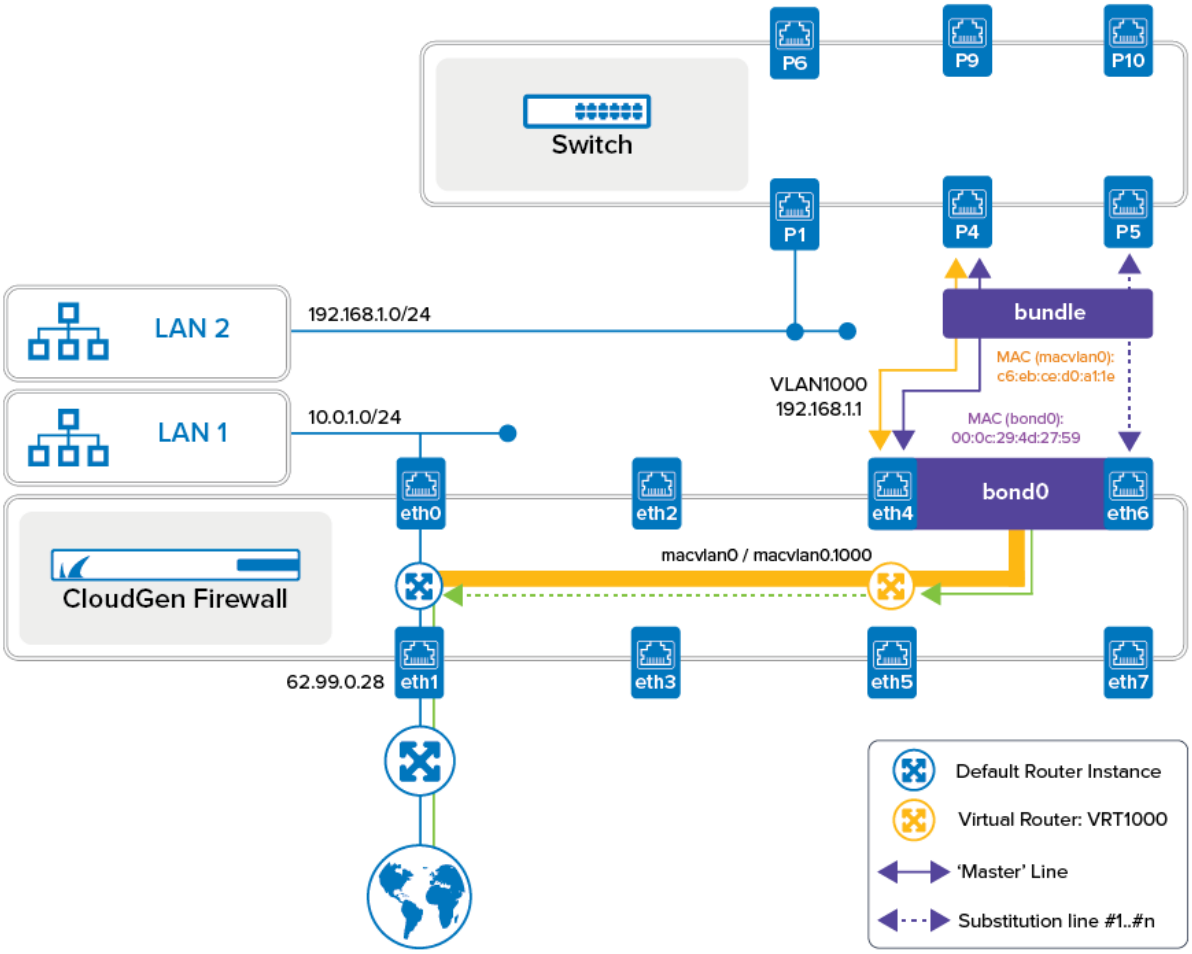
The Management Interface and LAN1

The CGF is connected to the local network LAN1. The management IP address is configured on the interface `eth0`. The traffic from LAN1 is forwarded to the WAN by the CGF's default router.

The Ethernet Bundle and LAN2

In the image below, port P1 and LAN2 are symbolical placeholders for any given number of clients connected to the switch on the network LAN2.

The bond on the CGF uses interface ports `eth4` and `eth6` and is connected to ports P4 and P5 on the switch. To work correctly, the switch is configured in the same way as the CGF, and both appliances run an ethernet bond as an **Active-Backup** setup.



In such a setup, a new virtual interface is created, and during the configuration, you must assign an identifier to this virtual interface by selecting from a list of 16 entries, ranging from `bond0` to `bond15`. The bundle consists of multiple wired ethernet connections (i.e., `eth4` and `eth6`) which are handled by a special driver that controls the flow of information over those lines.

In the active-backup setup, the first configured line that actively transmits information (i.e., `eth4`) is in all technical operating system manuals referenced as the 'master' line. If this line fails, the underlying driver immediately switches to the next configured line to substitute the previous one until its connection becomes reestablished. This failure-switching continues until the last configured line in the bundle becomes activated. The switching process in the reverse direction keeps going until the 'master' line becomes active again.

On the level of MAC addresses, the corresponding driver replaces the different generic MAC addresses of all bundled interfaces with a common, identical MAC address. To technically address and access the bundle, it inherits the MAC address from the first configured ethernet MAC interface in the bundle.

The following table shows the configuration of the MAC addresses for multiple connection lines as part of a common bundle interface (`bond0`) in an active-backup setup.

Interface	Usage	MAC Address	Note
eth0	Standard	00:0c:29:4d:27:6d	MIP on LAN1
eth1	Standard	00:0c:29:4d:27:95	WAN
....			
eth4	bond0	00:0c:29:4d:27:**59**	Master line of bond0
eth6	bond0	00:0c:29:4d:27:**59**	Substitution line (#1) for eth4
....	bond0	00:0c:29:4d:27:**59**	Optional: substitution line (#2) for eth6
ethX	Standard	00:0c:29:4d:27:xx	

As a consequence, the connected switch doesn't need to learn a new MAC address during a failover, thus ensuring that traffic is always forwarded transparently between the CGF and the switch and providing a minimal switch-over time and optimal continued throughput.

Using VLANs on Bond in Virtual Routers

In addition to the requirements above, the traffic from LAN2 over the bond must be transmitted over a VLAN. To achieve this, the CGF provides the MACVLAN option in the **Advanced View** mode of Firewall Admin that facilitates using VLANs to be used in virtual routers on top of a bond interface. When such a MACVLAN interface is created, a new MAC address will be configured for it to work as a wrapper for the underlying bond interface. The MAC address of the underlying bond interface can from then on no longer be accessed directly.

After creating the required virtual router, a shared IP address can be configured and assigned to the new MACVLAN interface. Due to the MACVLAN option, the VLAN can now be handled by virtual routers, and traffic can also be forwarded between the default router and any additional configured virtual router.

In this example, the virtual router VRT1000 hands over traffic from LAN2 to the default router which in turn forwards the traffic to the WAN.

The thick orange line in the figure above indicates that VLAN1000 is configured on the `macvlan0` interface with the IP address `192.168.1.1`, and that the `macvlan0` and `macvlan0.1000` interfaces on top of the `bond0` interface can be handled by any configured virtual router, i.e., `VRT1000`.

The thin orange line indicates that traffic through the VLAN1000 interface is transmitted on top of the active line (i.e., `eth4`) of the `bond0` interface. In case of a failover, this line will be switched to the next configured bond interface (i.e., `eth6`).

Allowing Traffic to Be Forwarded Between Multiple Router Instances

Finally, to enable traffic flow between the default and any additional virtual router, an appropriate access rule must be created.

How to Configure the CGF to Operate VLANs on an Ethernet Bond with Virtual Routers (VRFs)

The configuration of the CGF for the described scenario will cause multiple changes that can be tracked optimally in the table at **CONTROL > Network**, tab **Interface**.

Initially, the interface table looks like this:

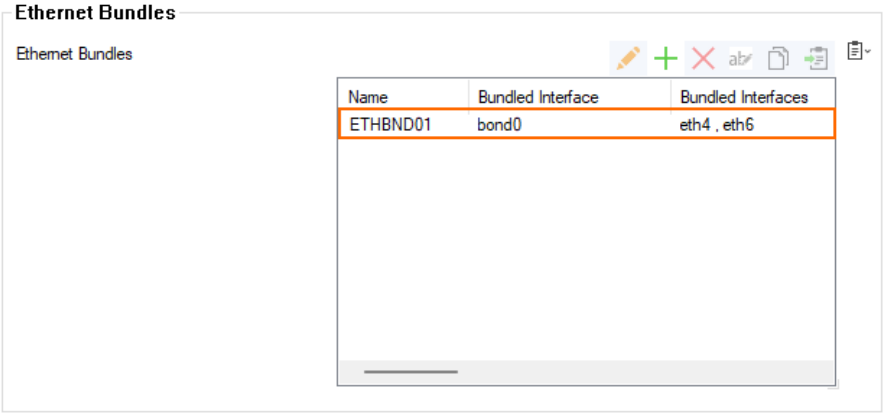
Interface	Provider Name	MAC	Link	Speed	Duplex
eth0		00:0c:29:4d:27:6d	UP	10000Mb/s	Full
eth1		00:0c:29:4d:27:95	DOWN		
eth2		00:0c:29:4d:27:4f	DOWN		
eth3		00:0c:29:4d:27:77	DOWN		
eth4		00:0c:29:4d:27:59	DOWN		
eth5		00:0c:29:4d:27:81	DOWN		
eth6		00:0c:29:4d:27:63	DOWN		
eth7		00:0c:29:4d:27:8b	DOWN		
lo		00:00:00:00:00:00	UP		

Step 1. Create the Ethernet Bundle 'bond0'

The ethernet bundle must be created from `eth4` and `eth6` and will be named `bond0`.

1. Log into your firewall.
2. Go to **CONFIGURATION > Configuration Tree > Box > Network > Ethernet Bundles**.
3. Click **Lock**.
4. Click the green '**+**' on top of the **Ethernet Bundles Configuration** table.
5. The **Ethernet Bundles** dialog window is displayed.
6. Enter the name of the bundle. E.g., `ETHBNDL01`
7. The **Ethernet Bundles : ETHBND01** window is displayed.
8. The field **Bundled Interface** is initially preset with the identifier `bond0` unless another bundle is already present.
9. Click the green '**+**' to add the first bundle interface `eth4`.
10. Double-click `eth4` in the menu list.
11. The interface is added to the table.
12. Double-click `eth6` in the menu list.

13. The interface is added to the table.
14. Click **OK**.



15. Click **Send Changes**.
16. The window **Boxnet Activation required** is displayed.
17. Click **OK**.
18. Click **Activate**.
19. The **Activate Changes** window is displayed.
20. Click **Activate**.
21. Go to **CONTROL > Box**.
22. Expand the **Network** entry in the left menu area.
23. Click **Activate new network configuration**.
24. The **Network Activation** window is displayed.
25. Click the **Activate now** button.

Step 1a. Configure the Same Bond on Your Switch

Configure your switch to use 2 ports as an ethernet bond to operate in **Active-Backup** mode and connect the CGF to the switch with 2 ethernet cables. Ensure that the corresponding ports (`master` and `substitution`) are connected suitably.

> If you are running a bond with more than one substitution line, ensure to link the corresponding substitution lines (#1-#1, #2-#2).

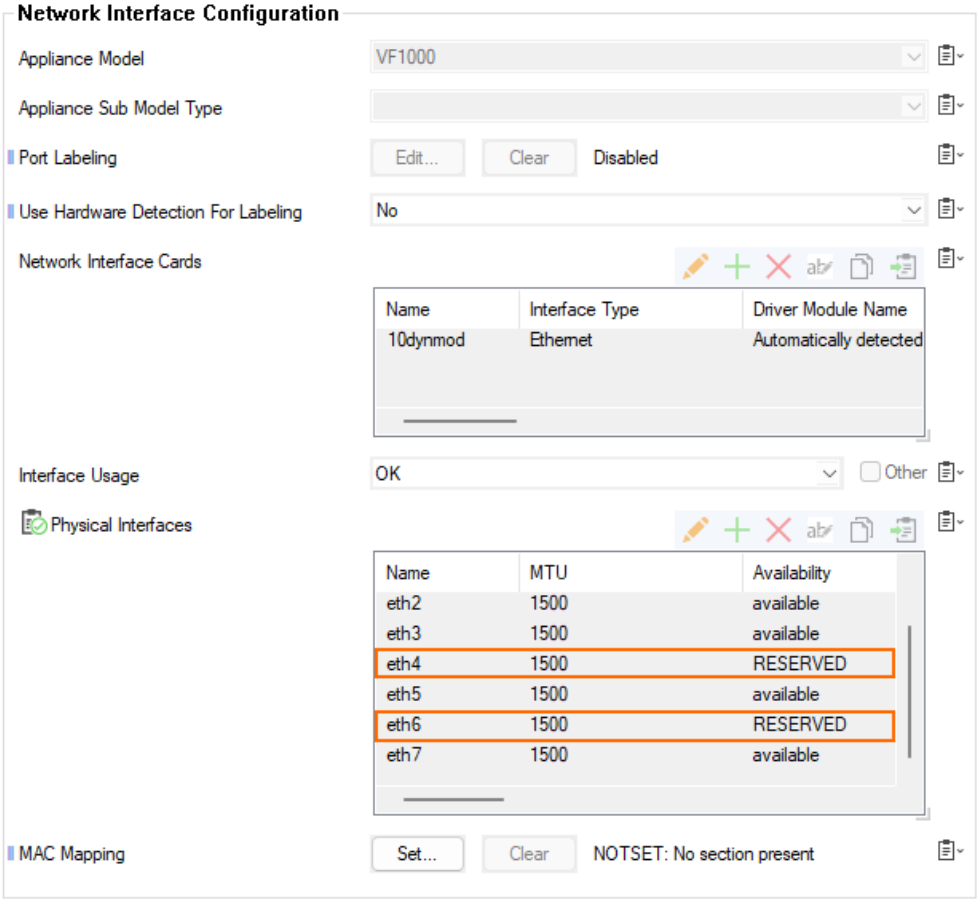
Step 2. Check that the Bundle Interface has been Created

1. Go to **CONTROL > Network**.
2. The newly created bundle interface `bond0` is displayed in the list.
3. Note that the MAC address of the first configured interface `eth4` has been assigned to the bundle `bond0` and to all contained additional interfaces, i.e. `eth6`.

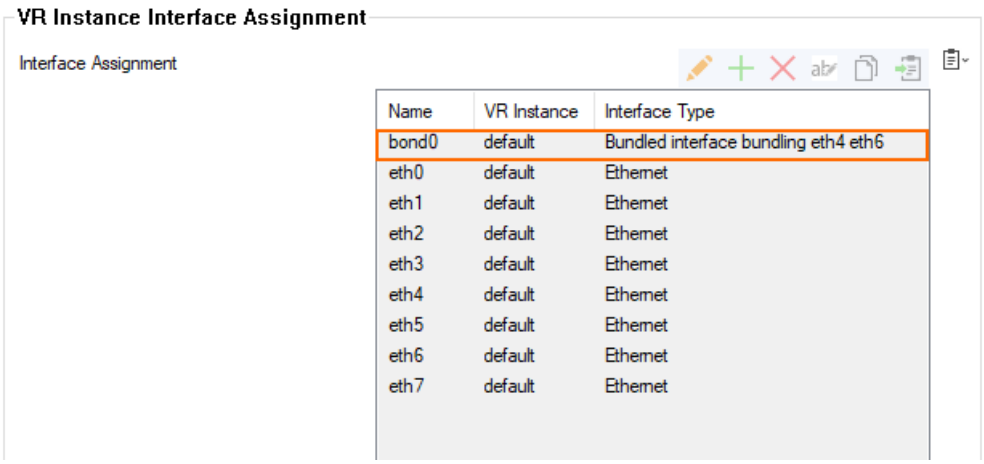
Interface	Provider Name	MAC	Link	Speed	Duplex
bond0		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth0		00:0c:29:4d:27:6d	UP	10000Mb/s	Full
eth1		00:0c:29:4d:27:95	DOWN		
eth2		00:0c:29:4d:27:4f	DOWN		
eth3		00:0c:29:4d:27:77	DOWN		
eth4		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth5		00:0c:29:4d:27:81	DOWN		
eth6		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth7		00:0c:29:4d:27:8b	DOWN		
lo		00:00:00:00:00:00	UP		

The driver for handling the ethernet bundle now manages all contained interfaces transparently. If `eth4` fails, traffic will immediately be transmitted through `eth6`.

4. Go to **CONFIGURATION > Network > Interfaces**.
5. Note that in the section **Physical Interfaces**, the interfaces `eth4` and `eth6` now report their availability status as **RESERVED**.



6. Go to **CONFIGURATION > Network > Virtual Router**.
7. Note that the bundle interface `bond0` has been added at the beginning of the table for **VR InstanceInterface Assignment**.



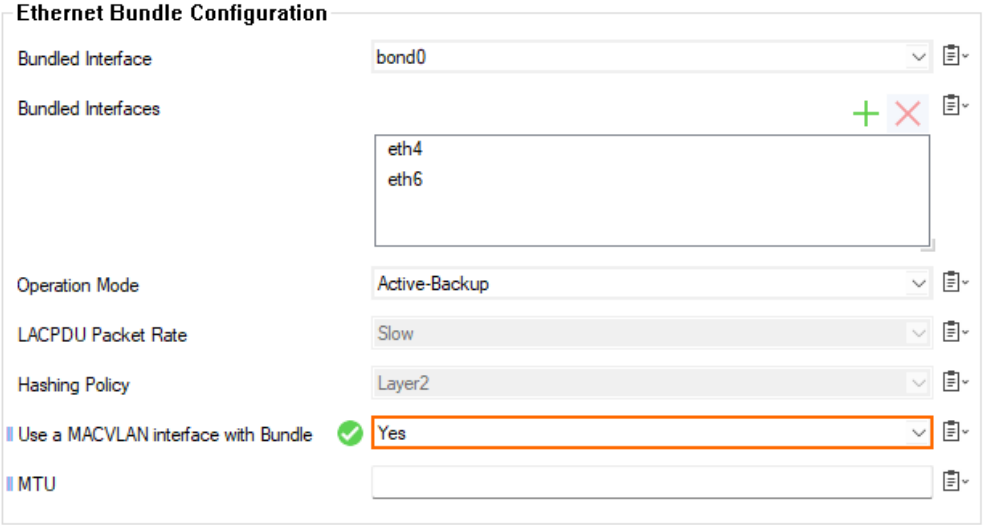
8. It is now possible to also create VLANs on top of the bundle if required. However, note at this stage that VLAN traffic on a bundle can only be transmitted through the default router.

Step 3. Enable Transferring Traffic through Virtual Routers

Because only the default router can forward traffic through VLANs on top of a bundle interface, it is necessary to introduce a new virtual interface on top of the bundle which then facilitates also virtual routers to handle VLAN traffic on a bond.

To enable virtual routers to do so, perform the following steps:

1. Go to **CONFIGURATION > Network > Ethernet Bundles**.
2. Ensure that you have selected **Advanced Configuration** mode in the left menu area.
3. Click **Lock**.
4. Double-click the entry of your ethernet bundle.
5. The **Ethernet Bundles : ETHBND01** window is displayed.
6. For **Use a MACVLAN interface with Bundle**, select **Yes**.



7. Click **OK**.
8. Click **Send Changes**.
9. The window **Boxnet Activation required** is displayed.

10. Click **OK**.
11. Click **Activate**.
12. The **Activate Changes** window is displayed.
13. Go to **CONTROL > Box**.
14. Expand the **Network** entry in the left menu area.
15. Click **Activate new network configuration**.
16. The **Network Activation** window is displayed.
17. Click the **Activate now** button.

Step 4. Check that the MACVLAN Interface has been Created

Creating a virtual MACVLAN interface on top of the bundle interface facilitates virtual routers to handle traffic between source and destination interfaces and also allows forwarding traffic between different virtual routers and/or the default router on the CGF. Thus, traffic can be received from a source by a virtual router and can be sent to the destination by another virtual or by the default router.

To check the new virtual interface in the interface table, perform the following steps:

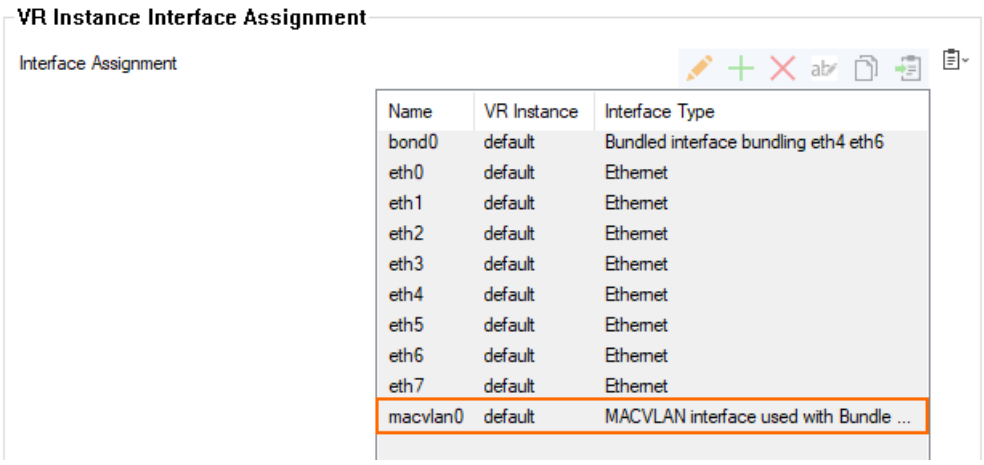
1. Go to **CONTROL > Network**.
2. The newly created virtual interface `macvlan0` is displayed in the list.
3. Note that the `macvlan0` interface now uses a different virtual MAC address like the underlying `bond0` interface!

Interface	Provider Name	MAC	Link	Speed	Duplex
bond0		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth0		00:0c:29:4d:27:6d	UP	10000Mb/s	Full
eth1		00:0c:29:4d:27:95	DOWN		
eth2		00:0c:29:4d:27:4f	DOWN		
eth3		00:0c:29:4d:27:77	DOWN		
eth4		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth5		00:0c:29:4d:27:81	DOWN		
eth6		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth7		00:0c:29:4d:27:8b	DOWN		
lo		00:00:00:00:00:00	UP		
macvlan0		c6:eb:ce:d0:a1:1e	UP	10000Mb/s	Full

   The underlying driver still handles failovers on the bond, however, the `bond0` MAC address (i.e., `00:0c:29:4d:27:59`) is now overridden by the new `macvlan0` MAC address (i.e., `c6:eb:ce:d0:a1:1e`).

   > Once the `macvlan0` MAC is established, you no longer can modify the `bond0` interface. Be aware that if you want to change the bundle later, you must completely remove the `macvlan0` interface and all VLANs on top of it!

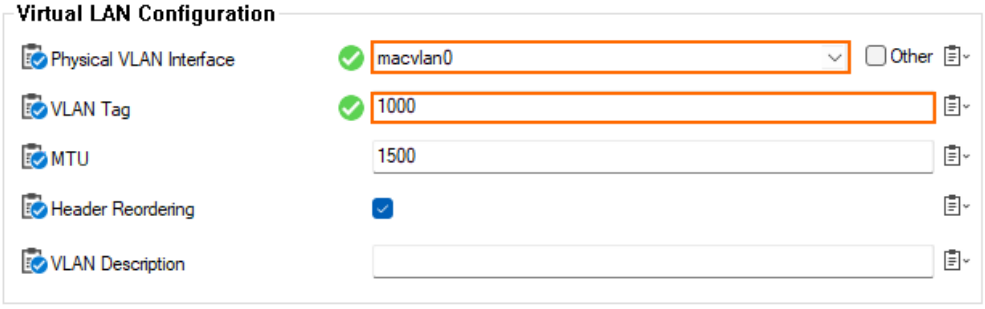
4. Go to **CONFIGURATION > Network > Virtual Router**.
5. Note that the bundle interface `macvlan0` has been added at the beginning of the table for **VR InstanceInterface Assignment**.



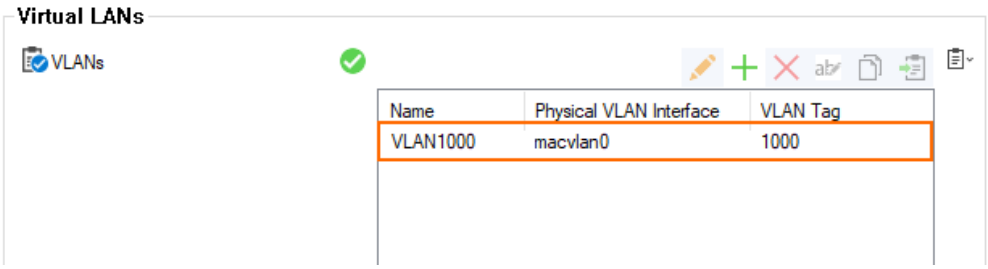
Step 5. Create a VLAN on top of MACVLAN0

After creating the MACVLAN virtual interface that can be handled by virtual routers, you can now configure your individual VLAN with the ID 1000 on top of the `macvlan0` interface.

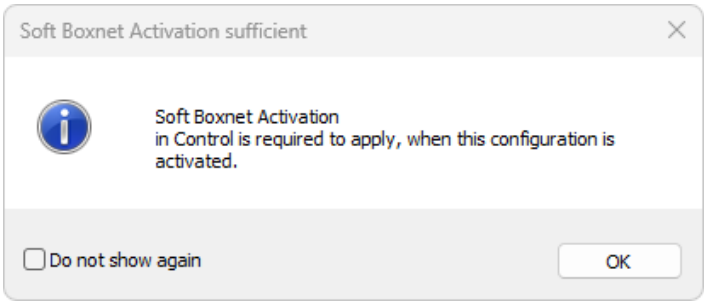
1. Go to **CONFIGURATION > Network > Virtual LANs**.
2. Click **Lock**.
3. Click the green '**+**' on top of the **Virtual LANs** table.
4. The **VLANs** window is displayed.
5. Enter the name for the VLAN, i.e. VLAN1000.
6. Click **OK...** .
7. The **VLANS : VLAN1000** window is displayed.
8. For **Physical VLAN Interface,** select `macvlan0` from the list.
9. For **VLAN Tag**, enter 1000.



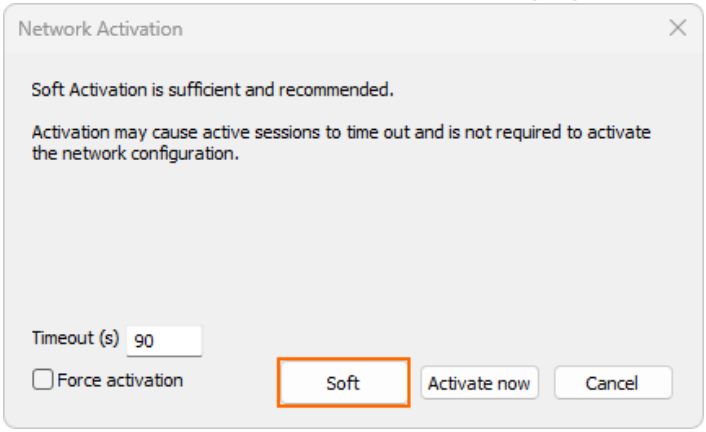
10. Click **OK**.
11. The table in the **Virtual LANs** section now contains the new VLAN1000 entry.



12. Click **Send Changes**.
13. Click **Activate**.
14. The **Soft Boxnet Activation sufficient** window is displayed.



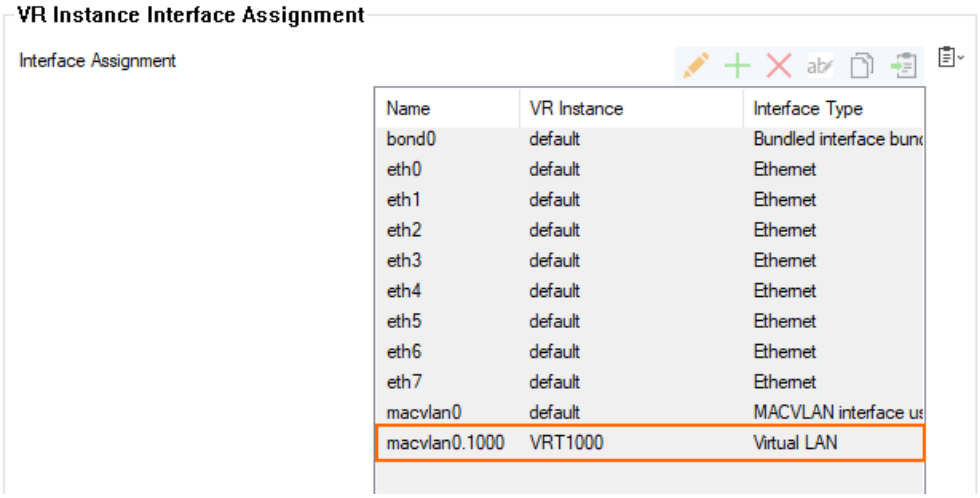
15. Click **OK**.
16. Click **Activate**.
17. The **Activate Changes** window is displayed.
18. Click **Activate**.
19. Go to **CONTROL > Box**.
20. Expand the **Network** entry in the left menu area.
21. Click **Activate new network configuration**.
22. The **Network Activation** window is displayed.
23. Click the **Activate now** button.
24. The **Network Activation** window is displayed.



25. Click the **Soft** button.

Step 6. Check the Configuration of the New MACVLAN0 Interface

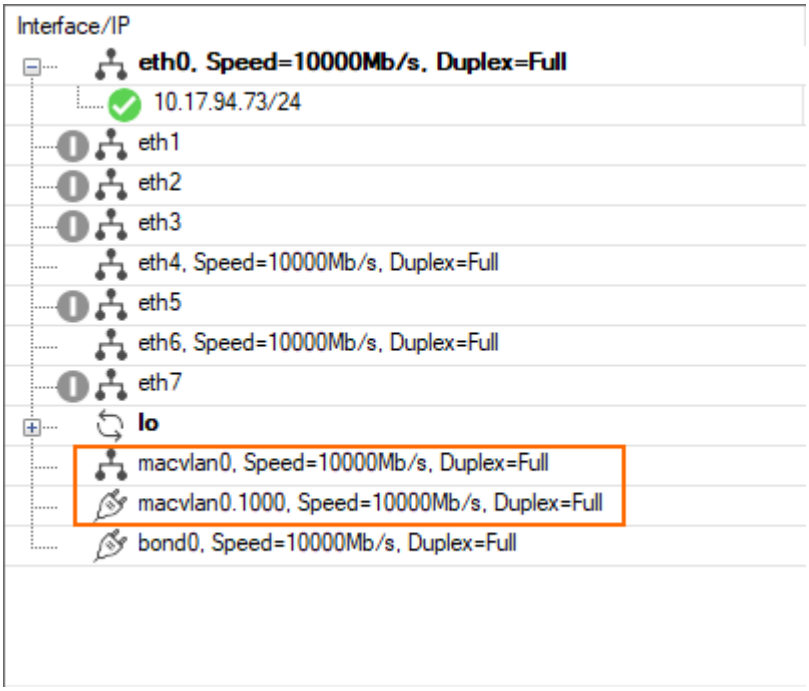
1. Go to **CONFIGURATION > Network > Virtual Router**.
2. Note that the bundle interface `macvlan0` has been added at the beginning of the table for **VR InstanceInterface Assignment**.



3. Go to **CONTROL > Network**.
4. The newly created virtual interface `macvlan0` is displayed in the list.
5. Note that the `macvlan0.1000` interface now uses the same virtual MAC address as the `bond0` interface, but the same virtual MAC address as the `macvlan0` interface.

Interface	Provider Name	MAC	Link	Speed	Duplex
bond0		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth0		00:0c:29:4d:27:6d	UP	10000Mb/s	Full
eth1		00:0c:29:4d:27:95	DOWN		
eth2		00:0c:29:4d:27:4f	DOWN		
eth3		00:0c:29:4d:27:77	DOWN		
eth4		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth5		00:0c:29:4d:27:81	DOWN		
eth6		00:0c:29:4d:27:59	UP	10000Mb/s	Full
eth7		00:0c:29:4d:27:8b	DOWN		
lo		00:00:00:00:00:00	UP		
macvlan0		c6:eb:ce:d0:a1:1e	UP	10000Mb/s	Full
macvlan0.1000		c6:eb:ce:d0:a1:1e	UP	10000Mb/s	Full

6. Go to **CONTROL > Network**, tab **Interfaces/IPs**.
7. Note that the VLAN interfaces are now listed, but they have no IP address assigned yet!



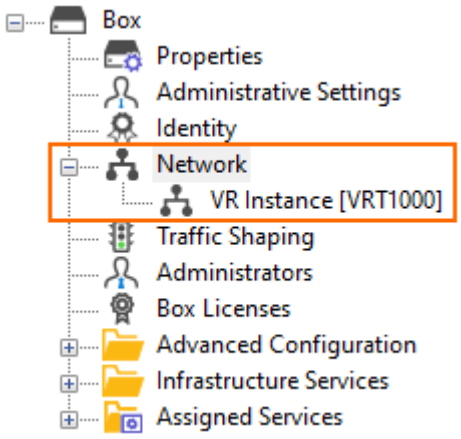
How to Configure a Virtual Router to Use the Newly Created MACVLAN0.1000

Before routing traffic from LAN2 to the WAN, you must first create a virtual router.

Step 1. Create the Virtual Router VRT1000

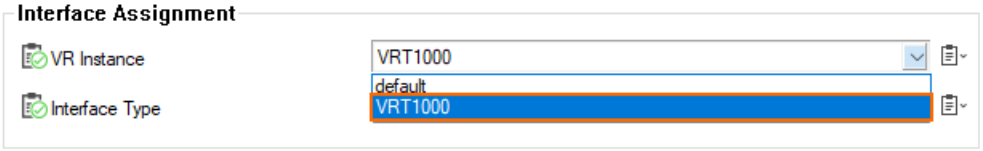
To hand over traffic between virtual routers and the default router, the virtual router must be associated with the VLAN1000. To achieve this, perform the following steps:

1. Go to **CONFIGURATION > Configuration Tree > Network**.
2. Right-click the **Network** node in the configuration tree.
3. A menu list is displayed.
4. Select **Create VR Instance** from the menu list.
5. The **Create a new VR Instance** dialog window is displayed.
6. Enter the name of your new virtual router instance, i.e., VRT1000.
7. Click **OK**.
8. The node for the new virtual router is added as a child node to the **Network** node. This is because the default router is directly related to the **Network** node and can not be deleted. In contrast, a virtual router node can be removed at any time if no longer needed.
9. Click the '**+**' symbol to expand the **Network** node.

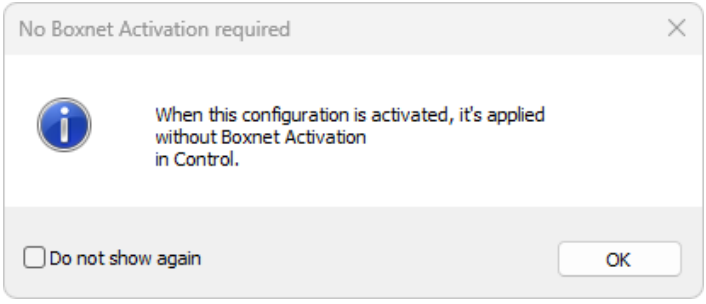


Step 2. Assign the New Virtual Router to the VLAN

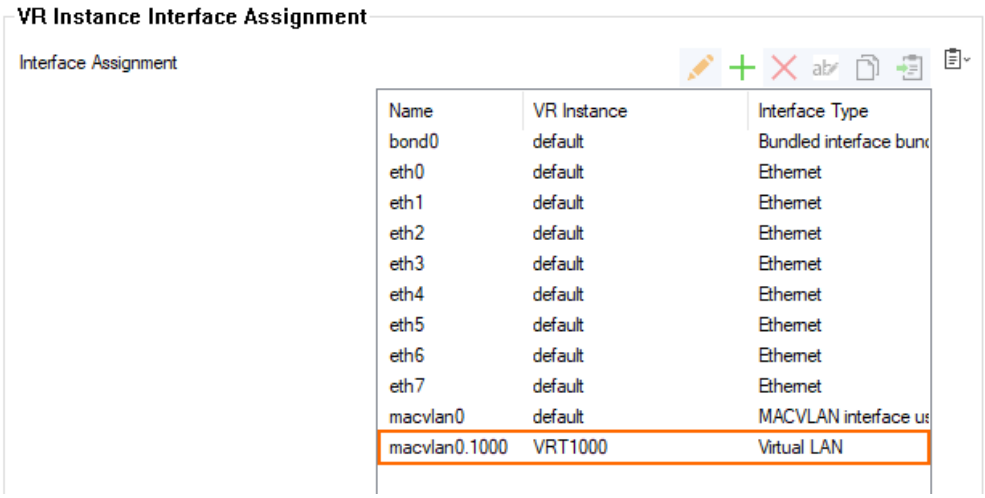
1. Go to **CONFIGURATION > Configuration Tree > Network > Virtual Router**.
2. Click **Lock**.
3. Double-click the `macvlan0.1000` entry.
4. The **Interface Assignment : macvlan0.1000** window is displayed.
5. For **VR Instance**, select VRT1000 from the menu list.



6. Click **OK**.
7. Click **Send Changes**.
8. The **No Boxnet Activation required** window is displayed.



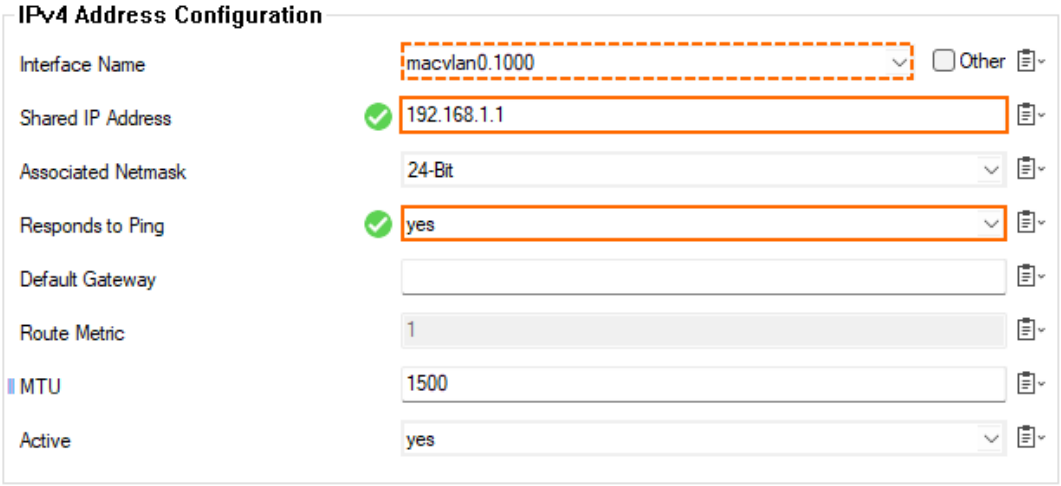
9. The virtual router is now assigned to the `macvlan0.1000` interface.



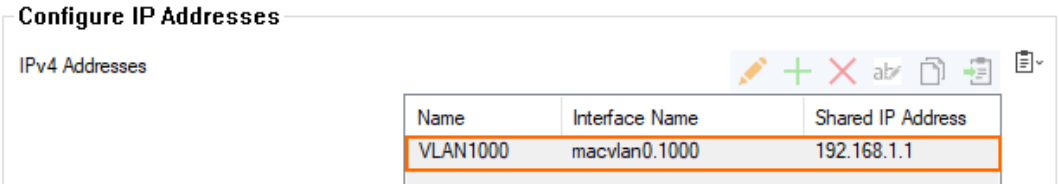
10. Click **Activate**.

Step 3. Assign the VLAN1000 with a Shared IP to the Virtual Router

1. Go to **CONFIGURATION > Network > VR Instance [VRT1000]**.
2. Click **IP Configuration** in the left menu column.
3. Click **Lock**.
4. Click the green '**+**' on top of the **Shared Networks and IPs** table.
5. The **IPv4 Addresses** window is displayed.
6. Enter the name to identify the shared IP address, i.e. `VLAN1000`.
7. The **IPv4 Address Configuration** window is displayed.
8. If the previous VLAN configuration is the only one, the value for **Interface Name** is already preset to `macvlan0.1000`. Otherwise, select `macvlan.01000` from the list.
9. Enter `192.168.1.1` for **Shared IP Address**.
10. Select **yes** for **Responds to Ping**.



11. Click **OK**.
12. Click **Send Changes**.

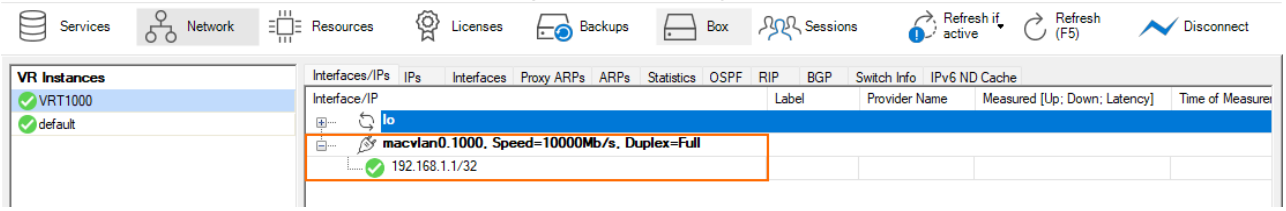


13. Click **Activate**.

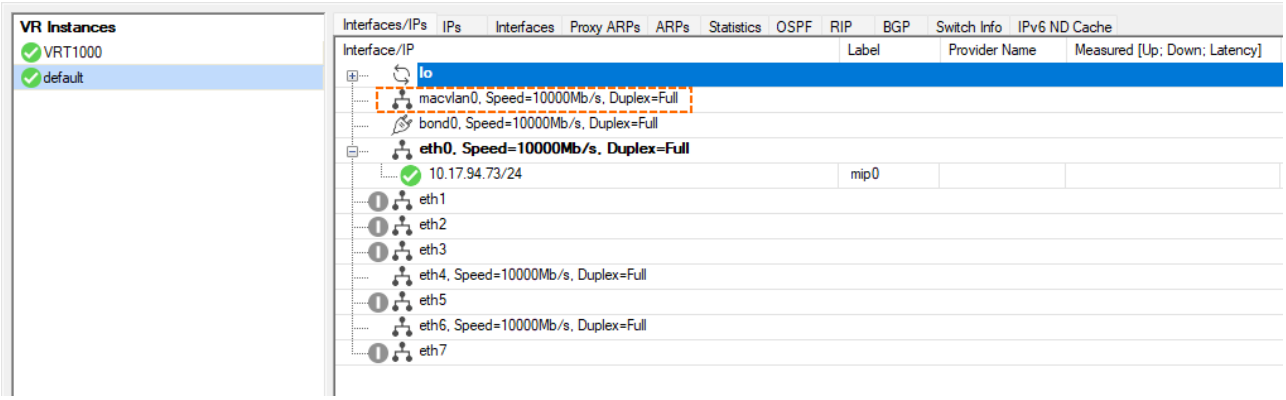
Step 4. Check that the Firewall Updated the New Configuration

After activating the configuration for the VLAN, you can check how the interface has been moved to the assigned virtual router.

1. Go to **CONTROL > Network**.
2. In the left menu column, locate the entry for the configured virtual router and click **VRT1000**.



3. In the left menu column, click **default** to display the interface setting for the default router.

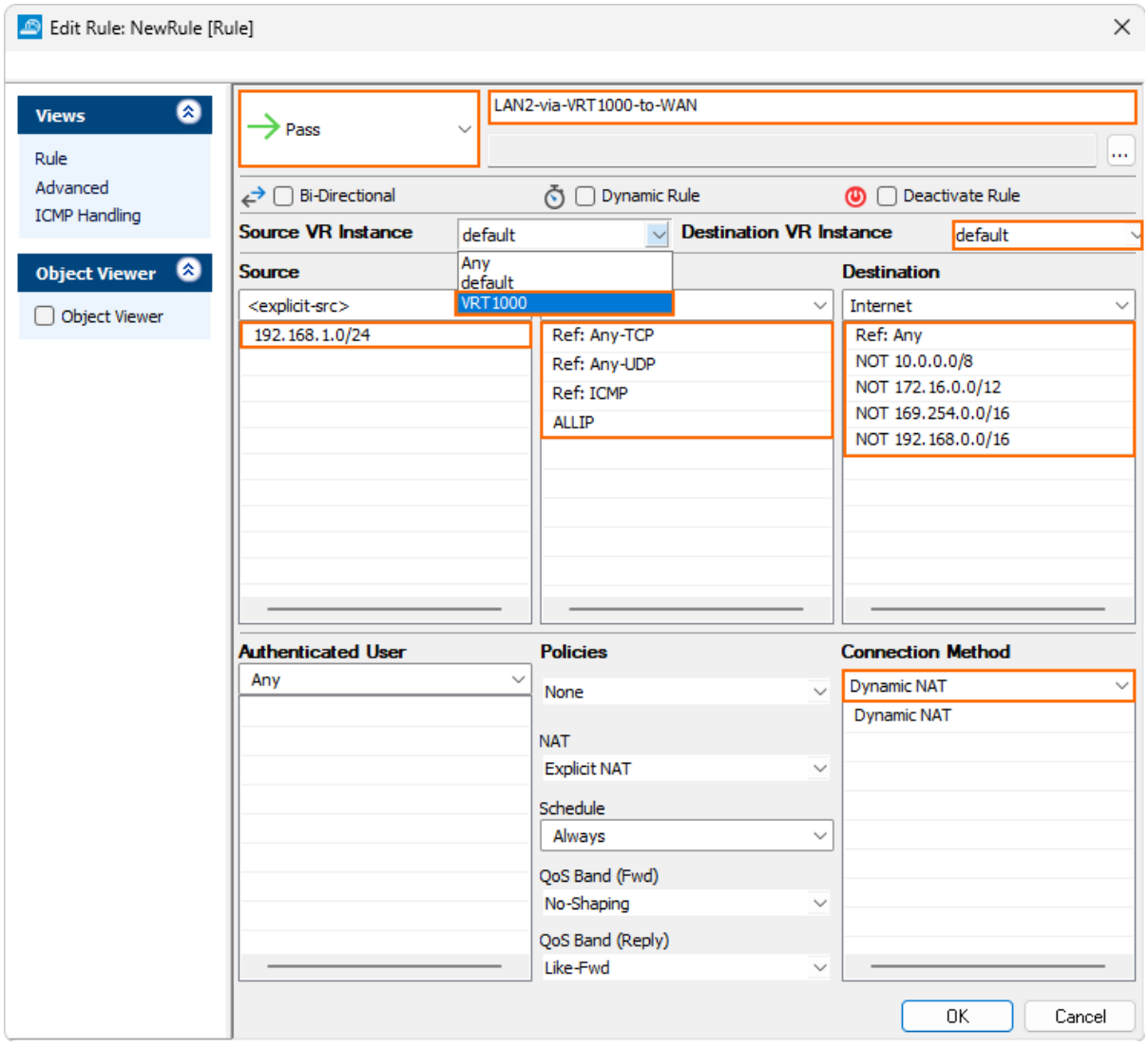


As the screenshots show, the `macvlan0.1000` interface has been assigned to the virtual router `VRT1000` with the **Shared IP** `192.168.1.1` assigned to it. In comparison, the `macvlan0` interface has not been used and is therefore still located in the scope of the default router.

How to Forward Traffic from LAN2 between Virtual Routers to the WAN

To forward traffic from LAN2 over the virtual router VRT1000 to the default router and the WAN, an appropriate access rule must be created to hand traffic over from the virtual router to the default

router. For this, perform the following steps:

1. Go to **CONFIGURATION > Configuration Tree > Assigned Services > NGFW (Firewall) > Forwarding Rules**.
2. Click **Lock**.
3. Click '**+**' to add an access rule.
4. For the access rule type, select **Pass.**
5. Enter the name for the new access rule, i.e., **LAN2-via-VRT1000-to-WAN**.
6. Set the following values for the listed parameters:
   - **Source VR Instance** – `VRT1000`.
   - **Destination VR Instance** – `default`.
   - **Source** – Enter the IP address of the source network, i.e. `192.168.1.0/24`
   - **Service** – Any.
   - **Destination** – Enter the IP address for the Internet from the list.
   - **Policies** – Set the value according to your preferences for using policies or not.
   - **Connection Method** – `Dynamic NAT`.
   - 

7. Click **OK**.
8. Click **Send Changes**.
9. Click **Activate**.

The CloudGen Firewall can now forward traffic from the LAN2 network via the virtual router VRT1000 and the default router to the WAN.

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