

APPLICATION NOTE-VRRP

Virtual Router Redundancy Protocol (VRRP) and the iMX350 RAPTOR Layer 3 Switch

One important function of a router or layer 3 switch is to be a gateway to the Wide Area Network (WAN) for hosts on the Local Area Network (LAN). On large and/or critical LANs, multiple routers may act as the gateway, using dynamic routing protocols, such as OSPF or RIP. However, there are applications where static routing is preferable to dynamic routing, but this will result in the gateway being a single point of failure. Virtual Router Redundancy Protocol (VRRP), as defined by RFC 5798, offers a solution to this.

VRRP allows the creation of a high availability configuration by combining two or more physical routers into a logical grouping called a virtual router. These physical routers then coordinate their operation to provide a single logical gateway for hosts on the LAN. The virtual router is configured as the host's gateway, with the individual physical routers that comprise the virtual router being unknown to the hosts. As long as one of the physical routers in the virtual router is operational, data to and from the hosts will be forwarded.

VRRP OPERATION

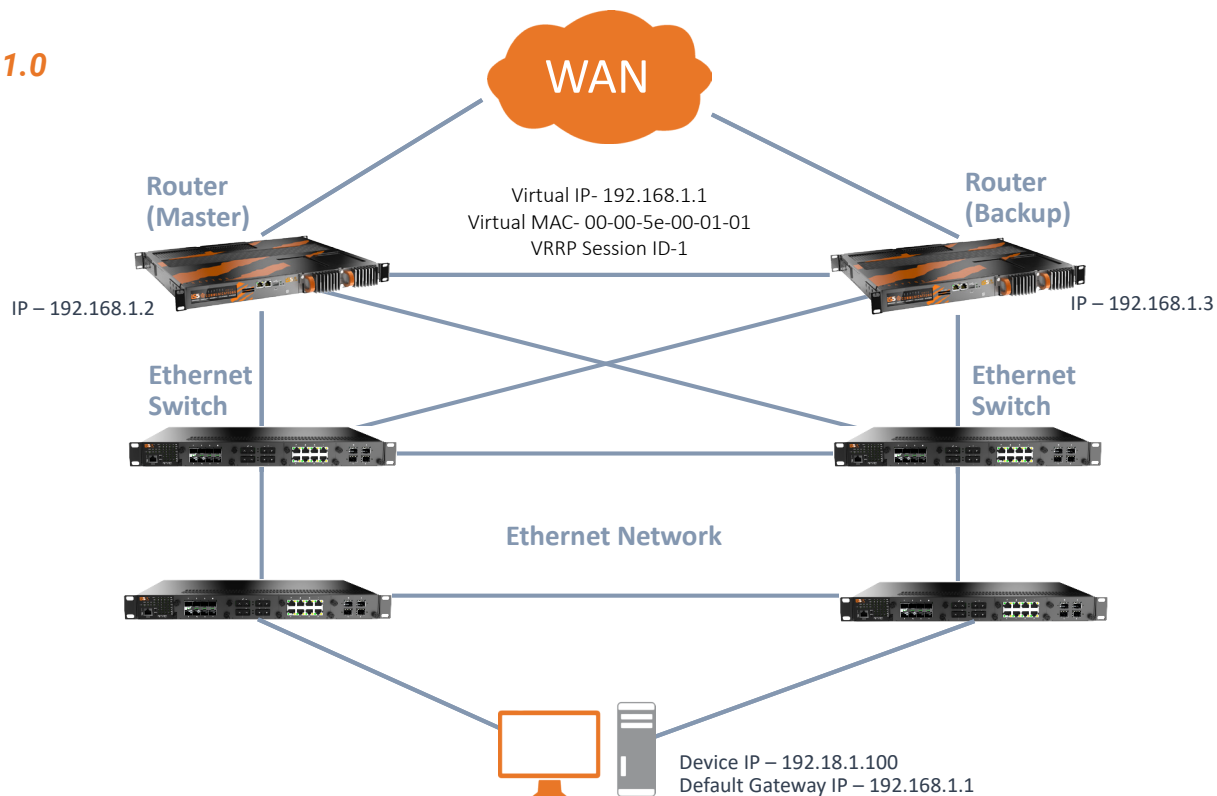
A VRRP virtual router consists of a master router and one or more backup routers. Normally, there will only be one backup router in an implementation. The routers will be given a VRRP priority; the one with the highest priority will be considered the preferred master. The master router performs the function of forwarding packets between the local hosts and the remote network, while the backup router is in a passive state until needed. The master router informs the backup router(s) of its status by sending advertisement messages at regular intervals, typically every second. If the master router fails, the backup router with the highest priority takes over and becomes the new master router.

The virtual router has both a MAC address and an IP address. By sharing these addresses across multiple physical routers, connectivity is maintained with the remote network if a router fails, and a backup takes over as the master, generally within a few seconds.

The MAC address used by the virtual router is called the VRRP virtual MAC. This MAC address is returned by the master router when responding to any ARP requests related to the gateway IP address.

The virtual MAC address is derived from the virtual router identifier, which is a user-defined value from 1 to 255. The full virtual MAC address will be 00-00-5e-00-01-xx, where xx is the VRRP ID. The virtual router's IP address is configured into all hosts on the LAN as their default gateway address.

Figure 1.0



VRRP supports the use of VLANs. There is a VRRP instance created for each VLAN with its own unique settings. Each VRRP instance has an identifier that is associated with a virtual IP/MAC Address pair.

For example:

VLAN 1- router 1 (master) LAN Interface- 192.168.1.2

VLAN 1- router 2 (backup) LAN Interface- 192.168.1.3

VRRP Session ID- 1

Virtual IP/MAC Address- 192.168.1.1/00-00-5e-00-01-01

VLAN 239- router 1 (master) LAN Interface- 192.168.239.2

VLAN 239- router 2 (backup) LAN Interface- 192.168.239.3

VRRP Session ID- 2

Virtual IP/MAC Address- 192.168.239.1/00-00-5e-00-01-02

VLAN 1024- router 1 (master) LAN Interface- 192.168.24.2

VLAN 1024- router 2 (backup) LAN Interface- 192.168.24.3

VRRP Session ID- 3

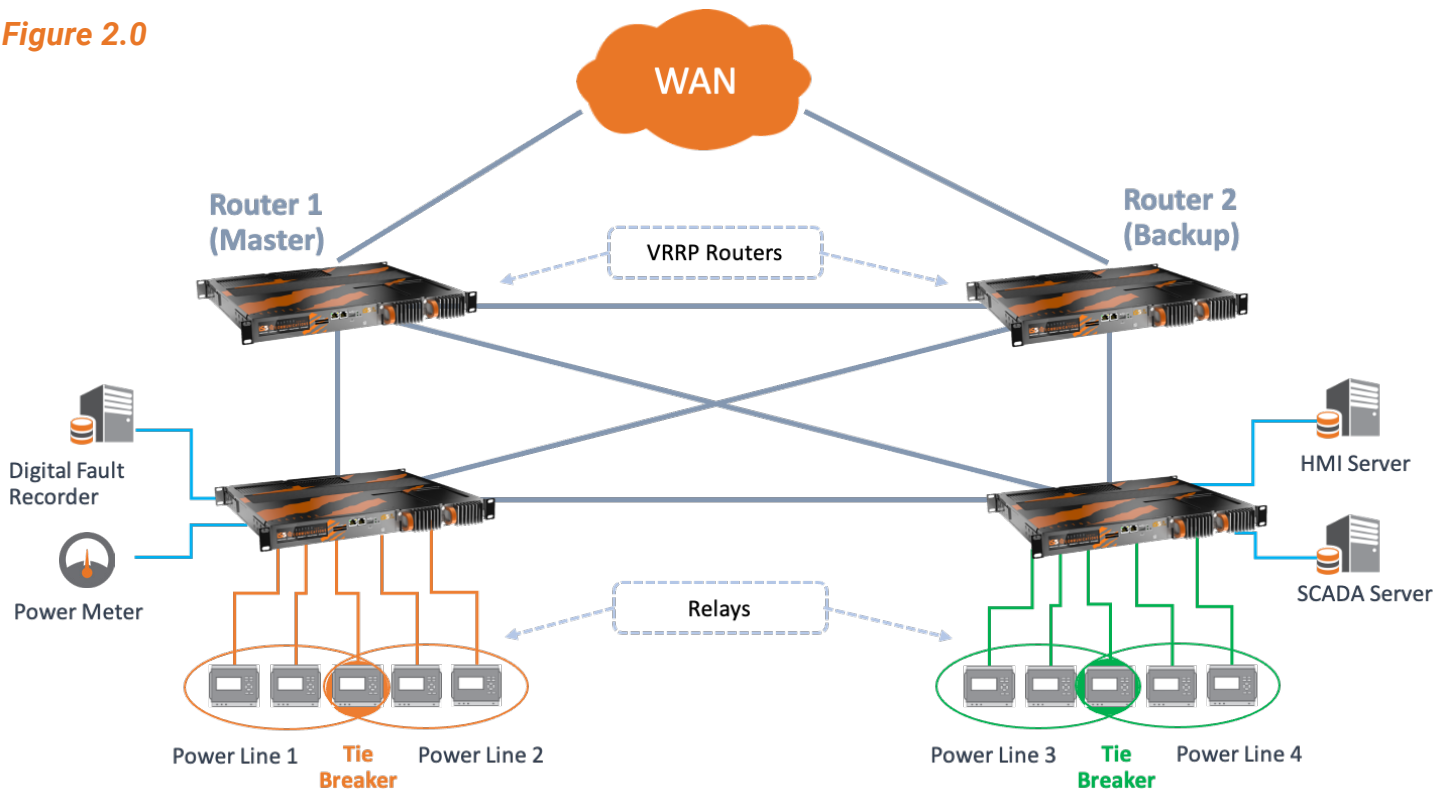
Virtual IP/MAC Address- 192.168.24.1/00-00-5e-00-01-03

EXAMPLE USE CASES

LARGE SUBSTATION WITH WAN ACCESS

The critical aspect of VRRP is maintaining the Default Gateway for the local Subnets sitting behind the routers. The VRRP routers are the gateway to the WAN and support routing for the VLANs behind them in the substation. There is a VRRP instance for every VLAN configured in the substation on the participating physical VRRP routers. If the master router fails, the backup router takes over seamlessly, with no loss of connectivity between the devices behind the router and the WAN. There is no need to change the Default Gateway on any end device on any configured VLAN.

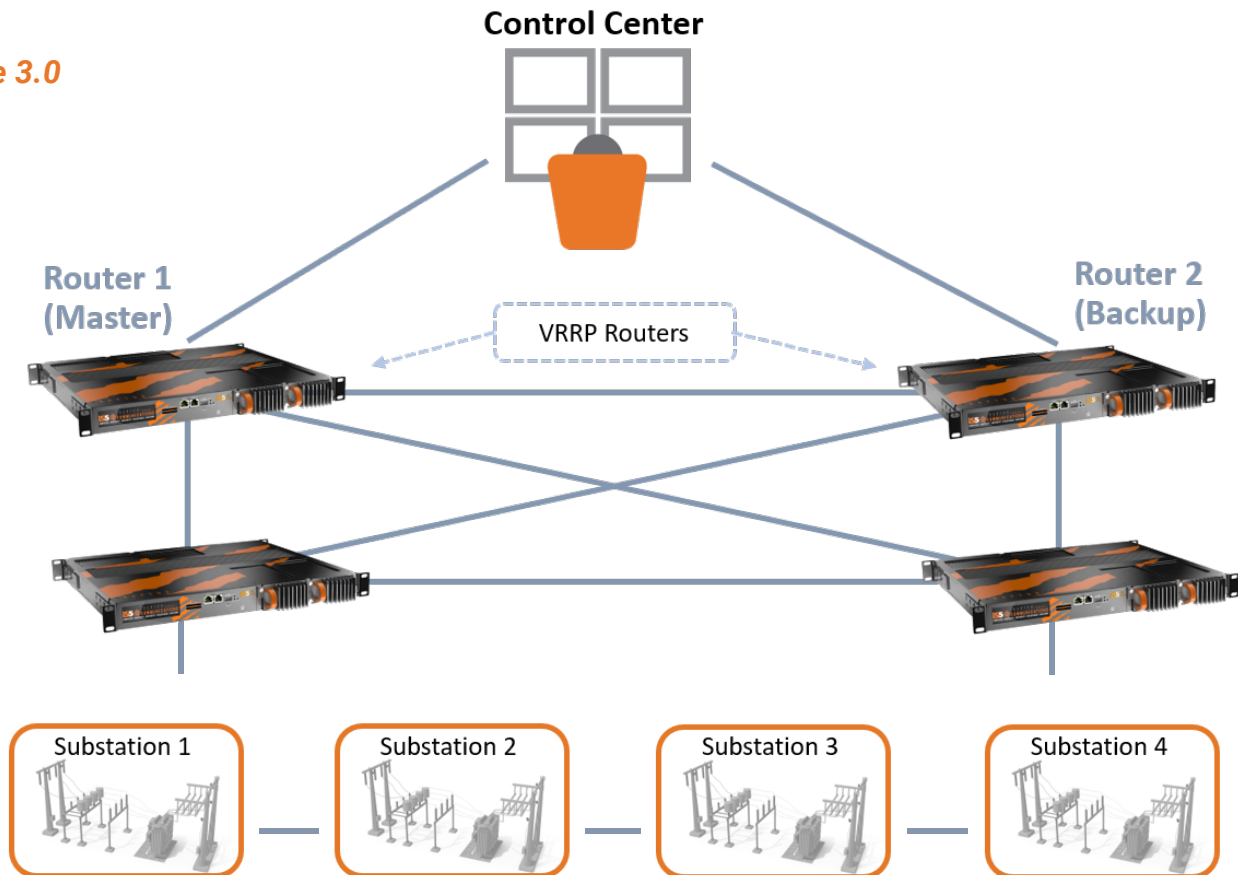
Figure 2.0



GROUP OF REMOTE SUBSTATIONS WITH CONNECTION TO THE CONTROL CENTER ON A PRIVATE NETWORK

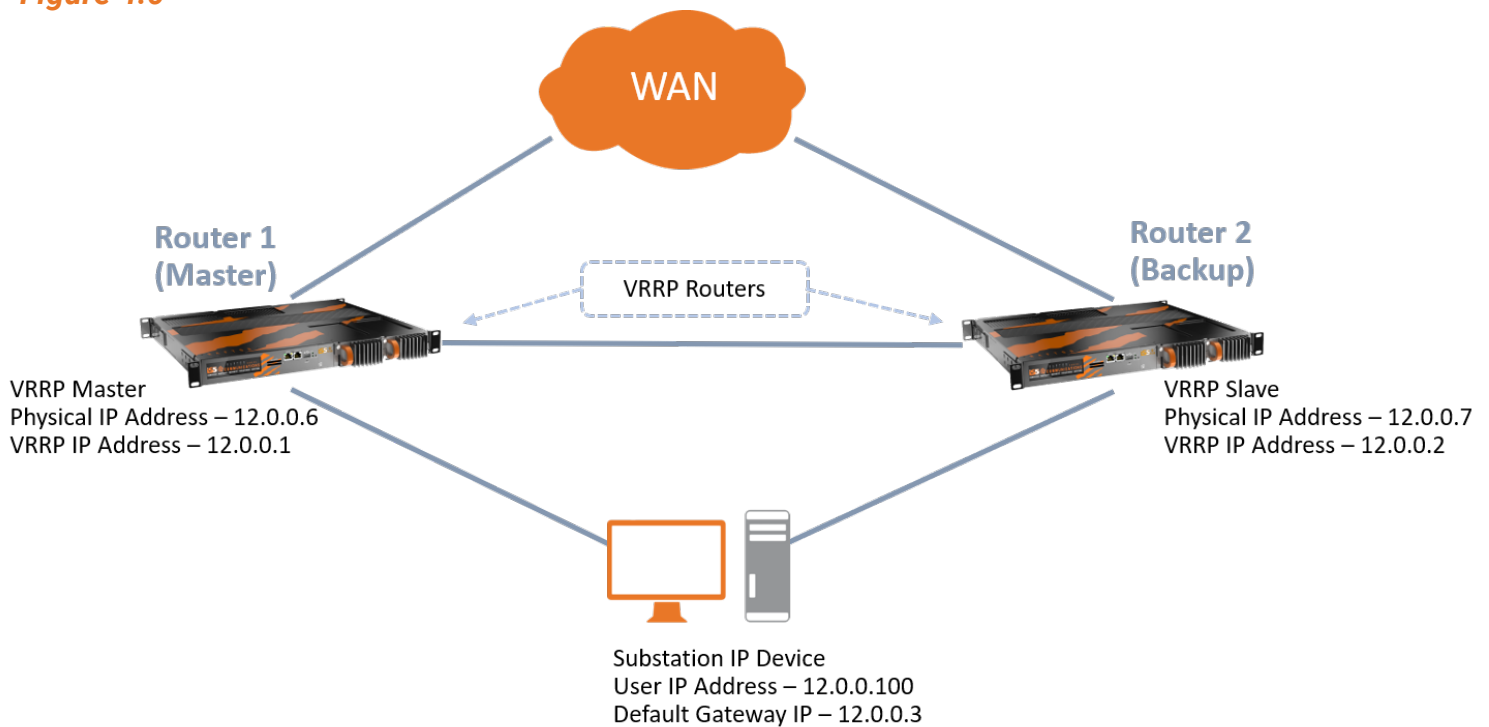
In this example, all the remote substations get their remote connectivity through the Control Center. All the configured VLANs in the remote substations are routed to the control Center through the VRRP routers installed there. The remote/field substations connect into a network that is owned/managed by the electric utility, so these are private subnets. They only have access to the WAN through the Control Center VRRP routers, so these are of extreme importance to the operation of the utility.

Figure 3.0



VRRP SETTINGS FOR THE iMX350 RAPTOR

Figure 4.0



Example Settings

To enable VRRP and configure an instance over a VLAN interface, execute the following commands in both of the switches (the specific address used are from the diagram above). The first set of commands for the first RAPTOR (router/Layer 3 switch) will be followed by the backup RAPTOR settings.

RAPTOR #1 settings

- Enter the Global Configuration Mode.

```
iS5comm# configure terminal
```

- Enable VRRP and enter the VRRP Configuration Mode.

```
iS5comm(config)# router vrrp
```

- Select an interface to configure VRRP and enter the VRRP Interface Configuration Mode.

```
iS5comm(config-vrrp)# interface vlan 1
```

- Create a VRRP instance and specify a primary IP address. This IP address should be same IP address of the VLAN interface. This is used as source IP Address for VRRP advertisement packets.

```
iS5comm(config-vrrp-if)# vrrp 1 ipv4 12.0.0.1
```

- Add an associated IP address 12.0.0.6 to the VRRP instance. This IP Address should be in the same subnet of interface IP address.

```
iS5comm(config-vrrp-if)# vrrp 1 ipv4 12.0.0.6 secondary
```

- Exit from the VRRP Interface Configuration Mode.

```
iS5comm(config-vrrp-if)# end
```

Exit to iS5comm# and enter "wr startup-config" to save entries

RAPTOR #2 settings

- Enter the Global Configuration Mode.

```
iS5comm# configure terminal
```

- Enable VRRP and enter the VRRP Configuration Mode.

```
iS5comm(config)# router vrrp
```

- Select an interface to configure VRRP and enter the VRRP Interface Configuration Mode.

```
iS5comm(config-vrrp)# interface vlan 1
```

- Create a VRRP instance and specify a primary IP address. This IP address should be same IP address of the VLAN interface. This is used as source IP Address for VRRP advertisement packets.

```
iS5comm(config-vrrp-if)# vrrp 1 ipv4 12.0.0.1
```

- Add an associated IP address 12.0.0.5 to the VRRP instance. This IP Address should be in the same subnet of interface IP address.

```
iS5comm(config-vrrp-if)# vrrp 1 ipv4 12.0.0.5 secondary
```

- Exit from the VRRP Interface Configuration Mode.

```
iS5comm(config-vrrp-if)# end
```

Exit to iS5comm# and enter "wr startup-config" to save entries

Settings from the viewpoint of the master VRRP router

```
iS5comm# show vrrp interface vlan 1 detail
```

```
vlan1 - vrid 1
```

```
-----
```

```
State is master
```

```
Virtual IP address is 12.0.0.1
```

```
Virtual MAC address is 00:00:5e:00:01:01
```

```
master router is 12.0.0.5
```

```
Associated IP Addresses :
```

```
-----
```

```
12.0.0.5
```

```
12.0.0.6
```

```
Advertise time is 1000 milli secs
```

```
Current priority is 200
```

```
Configured priority is 200, may preempt
```

Settings from the viewpoint of the backup VRRP router

```
iS5comm# show vrrp interface vlan 1 detail
```

```
vlan1 - vrid 1
```

```
-----
```

```
State is backup
```

```
Virtual IP address is 12.0.0.1
```

```
Virtual MAC address is 00:00:5e:00:01:01
```

```
master router is 12.0.0.5
```

```
Associated IP Addresses :
```

```
-----
```

```
12.0.0.5
```

```
12.0.0.6
```

```
Advertise time is 1000 milli secs
```

```
Current priority is 150
```

```
Configured priority is 150, may preempt
```

ABOUT iS5 COMMUNICATIONS INC.

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For more information, visit: is5com.com

toll free: +1-844-520-0588 | **fax:** +1-289-401-5206 | info@is5com.com

technical support: +1-844-475-8324 | support@is5com.com

Address: 5895 Ambler Dr, Mississauga, ON L4W 5B7