L3 communications
Nova Engineering

Planning a NovaRoam Network

NovaRoams can be used in a large variety of network configurations. It would be impossible to explain how to plan for each in this paper. Instead, this application note is designed to teach the basic principles involved in planning a NovaRoam network, so that you will be able to use this information as a basis for your particular needs.

Planning your network ahead of time is recommended. This provides a chance to develop an IP addressing scheme that makes the most sense for your particular situation. Depending on the type of network you are creating, several factors may influence your planning.

- Mobile vs. static network
- Point-to-point vs. point-to-multipoint
- Standalone vs. Internet connection
- Public vs. private IP addresses

Basic Principles

When planning a NovaRoam network, it is important to understand several basic principles.

- Each NovaRoam is an IP router that has two separate interfaces: Ethernet and Wireless
- All NovaRoams must participate in the same Wireless network
- Each NovaRoam must participate in a unique Ethernet network

Choosing the Routing Mode

The type of network you are designing will help determine the routing mode to use. If the network consists of stationary NovaRoams that are communicating either point-to-point or point-to-multipoint, choose “None” for Routing Mode. This will allow you to insert static routes for each NovaRoam and its connected network.

If the network consists of mobile NovaRoams, choose “Dynamic” for Routing Mode. This mode allows the NovaRoams to automatically find their neighbors and update their route tables to reflect this. When used in conjunction with the TORA mobile ad hoc networking algorithm, Dynamic mode allows NovaRoams to quickly and dynamically update their route tables as the network topology changes.

Using Static Routes

Figure 1 is an example of a point-to-point network using NovaRoams. In this example, we have assigned the 10.1.1.0 Class C network to Node 1 and the 10.2.1.0 Class C network to Node 2. For the wireless network we have assigned the 10.10.10.0 Class C network.

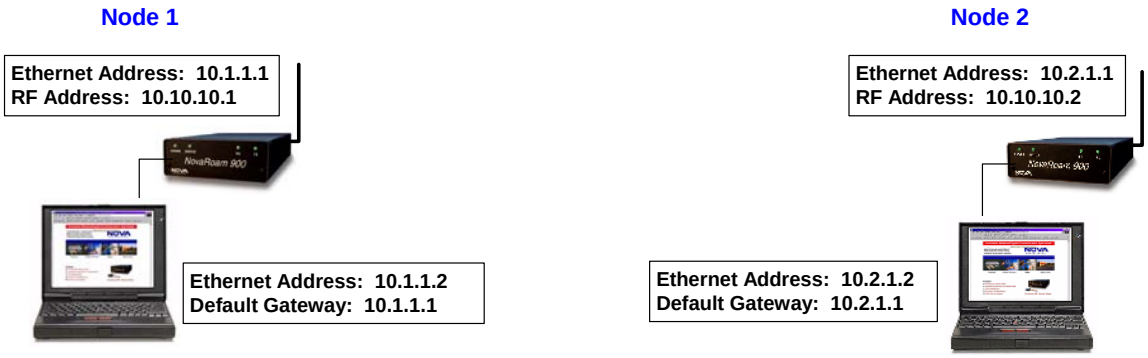

Figure 1: Example of point-to-point network using NovaRoams

In order to route traffic between nodes, several things must happen. First, all hosts on a given network need to use the attached NovaRoam as their default gateway. On Node 1, all hosts will list 10.1.1.1 as their default gateway. It is also necessary to add static routes to each NovaRoam. The NovaRoam from Node 1 must have a static route to Node 2, using the wireless interface of the Node 2 NovaRoam as the gateway. The route statement should look like this:

```
10.2.1.0        255.255.255.0       10.10.10.2      1
Network         Netmask             Gateway         Metric
```

All hosts from Node 2 must have their default gateways set to 10.2.1.1. The Node 2 NovaRoam must also have a static route to Node 1, using the wireless interface of the Node 1 NovaRoam as its gateway. This route statement should look like this:

```
10.1.1.0        255.255.255.0       10.10.10.1      1
Network         Netmask             Gateway         Metric
```

Note: It is important to understand that there are actually three networks in this example: Node 1, Node 2, and the wireless network.

Using Dynamic Routing

The Dynamic Routing mode of the NovaRoam does not rely on static routes. Instead, it relies on a proactive routing protocol called IMEP (Internet MANET (Mobile Ad hoc Networking) Encapsulation Protocol). IMEP allows NovaRoams to find neighboring NovaRoams and establish routes to them. There are a number of settings pertaining to Dynamic Routing mode that affect the network responsiveness and RF overhead.

When using Dynamic Routing mode, there is no need for static routes. Routes will be established and periodically maintained based on the Proactive Update (PUP) rate that is set on each NovaRoam. Again, it is still important to follow some basic concepts.

- Each NovaRoam must participate in a unique Ethernet network
- All NovaRoams must participate in the same wireless network

Once the network addresses have been established, Dynamic Routing will proactively create the necessary routes.

Using Dynamic Routing and TORA

The NovaRoam has a reactive routing algorithm called TORA (Temporally-Ordered Routing Algorithm) that works along with IMEP to establish routes. Since TORA is a reactive process, routes are created when they are requested. The combination of IMEP's proactive updates and TORA's reactive updates provides the most dynamic functionality.

When using Dynamic Routing and TORA, it is still necessary to follow the same network addressing scheme, but routes will be created proactively with IMEP and on demand with TORA. In other words, once the IP addresses have been setup on all NovaRoams, everything is ready to go.

Figure 2 shows an example of a simple network using Dynamic Routing. Nodes 1 and 2 are mobile nodes, while node 3 is a fixed node on a wired network. With Dynamic Routing configured, all subnets will be able to communicate to each other. If one of the mobile nodes goes out of range of the fixed node, the mobile node will automatically try to reach the fixed node by routing packets through the other mobile node.

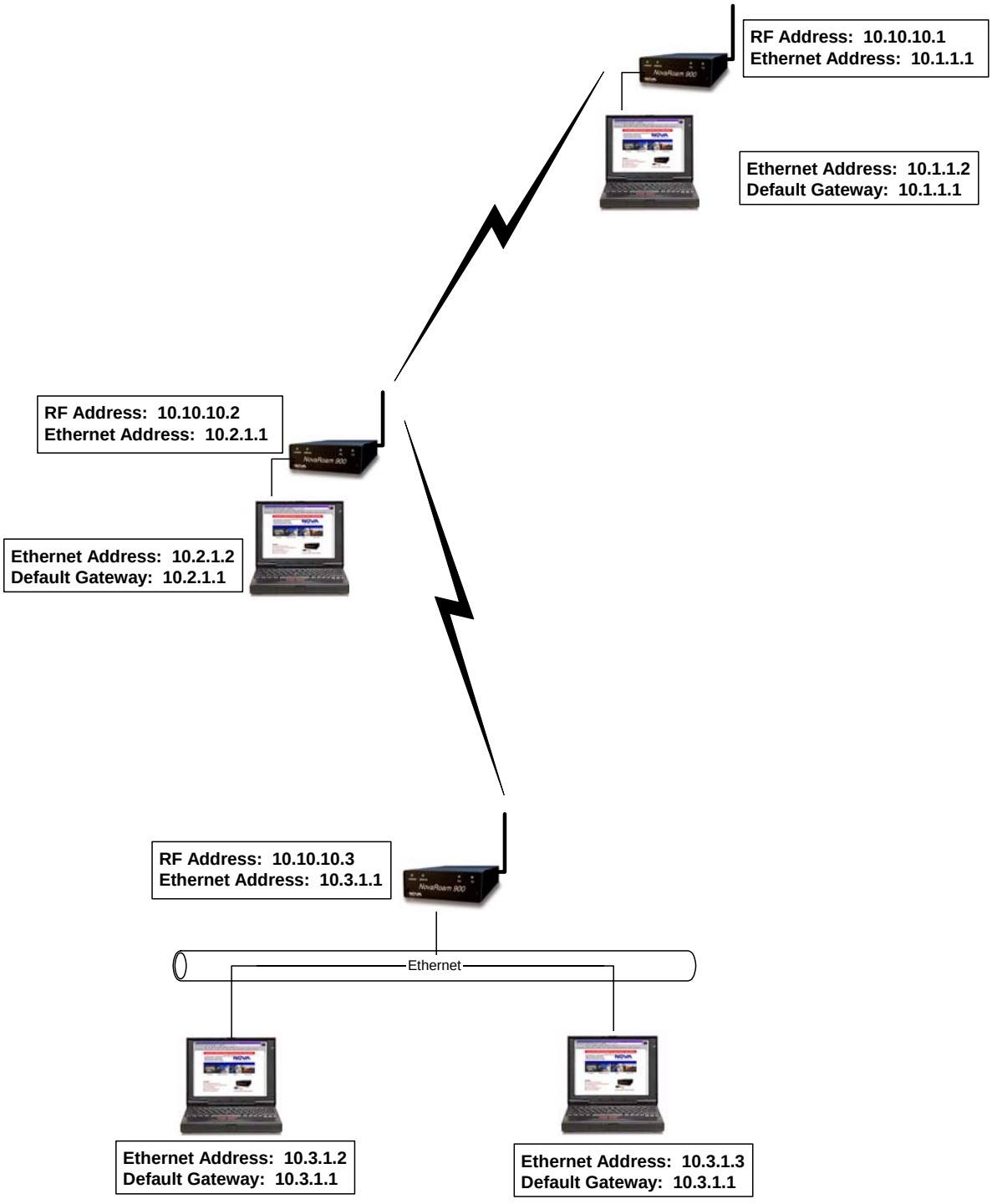

Figure 2: Example of NovaRoam network using Dynamic Routing

Setting up NovaRoams really can be as easy as the example in **Figure 2**. However, some real world applications are a bit more involved. **Figure 2** uses all private IP addresses. But what if Node 3 was on a public network? Or what if a private network is connected to the Internet? These may make setup a bit more complicated. In these cases, the setup of the NovaRoam is not much more difficult, but there are a number of general networking issues that may arise.

Figure 3 shows a basic NovaRoam network that utilizes both private (10.x.x.x) and public (111.222.333.x) IP addresses. The NovaRoams are configured the same way as they were for the example in **figure 2**. The difference is that Node 3 is participating on a network that uses public IP addresses. In order for all computers on the wired network to communicate with all mobile nodes, a route entry is added to the Internet router on the wired network. The Internet router needs a route addition that states that traffic destined for 10.0.0.0 must use the Node 3 NovaRoam's Ethernet interface as the gateway. All computers on the wired network uses the Internet router (111.222.333.10) as their default gateway. These two steps allow connectivity between all three networks.

If the mobile nodes need to browse the Internet, Network Address Translation (NAT) is required. Private IP addresses are not meant for Internet traffic. In order to send data from a private IP address to the Internet you must use NAT. NAT allows private IP addresses to "borrow" a public IP address to interface with the Internet. In many cases, a router interfacing with the Internet is capable of performing NAT. There are also a number of software packages available to perform the NAT functions.

In **figure 3**, assume that the Internet router performs NAT. The NovaRoam on the wired network will need to have a default gateway specified to direct traffic towards the Internet. In this example, the NovaRoam would have its default gateway set to 111.222.333.10, the Internet router. If Dynamic Routing is being used, all NovaRoams will need to have proper entries added to the "Wireless Net Description" entry of the NovaRoam Configuration Tool. The Wireless Net Description must define the networks that are available over the wireless network.

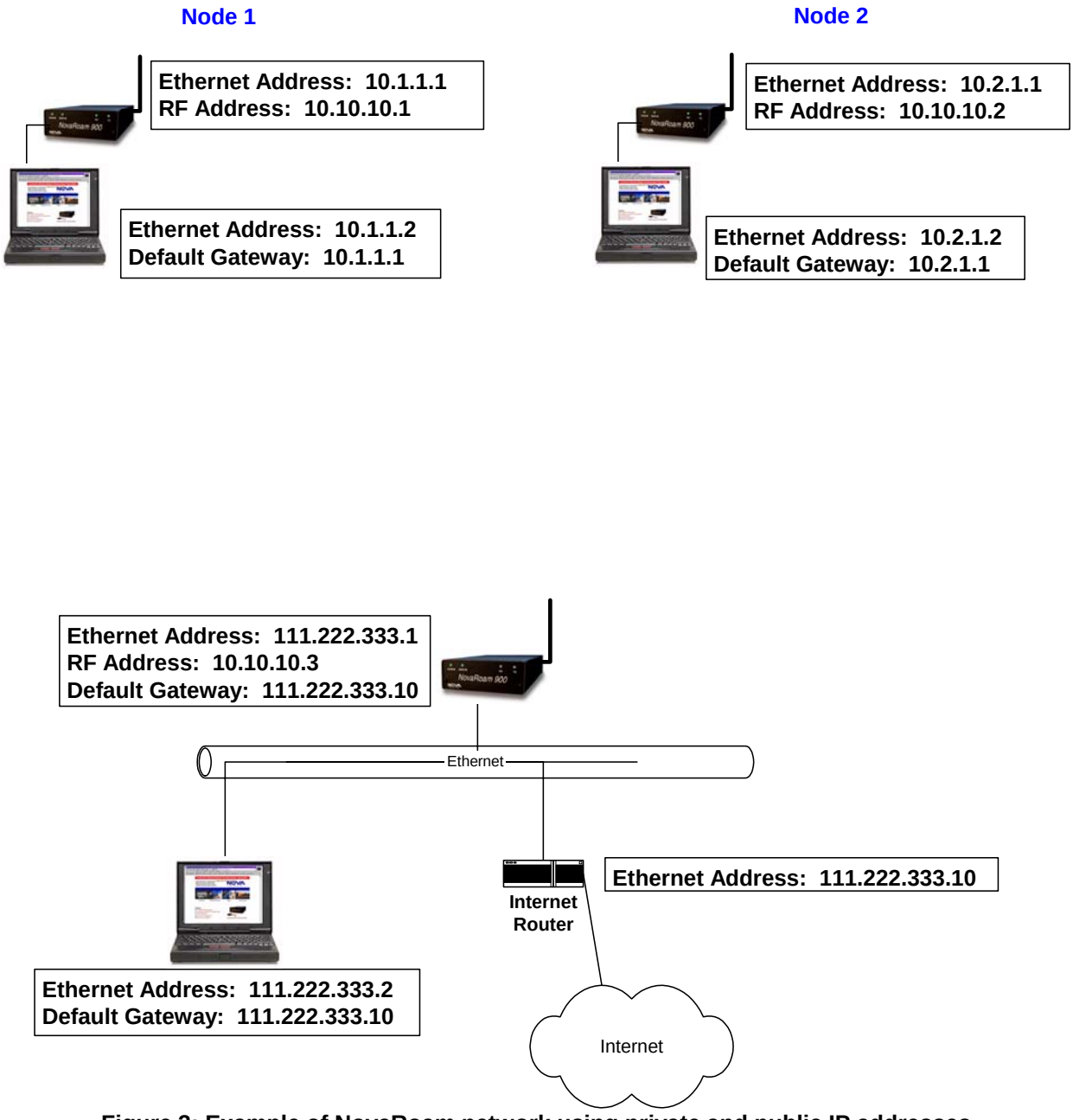

Figure 3: Example of NovaRoam network using private and public IP addresses

Using Multihop

Multihop is a flooding-type packet distribution method. In Multihop mode, the originating NovaRoam designates the packet as “Multihop”. Any NovaRoam that receives this Multihop packet will automatically retransmit it. The retransmitted packet will be tagged as Multihop only if the retransmit NovaRoam is configured in Multihop mode. Multihop mode essentially determines whether or not packets should be retransmitted on a packet-by-packet basis.

Figure 4 is shows an example of a NovaRoam network that utilizes Multihop mode. Each circle represents a NovaRoam. The red circles represent NovaRoams that are in Multihop mode.

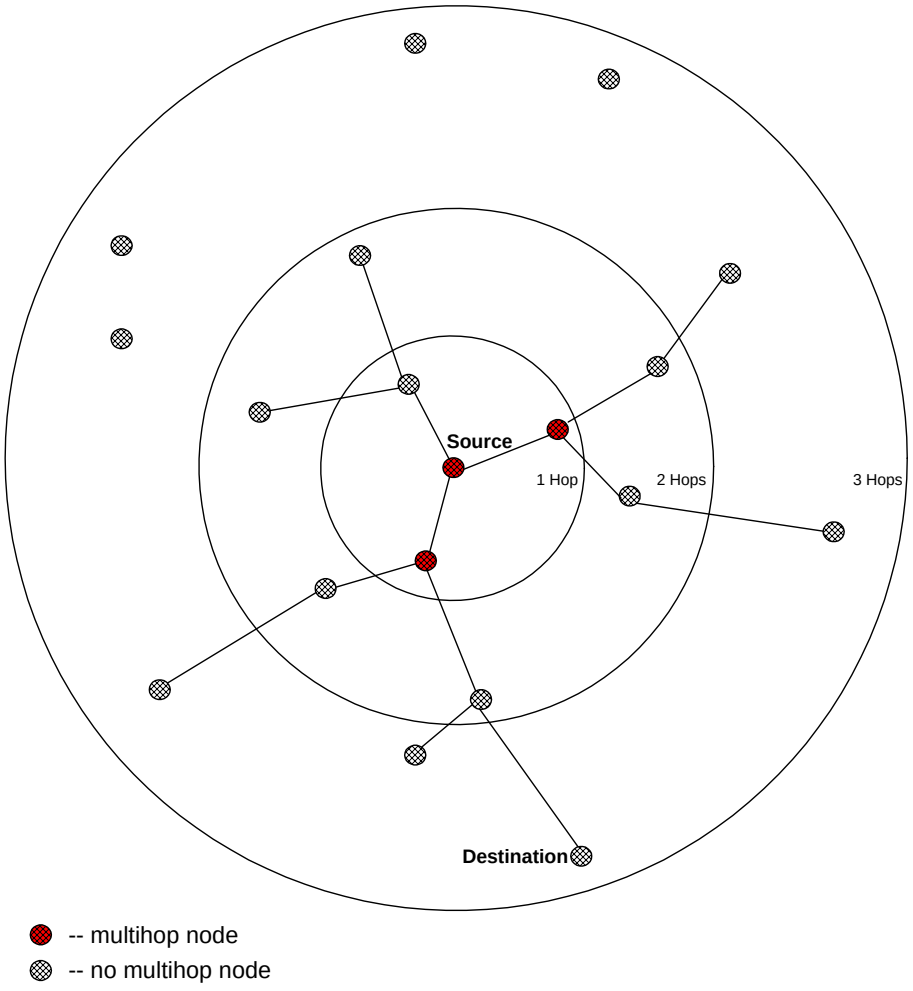

Figure 4: Example of a NovaRoam network using Multihop mode

Figure 4 displays the way that Multihop mode floods the network to get a packet to its destination. **Figure 5** displays the way that Dynamic Routing/TORA uses a more efficient hybrid of proactive and reactive route establishment to get a packet to its destination.

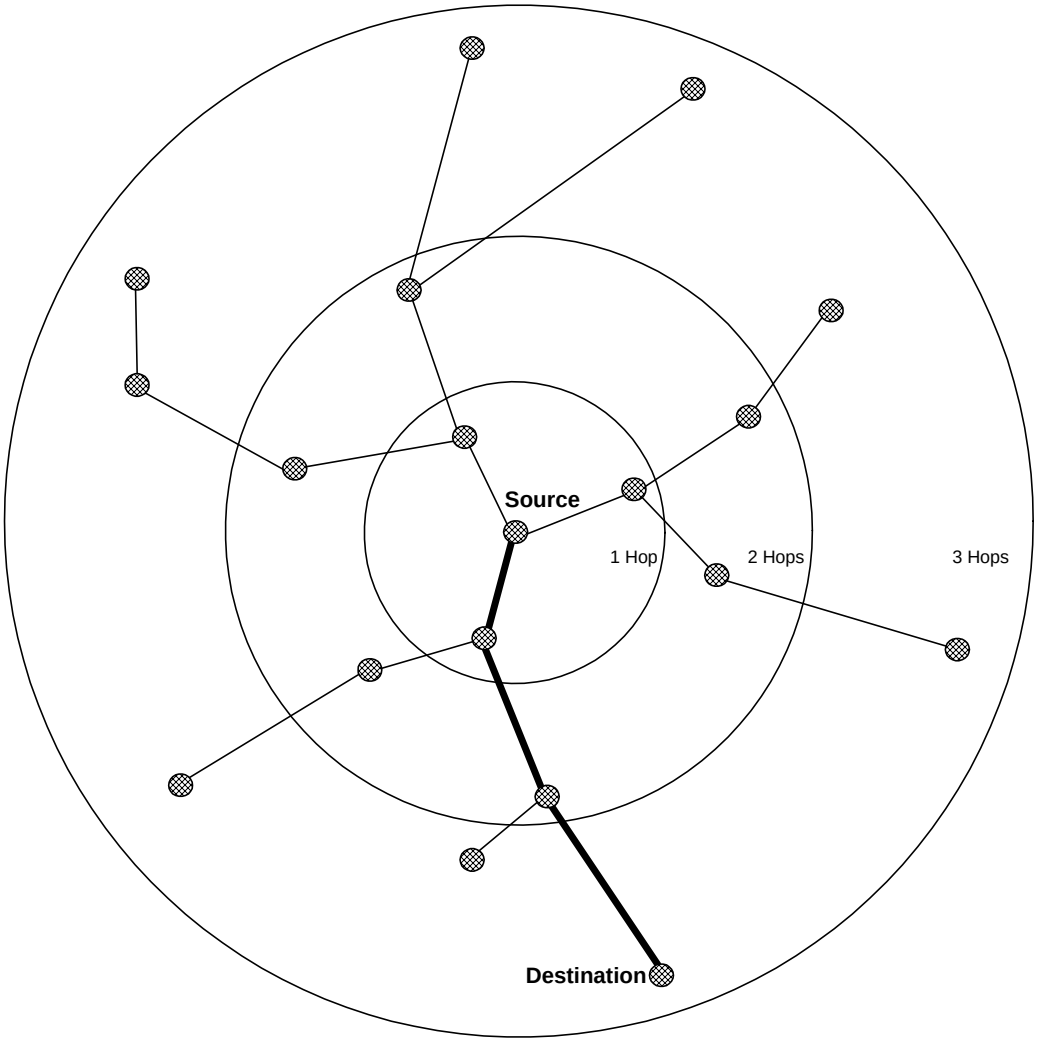

Figure 5: Example of NovaRoam network using TORA/IMEP Routing

Dynamic Routing establishes possible routes to a destination, and then sends the packet only to the NovaRoams that are required to reach the destination.

Frequently Asked Questions

Does it make a difference if I use public or private IP address?

Utilizing either public or private IP addresses is acceptable. Using private IP addresses is generally easier and costs nothing, whereas public IP addresses have to be leased. Private IP addresses allow multiple networks without the expense of leasing multiple blocks of IP addresses.

If I use private IP addresses, can I browse the Internet?

Private IP addresses are intended for private use, therefore will not communicate over the Internet. However, the use of Network Address Translation (NAT) allows hosts with private IP addresses to browse the Internet. NAT is available in many routers as well as standalone software.

Does the NovaRoam perform Network Address Translation (NAT)?

The NovaRoam does not currently perform NAT. There are plans to add this functionality to the NovaRoam in the future.

Can I use both private and public IP addresses simultaneously?

Both private and public IP addresses can be used simultaneously. In order for this to work, the router that is attached to the public IP network will need a routed added that reflects each private IP network.

What private IP addresses can I use?

The Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of the IP address space for private networks:

```
10.0.0.0      -    10.255.255.255
172.16.0.0    -    172.31.255.255
192.168.0.0   -    192.168.255.255
```

These address blocks can be subnetted to create smaller networks. For example, the 10.0.0.0 network is a Class A network. You could subnet this network into Class C networks such as 10.1.1.0, 10.2.1.0, etc.

Why does each NovaRoam have to be on a unique Ethernet network? Can't my NovaRoam act as an invisible piece of network cable?

NovaRoams are routers. Routers route data between unique networks. If a NovaRoam were to act as an invisible piece of network cable, the NovaRoam would be more of a wireless network card, not a wireless router therefore Dynamic Routing/TORA would not be possible.

Why is the NovaRoam wireless RF link considered a separate network?

Setting the Wireless Interface IP addresses of all NovaRoams to the same network allows communication between the wireless interfaces of all NovaRoams. Once all NovaRoams are able to communicate, they can effectively route data from their connected Ethernet networks.

Do I need Dynamic Routing/TORA enabled on every NovaRoam?

If you are using Dynamic Routing/TORA, each NovaRoam must have Dynamic Routing/TORA enabled. Each radio must also have the same Dynamic Routing settings.

Why is TORA not available on my NovaRoam?

TORA is an optional upgrade to the standard NovaRoam 900. The upgrades are easy to install to your existing units. Please contact Nova Engineering or your NovaRoam reseller to purchase TORA.

The Dynamic Routing mode seems so much easier that using static routes. Why would I ever use static routes?

Dynamic Routing mode is certainly easier to setup since you do not have to manually enter any routes. However, Dynamic mode does create additional RF overhead. This amount of overhead will vary with the size of your network as well as with the Dynamic Routing settings. Using static routes avoids creating extra overhead. In a fixed network, static routes are the most efficient choice.

What is the difference between Multicast mode and Repeater mode?

Both Multicast and Repeater modes are flooding modes. Multicast mode is a packet-based mode. Only packets designated as being Multicast packets are retransmitted. Repeater mode is a hardware-based mode. A NovaRoam that is in Repeater mode automatically retransmits all packets that it receives.

Summary

As you can see, there is no limit to the amount of applications for which the NovaRoam can be used. This application note explains the basic principles involved in planning and setting up some of the more common NovaRoam network scenarios. Use these planning concepts as starting points to build from when designing your NovaRoam network.

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