Digital Energy
MDS

INSTRUCTION SHEET

NUMBER: 05-4738A01, Rev. A
August 2009

Networking Configuration

GE MDS, LLC., 175 Science Parkway, Rochester, NY 14620 USA
Phone +1 (585) 242-9600, FAX +1 (585) 242-9620

GE MDS LEDR

Networking Configuration of LEDR Radios

LEDR Networking Features

General Overview

The LEDR radio employs a TCP/IP stack to provide Internet Protocol (IP) connectivity. This connectivity includes SNMP, Telnet, TFTP, and ICMP messaging. The TCP/IP stack provides standard IP routing and forwarding services. In addition, the LEDR radio employs a self-discovery protocol, which allows it to detect other LEDR radios on a common network and automatically establish IP routes to them. The LEDR radio has a voice orderwire port to send broadcast voice data to all radios in the network.

Network Interfaces

The LEDR radio has two network interfaces: one interface uses the Ethernet port and the Ethernet II protocol. The other network interface is the radio's service channel which uses both the RF link as well as the Ethernet port. When passing service channel data over the Ethernet port the radio employs the IEEE 802.2 SNAP protocol.

Default IP Port

Because the LEDR radio has only one IP address but more than one port through which it can pass IP traffic, it has the concept of a default IP port. The default IP port defines which port the LEDR radio should use to configure its default route and subnet route. The default route has a destination address of 0.0.0.0 and is used if no other route in the LEDR routing table matches the destination address of a packet that needs to be sent. The subnet route is created by ANDing together the radio’s IP address and netmask. The default IP port defines the port that is associated with these automatically configured routes.

When the LEDR radio is connected to an Ethernet network such as a LAN, the default IP port should be set to “ETH” indicating “Ethernet”. The radio may be physically connected through a hub or router or it may be directly connected to a PC with an Ethernet crossover cable. On the other hand, if the radio is in the midst or at the end of a chain of LEDR radio links, and data traffic should be routed via the radio, the default IP port should be set to “AIR”. The default port should always be set to “AIR” when it is connected to its default gateway host through another LEDR radio. See the Configuration Examples later in this document for more information.

Network Configuration Commands

There are four commands used to configure the networking of the LEDR radio, they are: **ip**, **route**, **group**, and **network**.

The **ip** command is used to set the IP address, subnet mask, default gateway, and default network interface port. When setting any of the four parameters with the **ip** command, the user is prompted for changes to the other three parameters. Once all of the parameters are set a reboot is requested to ensure that the changes take effect.

The **route** command is used to display and modify the routing table. The subcommands **print**, **add**, and **delete** allow the user to view the routing table and add or remove entries. Once the IP configuration is set using the **ip** command, several routing entries will appear in the routing table. The first of these routes is the default route, which has a destination address of 0.0.0.0. This route is used when a more appropriate route is not available. Thus it becomes the "catch-all" route. The second route that will appear is the default network route. This route has a destination address calculated by ANDing the IP address and subnet mask together. The Next Hop address of this entry will be the default gateway configured using the **ip** command and the Interface will be the default port. This route is used to tell the radio how to reach its base network. For example, consider a radio whose IP configuration is:

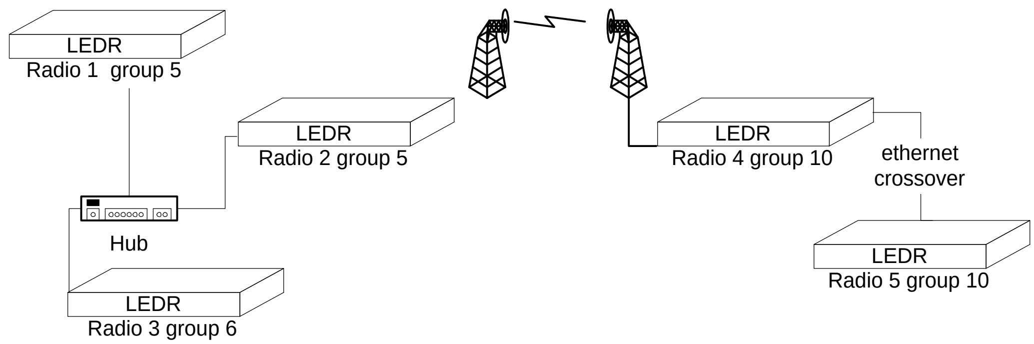
IP address: 192.168.1.1
IP netmask: 255.255.255.0
IP gateway: 0.0.0.0
IP port: ETH

The default routes for this radio would be:

Destination	Netmask	Next Hop	Interface
0.0.0.0	0.0.0.0	0.0.0.0	ETH
192.168.1.0	255.255.255.0	0.0.0.0	ETH
127.0.0.1	255.255.255.255	192.168.1.1	LPBK

In this example, the radio will send all IP traffic directly out its Ethernet port. See the examples later in this document for additional examples. The third route that is added has a destination address of 127.0.0.1. This is known as the loopback route and is used when the radio sends a packet to its own IP address.

The **group** command is used to associate LEDR radios which are connected to the same Ethernet. When two or more LEDR radios are connected to the same Ethernet they can share service channel data. The LEDR service channel operates over both the RF link as well as the Ethernet. The LEDR service channel carries orderwire voice, remote login packets, network self-discovery data, and IP packets. The network group parameter is used by LEDR radios to either share or ignore service channel data. If two LEDR radios connected to the same Ethernet are set to the same network group they will share service channel data. If a third LEDR radio is present on the same Ethernet but has a different network group, it will ignore the service channel data from the first two radios. See the following diagram for an example:



The network group only matters for radios connected to the same Ethernet. As can be seen in the above example, Radio #4 and Radio #5 have a network group of 10, which is different from Radio #1 and Radio #2. However, Radio #1, 2, 4, and 5 all share service channel data. The network group limits all service channel data. Voice orderwire, rlogin, IP, and customer service channel data will be shared according to the network group configuration. In the above example, a user speaking into a handset connected to Radio #5's orderwire port can be heard at Radio #1, 2, and 4 but not at Radio #3.

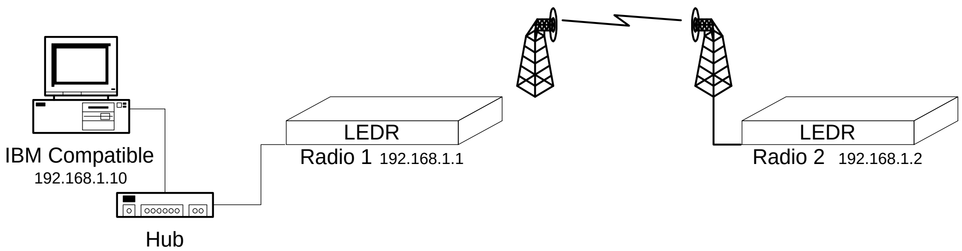
The **network** command is used to view the radio's network table. The **network** command displays a table containing all of the LEDR radios that a particular LEDR radio has discovered using Network Self-Discovery (see Network Self-Discovery below). The network group directly affects which radios will appear in a radio's network table. The network table includes each radio's unit ID, IP address, IP subnet mask, the number of Ethernet and RF hops, the "Received on port", and the owner name. The "Received on port" parameter indicates whether the network self-discovery packet for this node was received on the RF or Ethernet port. This information aids in determining the radio network's topology. The owner name is a 10-character user-configurable parameter, which is used to identify each radio. The owner name could be, for example, the radio's location or a network administrator's name.

Network Self-Discovery

The LEDR radio employs a proprietary protocol known as Network Self-Discovery (NSD), which provides a way for the LEDR radios to detect one another. Each LEDR radio sends out an NSD "ping" message, which contains information about that radio. Other radios on the network receive the NSD message and add the information to their network tables. In addition, a host route is added to the IP routing table using the AIR network interface. These host routes are added as part of the radio's process to automatically configure IP routing and forwarding within the radio network. NSD is directly affected by the network group parameter of the radios. If two radios, which are connected to the same Ethernet, are not configured to the same network group they will not "discover" one another because they will ignore one another's service channel data (see the **group** command above).

Proxy ARP - Version 2.4.0 and later

The LEDR radios provide proxy ARP services to simplify IP routing requirements on NMS workstations and routers. In the following example the PC needs to be able to send and receive IP data, such as SNMP, to both radios.

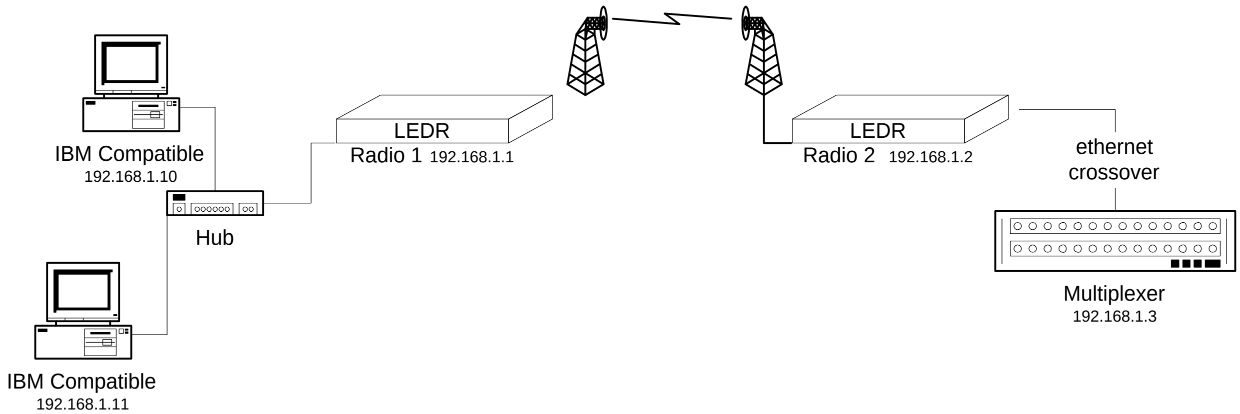


Normally, the PC would need a route added to its routing table using the first radio as a gateway to the second radio. This route would look like this:

Destination	Netmask	Next Hop
192.168.1.2	255.255.255.255	192.168.1.1

However, the LEDR radios provide proxy ARP so that the route does not need to be added to the PC. The LEDR radio examines all ARP requests to determine if it is for a radio that it has discovered and that is reachable over the RF link. If the ARP request matches these criteria, the LEDR radio will send a proxy ARP reply containing its own Ethernet address. In the above example, the PC will send out a broadcast ARP request containing Radio #2's IP address. Radio #1 will recognize the IP address for Radio #2 and will respond to the ARP request using its own Ethernet address. Upon receiving the proxy ARP reply, the PC will send the data packet to Radio #1's Ethernet address. Radio #1 will subsequently forward the data packet over the RF link for Radio #2 to process.

Proxy ARP also assists in routing in the following configuration:



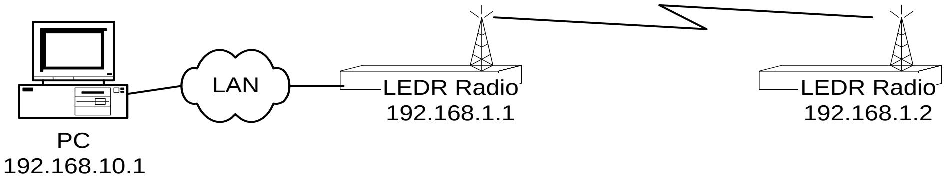
In this configuration both PC's need to send data to the mux at the far end of the radio link. Instead of adding a gateway route to each PC, Radio #1 can be configured to proxy ARP for the MUX as well as Radio #2. This can be done easily using the **arp -s** command on Radio #1. In the above example the command would be:

arp -s 192.168.1.3

Configuration Examples

A Single LEDR Link

Consider the following network to configure IP routing.



Assign each radio an IP address, netmask, default gateway, and port as follows:

On the 192.168.1.1 radio:

```
LEDR> ip address 192.168.1.1
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0)
ip {port}:  (ETH)

ip {address}: 192.168.1.1
ip {netmask}: 255.255.255.0
ip {gateway}: 0.0.0.0
ip {port}:  ETH
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

On the 192.168.1.2 radio:

```
LEDR> ip address 192.168.1.2
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0) 192.168.1.1
ip {port}:  (ETH) AIR

ip {address}: 192.168.1.2
ip {netmask}: 255.255.255.0
ip {gateway}: 192.168.1.1
ip {port}:  AIR
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

In this example, the LEDR radio with an IP address of 192.168.1.1 will use the “ETH” port and the LEDR radio with an IP address of 192.168.1.2 will use the “AIR” port. The 192.168.1.1 LEDR radio is specified as the gateway for the 192.168.1.2 LEDR radio. Because the 192.168.1.2 LEDR radio’s IP default port is set to “AIR”, the default network route is automatically configured using the gateway (192.168.1.1) address.

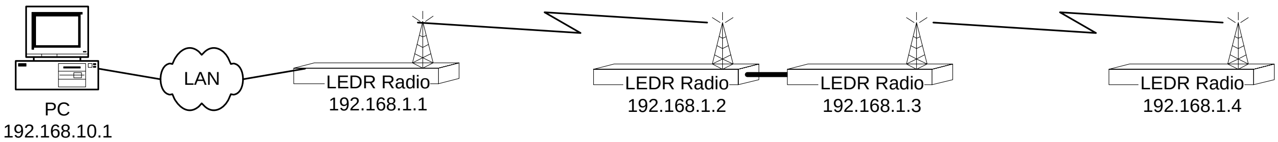
Radio software version 2.3.1 or earlier: This is all that is needed to configure the routing for the LEDR radios in this configuration. However, the PC requires routes to access each of the radios. A route to 192.168.1.2 needs to be added to the PC’s routing table. This can be done by using the route command on the PC:

    route add 192.168.1.2 192.168.1.1

Note that the PC will discover the 192.168.1.1 radio via the ARP protocol, but any radios beyond the first RF hop are invisible to ARP since the LEDR radio does not forward ARP requests (this only applies to radios running version 2.3.1 or older software, see Proxy ARP above).

Two Back-to-back LEDR Links

Extending the example with another link



On the 192.168.1.3 radio:

```
LEDR> ip address 192.168.1.3
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0) 192.168.1.1
ip {port}:  (ETH) AIR

ip {address}: 192.168.1.3
ip {netmask}: 255.255.255.0
ip {gateway}: 192.168.1.1
ip {port}:  AIR
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

On the 192.168.1.4 radio:

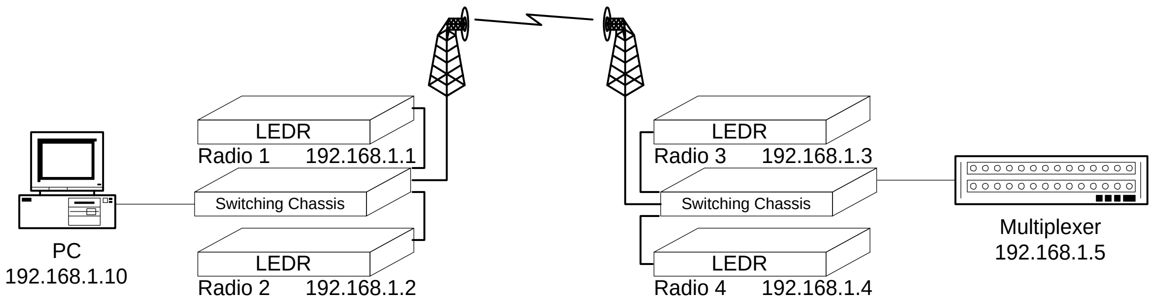
```
LEDR> ip address 192.168.1.4
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0) 192.168.1.1
ip {port}:  (ETH) AIR

ip {address}: 192.168.1.4
ip {netmask}: 255.255.255.0
ip {gateway}: 192.168.1.1
ip {port}:  AIR
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

The additional two LEDR radios are configured similar to the second radio in the first example. Radios 192.168.1.3 and 192.168.1.4 both use 192.168.1.1 as the default gateway and “AIR” as the default port.

Radio software version 2.3.1 or earlier: In this example the PC will again need to have routes added to its routing table to reach the 192.168.1.3 and 192.168.1.4 radios. An alternate method for setting the routing on the PC is to add a route to the 192.168.1.0 subnet via the 192.168.1.1 radio:

route add 192.168.1.0 mask 255.255.255.0 192.168.1.1

Protected LEDR Link



Assign each radio an IP address, netmask, default gateway, and port as follows:

On Radio #1 (and Radio #2):

```
LEDR> ip address 192.168.1.1 (192.168.1.2)
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0)
ip {port}:  (ETH)

ip {address}: 192.168.1.1 (192.168.1.2)
ip {netmask}: 255.255.255.0
ip {gateway}: 0.0.0.0
ip {port}:  ETH
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

On Radio #3 (and Radio #2:

```
LEDR> ip address 192.168.1.3 (192.168.1.4)
ip {netmask}: (255.255.255.0)
ip {gateway}: (0.0.0.0) 192.168.1.1
ip {port}:  (ETH) AIR

ip {address}: 192.168.1.3 (192.168.1.4)
ip {netmask}: 255.255.255.0
ip {gateway}: 192.168.1.1
ip {port}:  AIR
ip: A reboot is strongly recommended. Do
you wish to reboot? (y/n) > y

REBOOT
```

In this example, the two protected LEDR radios, Radio #1 and #2, will use the “ETH” port and the remote protected LEDR radios, Radio #3 and #4, will use the “AIR” port. The 192.168.1.1 LEDR radio is specified as the gateway for the 192.168.1.3 LEDR radio. Because the 192.168.1.3 LEDR radio’s IP default port is set to “AIR”, the default network route is automatically configured using the gateway (192.168.1.1) address.

<u>Configuring the protected radio's sibling IP addresses</u>
The sibling IP addresses of the protected radios should be set using the **rdnt ip** command.
On Radio #1 the command will be:
    rdnt ip 192.168.1.2

On Radio #2 the command will be:
    rdnt ip 192.168.1.1

On Radio #3 the command will be:
    rdnt ip 192.168.1.4

On Radio #4 the command will be:
    rdnt ip 192.168.1.3

This allows the protected radios to proxy ARP for one another in case one of them fails, is removed, or replaced . For example, if Radio #1 is used as the default gateway for Radio #3 and Radio #1 is removed, Radio #2 will perform IP routing and forwarding in its place.

Accessing the Remote Mux

In the example above the remote mux is connected the protected LEDR radio chassis via an Ethernet crossover cable. The mux will be configured to use Radio #3 as its IP gateway. In the event that Radio #3 fails, is removed, or replaced, Radio #4 will serve in its place as the IP gateway. When the mux has an IP packet to send it will attempt to forward it to Radio #3. **The mux may not be able to communicate with the network for up to 20 minutes**. The reason for this is that after Radio #3 is no longer available (in the event of failure or removal), the mux may still have the MAC address of Radio #3 in its ARP table. When the ARP entry is aged out of the mux's ARP table the mux will issue an ARP request for the IP address 192.168.1.3. When the ARP request is generated, Radio #4 will recognize the IP address as its sibling radio and generate a proxy ARP reply in place of Radio #3. ARP table entries are normally retained for 20 minutes.

Adding Mux as Proxy ARP entry

In order to ease routing requirements on management stations and routers, the user can specify IP addresses for which the LEDR radio should proxy ARP. In the above example the PC would need to have a route added to its routing table to reach the remote mux using either Radio #1 or Radio #2 as the gateway. Alternatively, the user could specify to Radio #1 and Radio #2 to proxy ARP for the mux, IP address 192.168.1.5. The command to do this is:

```
arp -s 192.168.1.5
```

See the discussion on Proxy ARP above for more information.

Notice of Disclaimer

The information and specifications provided in this document are subject to change without notice. GE MDS reserves the right to make changes in design or components as progress in engineering and manufacturing may warrant.

The Warranty(s) that accompany GE MDS products are set forth in the sales agreement/contract between GE MDS and its customer. Please consult the sales agreement for the terms and conditions of the Warranty(s) proved by GE MDS To obtain a copy of the Warranty(s), contact your GE MDS Sales Representative at 1-585-242-9600 or 1-585-242-9620 (FAX).

The information provided in this GE MDS document is provided “as is” without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Some jurisdictions do not allow the exclusion of implied warranties, so the above exclusion may not apply to you.

In no event shall GE MDS be liable for any damages whatsoever – including special, indirect, consequential or incidental damages or damages for loss of profits, revenue, use, or data whether brought in contract or tort, arising out of or connected with any GE MDS document or the use, reliance upon or performance of any material contained in or accessed from this GE MDS document. GE MDS license agreement may be provided upon request. Additional Terms and Conditions will be finalized upon negotiation or a purchase.

The above information shall not be constructed to imply any additional warranties for GE MDS equipment including, but not limited to, warranties of merchantability or fitness for an intended use.

Trademark Information
All brand or product names herein are trademarks or registered trademarks of their respective companies or organizations.