

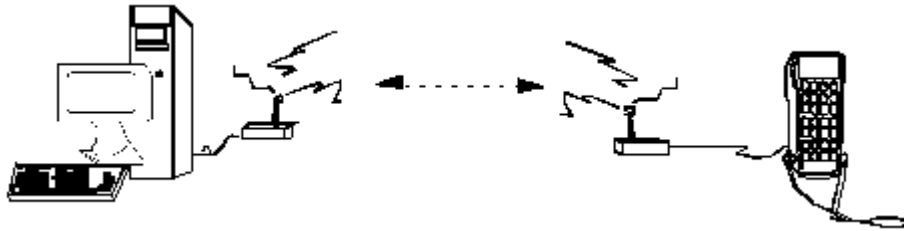
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## Product Overview

### Summary of Function and Use



The OS2400s radios have been designed to provide a wireless replacement for any serial cable. Any two devices which could otherwise function together with a physical serial cable between them can be incorporated into a wireless network and continue to function as before.

**Spread spectrum:** These radios transmit using a technique known as “spread spectrum, frequency hopping communications”. Using the spread spectrum technique a narrow band signal is spread over a broader portion of the radio frequency band.

**Frequency hopping:** A radio which rapidly changes its operating frequency several times per second following a pre-determined sequence of frequencies is defined as “frequency hopping”. The receiving and transmitting radios are programmed to follow the same frequency hopping sequence.

The OverAir design takes advantage of these characteristics which are inherent to the spread spectrum technique:

- ?? **increased immunity to noise.** Radios are designed to detect specific radio frequencies. “Noise” is defined as an unwanted signal which has been transmitted at the same frequency as the radio was designed to detect. There are many man-made and natural sources of “noise”. Due to the spread spectrum and frequency hopping techniques, the OS2400 operates more efficiently than a radio which operates using conventional technology.
- ?? **multiple users** can share the same frequency at the same time. As an example of this, cellphone use is dependent upon spread spectrum transmission.

Under FCC rules, users of FCC certified spread spectrum products do not require their own license from the FCC. The manufacturers of the products are required to apply for and be granted an FCC license for the device. OverAir has been granted a license by the FCC for the use of its OS2400 radios.

# FCC Rules

## FCC Compliance Statement

### FCC RULES

The statements contained in this section “FCC RULES” are required. If the Locus, Inc., OverAir Solutions OS2400 radio is used as a component of any device, these statements must be a component of that device’s product documentation.

### FCC COMPLIANCE STATEMENT

The Locus, Inc., OverAir Solutions OS2400 device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- ?? this device may not cause harmful interference, and
- ?? this device must accept any interference received, including interference that may cause undesired operation.

### WARNING

Changes or modifications to this radio module not expressly approved by its manufacturer, Locus, Inc., could void the user’s authority to operate the equipment.

### NOTE:

The Locus, Inc., OverAir Solutions OS2400 module is labeled with an FCC ID number. If this label is not visible when installed in an end device, the outside of the device **MUST** also display a label referring to the enclosed OS2400. Wording on the label similar to the following should be used:

“Transmitter Module FCC ID: OQ7OS2400”

### OR

“This device contains Transmitter Module FCC ID: OQ7OS2400.”

### NOTE:

OEM integrators using this module in their final products must provide appropriate information for end-users to comply with FCC RF exposure requirements, as indicated in this manual. Separate FCC approval is required for products operating with a separation distance of less than 20 cm between the antenna and persons.

## Approved Antennas

It is important to keep the radio's antenna a safe distance from the user. In order to meet the requirements of FCC part 2.1091 for radio frequency radiation exposure, this module must be used in such a way as to guarantee at least 20 cm between the antenna and the body, or more for high gain antennas. The FCC requires a minimum distance from the user of 1mW cm<sup>2</sup> squared power density" or 20cm, whichever is the greater distance.

If a specific application requires a proximity of less than 20cm, the application must be approved through the FCC for compliance to part 2.1093.

At the time of this printing, the antennas listed below were the only antennas approved for use with the OS2400 Radio Modem. Use of other antennas must be approved through Locus, Inc.

| Antenna gain (dBi)                                                                                | Antenna Type                                             | Locus, Inc., approved antennas (Manufacturer: mfg number)                    | Minimum Distance from Body (in) |
|---------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------|
| 2                                                                                                 | ¼ Wave Whip<br>¼ Wave Whip<br>¼ Wave Whip<br>¼ Wave Whip | NCC: N24ARSMA1<br>NCC: N2400SM8<br>NCC: NOV2400SMA<br>Centurion: WCR2400MRSP | 20cm (7.9in)                    |
| 5                                                                                                 | Collinear Whip<br>Collinear Whip                         | NCC: N24HGASM1B<br>NCC: NOV24HEARSMA2B                                       | 20cm (7.9in)                    |
| 6                                                                                                 | Collinear Whip                                           | MaxRad: MFB-24006                                                            | 20cm (7.9in)                    |
| 8                                                                                                 | Collinear Whip<br>Patch                                  | MaxRad: MFB-24008<br>MaxRad: MP24008FSMA                                     | 20cm (7.9in)                    |
| 9                                                                                                 | Collinear Whip                                           | Mobile Mark: 0D9-2400                                                        | 20cm (7.9in)                    |
| 11                                                                                                | Patch                                                    | MaxRad: MP24011FSMA                                                          | 20cm (7.9in)                    |
| <b>The following high-gain antennas can only be used for point-to-point network applications:</b> |                                                          |                                                                              |                                 |
| 13                                                                                                | Patch                                                    | MaxRad: MP24013FSMA                                                          | 20cm (7.9in)                    |
| 15                                                                                                | Yagi                                                     | Astron: P-2415                                                               | 20cm (7.9in)                    |
| 24                                                                                                | Parabolic Dish                                           | Pacific Wireless: PMANT25                                                    | 50cm (19.7in)                   |

## Max Antenna Gain / Output Power

### NOTE:

All of the Locus, Inc., **approved antennas** meet the Point-to-Point antenna gain / output power emissions requirement. The approved antennas with gains greater than 12dBi, however, can only be used for point-to-point networks and may not be used for point-multipoint networks. The calculations below illustrate this limitation.

The FCC transmitter power limit for this type of radio is 30 dBm (or 1 watt). In addition, to ensure safety, the output of this module is limited to 250mW. To meet the FCC requirements for emissions, the following restrictions on antenna gain must be adhered to when establishing a radio network.

#### Point-to-Point network:

max power 250 mW / max antenna gain 24 dBi

?? The transmitter power reference for a Point-to-Point network is 30dBm (1 watt) of output power with an antenna gain of 6dBi. For each 1 dB decrease in output power below this reference point, the antenna gain can increase by 3 dB.

?? With the OS2400 radio module's maximum output power of 250 mW, the maximum allowable antenna gain is 24 dBi in a Point-to-Point application.

$$(30\text{dBm} - 24\text{dBm}) + (6\text{dBi} * 3) = 24\text{dB}$$

#### Point-Multipoint network:

max power 250 mW / max antenna gain 12 dBi

?? The transmitter power reference for a Point-Multipoint network is 30 dBm (1 watt) of output power with a maximum antenna gain of 6 dBi.

?? For each 1 dB decrease of output power below this reference point, the antenna gain can increase by 1 dB.

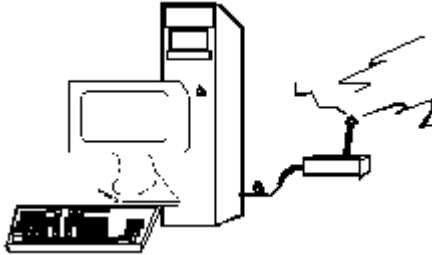
?? The OS2400 radio module has a maximum output power of 250 mW or 24 dBm. Therefore, the maximum allowable antenna gain at full output power is 12 dBi in a Point-Multipoint application.

$$(30\text{dBm} - 24\text{dBm}) + 6\text{dBi} = 12\text{dBi}$$

# Getting Started

## Setup Overview

A new radio network must be configured to function as required for the specific application.



These are the main steps in the configuration of a new OS2400 radio network:

- ?? Installing the setup/diagnostic software
- ?? Identifying and setting the serial port
- ?? Making the cable connections
- ?? Network design
- ?? Graphically defining the network
- ?? Configuring the radios
- ?? Physically installing the radios and antennas
- ?? Verification of network installation

## The Setup / Diagnostic Software

The OS2400 Setup Application provides a user interface for the configuration and maintenance of a radio network, regardless of the intended application. It graphically reflects the physical layout of the component radios.

The Setup Application provides a means to:

**?? configure new networks or radios:**

- ?? assign roles (Master or Remote) to the radios.
- ?? define data paths
- ?? set the radio's operation parameters (baud rate, parity, etc.)

**?? edit existing networks or radios:**

- ?? add or delete Remote Radios (in point-multipoint networks only)
- ?? re-assign roles to the radios.
- ?? re-define operation parameters

**?? diagnose functioning of existing networks.**

With a MASTER cabled to the PC, the status of each REMOTE can be displayed.

**NOTE:**

It is recommended that the OS2400 Setup Application be installed on only one computer and that the network configuration be done from only that one computer.

When a network is designed, the configuration settings are stored in a database which is internal to the OS2400 Setup Application. When networks are modified, the OS2400 Setup Application depends upon the retrieval of the network's configuration history. Network modification and maintenance is easier if the OS2400 Application Software is installed on only one computer. All subsequent network-related configurations are done using that one computer.

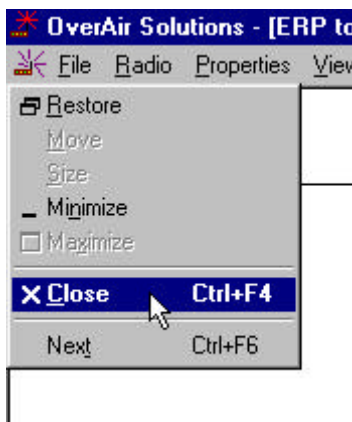
Through out these Help files, the computer into which the OS2400 Setup Application has been installed will be referred to as the Configuration PC.

## Functional Conventions

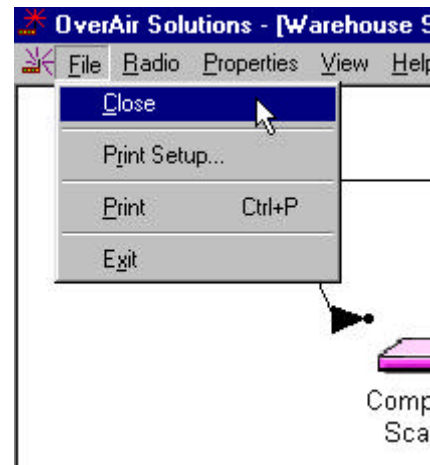
The OK, CANCEL, CLOSE and EXIT functions are available from many of the OS2400's Setup/Diagnostic Application screens. From any screen, these functions cause the same action. They provide a consistent function throughout the Application.

- ?? **OK** to confirm/enter any changes made and return to the Setup Software main menu.
- ?? **CANCEL** to discard any changes and return to the Setup Software main menu.
- ?? **CLOSE** the current screen and return to the Main Screen:

?? radio icon  
?? CLOSE



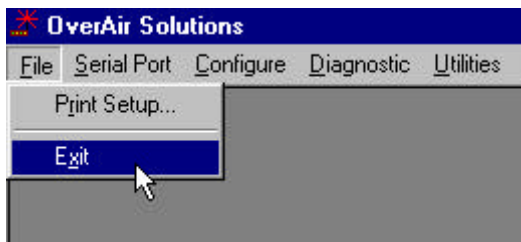
OR  
?? FILE  
?? CLOSE



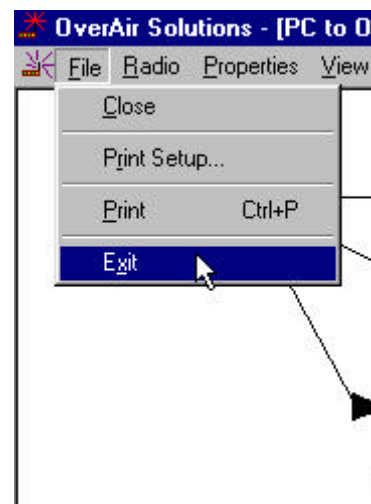
?? **EXIT** the application completely, select:

?? FILE  
?? EXIT

From the Main Screen:



From either the Diagnostic or the Configuration Screens:



## Hardware Installation

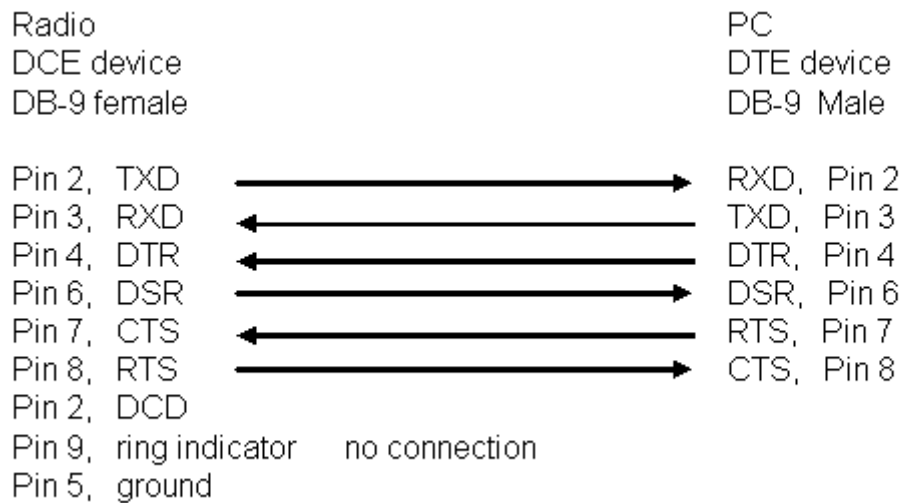
### CABLE SPECIFICATIONS

The **Radio** is considered to be a **DCE** device.

The **PC** is considered to be a **DTE** device.

The following illustrates the wiring of the straight through serial cable which is used to connect:

- ?? the Configuring PC and each radio during its configuration.
- ?? the Configuring PC and the Master radio during network operation.



### RADIO POWER REQUIREMENTS

The standard radio includes an RS232 interface board with a switching power supply. The switching power supply allows the operating input voltage to vary from 6 to 24VDC, while maintaining an unvarying 6 Watts of input power.

The input connector is a standard power jack (Switchcraft; RAPC 722).

The wall cube connector is not included with the standard radio.

When purchasing the wall cube connector verify that its polarity is as indicated:



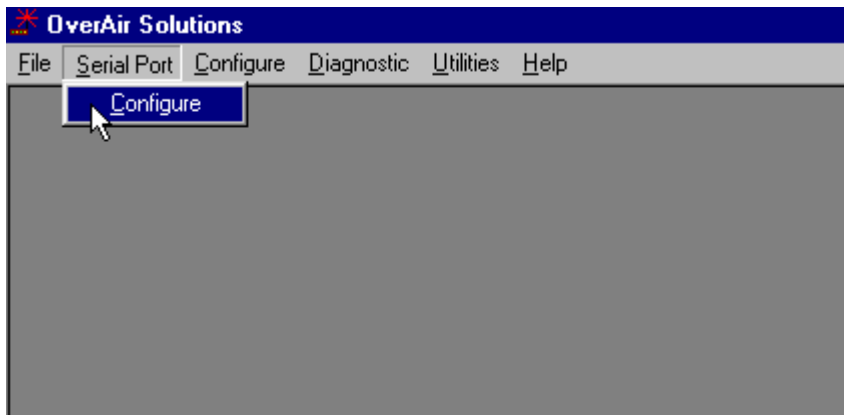
## THE SERIAL PORT

### VIEWING THE SERIAL PORT SETTINGS

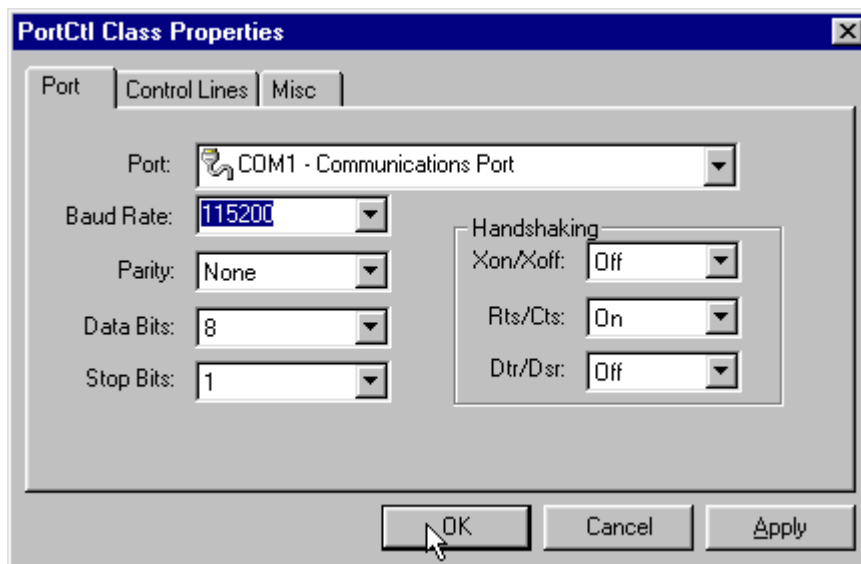
The serial port of the Configuration PC must be identified and its parameters set before radio communication can begin.

To view the current settings, from the main menu of the OS2400 Setup Application select:

- ?? SERIAL PORT
- ?? CONFIGURE



The displayed dialog box has three tabs. With the first of the tabbed dialog boxes, PORT, the serial port settings are displayed. To understand how to customize these settings see [Setting the Serial Port](#).



### SETTING THE SERIAL PORT

These are the factory-set serial port parameters for the Configuration PC.

Change these defaults with care.

?? Baud rate: 115200 (default).

?? Parity: None (default).

?? Data Bits: 8 (default).

?? Stop Bits: 1 (default).

?? Handshaking:

It is recommended that the handshaking defaults not be changed.

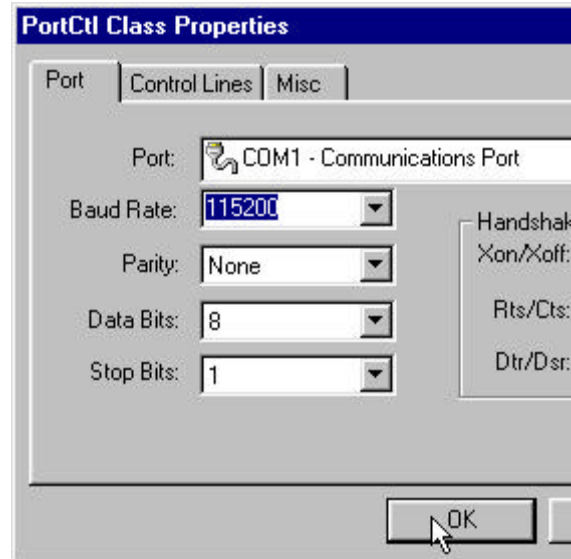
?? Xon/Xoff OFF

?? Rts/Cts ON

(Request to Send/Clear to Send)

?? Dtr/Dsr OFF

(Data Terminal Ready/Data Set Ready)



?? From the drop down list, select the COM port to be used. The term COM port refers to the hardware connectors which allow the computer to COMMunicate with other devices (like a printer or an OS2400 radio) through cables. Usually the hardware connectors are located on the back of the computer.

The OS2400 Setup Application automatically determines and displays the serial ports.

**NOTE:**

The determination of the designation (name) of each COM port can be accomplished several ways:

- ?? look for a label at the connector on the back of the PC.
- ?? consult the computer's documentation.
- ?? experiment, trial and error.
- ?? check (and or adjust) the PC's BIOS configuration.

In general, the factory set defaults will not have to be changed.

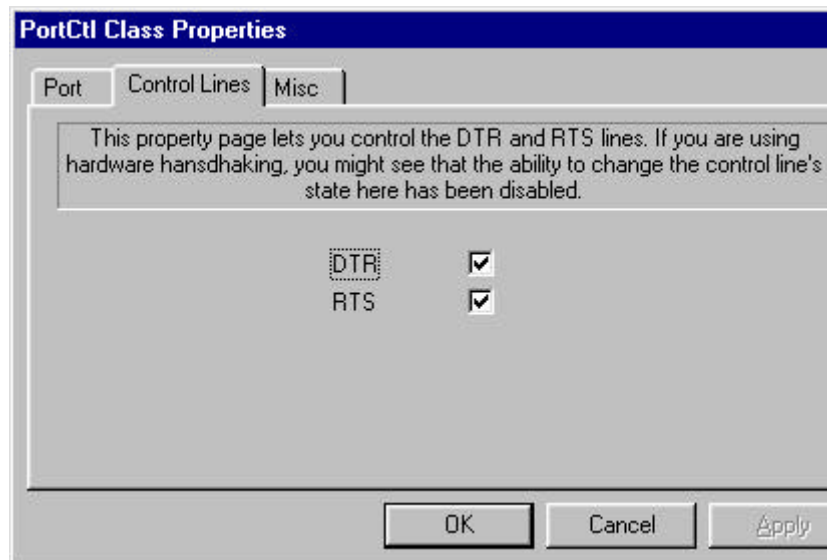
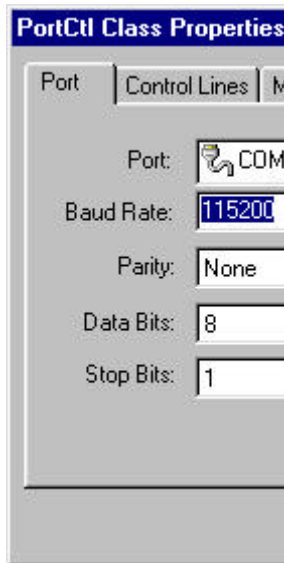
**OK** to accept the current settings.

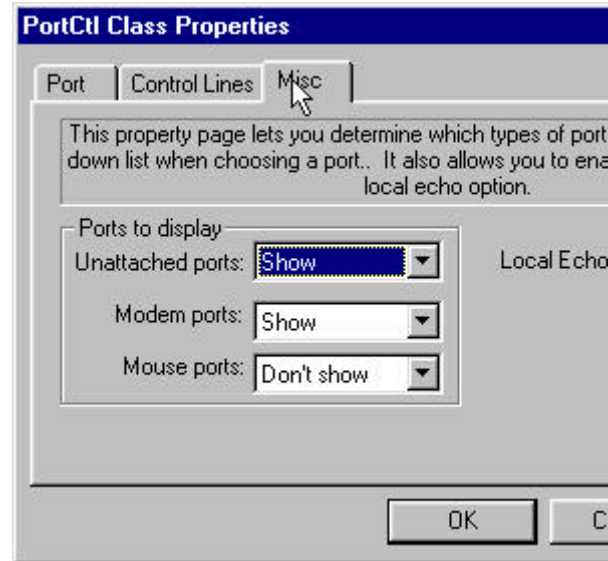
For an illustration of the factory default serial port settings see [Serial Port Factory Default Settings](#).

## SERIAL PORT FACTORY DEFAULTS ILLUSTRATED

From any of the three associated dialog boxes, select:

- ?? OK to confirm/enter any changes made and return to the Setup Software main menu.
- ?? CANCEL to discard any changes and return to the Setup Software main menu.





## Network Design

### Radio Network Basics

#### RADIO NETWORK DEFINED

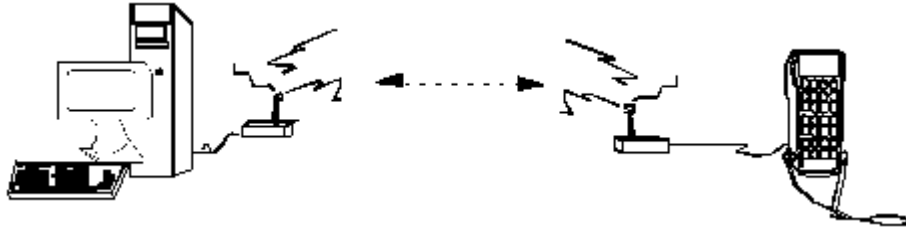
A radio network provides wireless replacements for serial cables. Any two devices which could otherwise function together with a physical serial cable between them can be incorporated into a wireless network and continue to function as before. The basic network consists of a Master Radio cabled to one Device and a Remote Radio cabled to another.

As examples, a Master Device - Remote Device pairs could be:

- ?? a computer with a printer
- ?? a computer with a scanner
- ?? a scanner with a printer
- ?? a Modbus controller and an industrial tool

A radio link can be used in any situation where a Master Device and its Remote Device are located such that a serial cable connection between them is impractical or impossible. The radios are designed to communicate up to 20 miles.

An example of a simple radio network is illustrated below. The Master Device is a computer and its Remote Device is a hand held terminal.



## NETWORK\_CHANNELS

Network channel selection is used to allow the operation of several networks in the same location. If the same network channel is selected for two networks which are close to each other, the networks will interfere with each other, and may not communicate at all.

For network functionality these network channel requirements **must** be adhered to:

- ?? The Master Radio and Remote Radio (or Radios) of each network must be assigned to the same network channel.
- ?? Networks in close proximity must be assigned to different network channels.

The Os2400 radio can support 32 channels. In this case a channel is a 500KHz wide frequency range used for communication between two radios.

## NETWORK TYPES

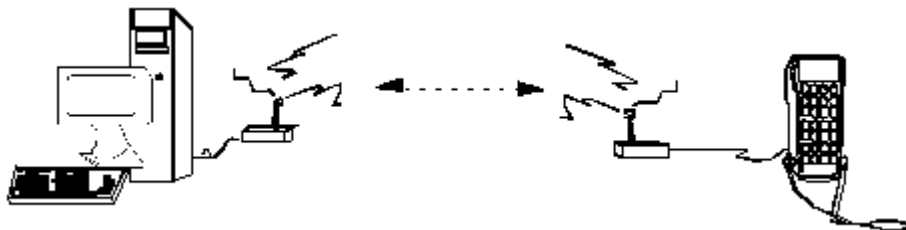
### POINT-TO-POINT

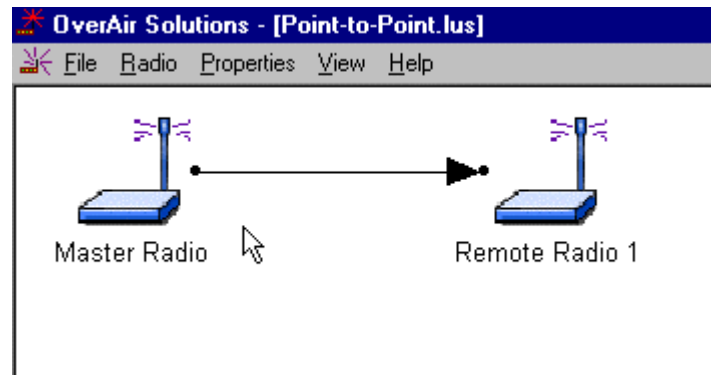
There are two network types, point-to-point and **point-to-multipoint**. In all networks there is only one Master Radio.

**Point-to-Point** networks are the simplest radio network. In a point-to-point network one Master Radio is cabled to a Master Device and one Remote Radio is cabled to a Remote Device.

Several point-to-point networks can operate at the same location, however each network must use a different communication channel.

Each point-to-point network operates independently of each other, there can be no intercommunication between the point-to-point networks.



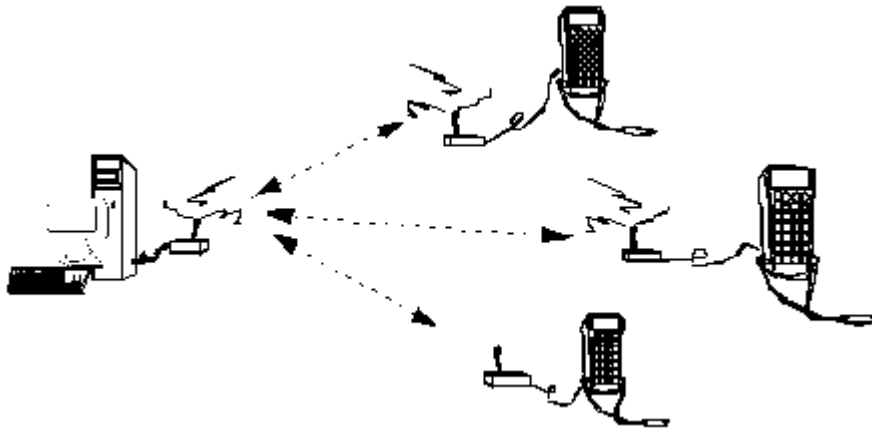


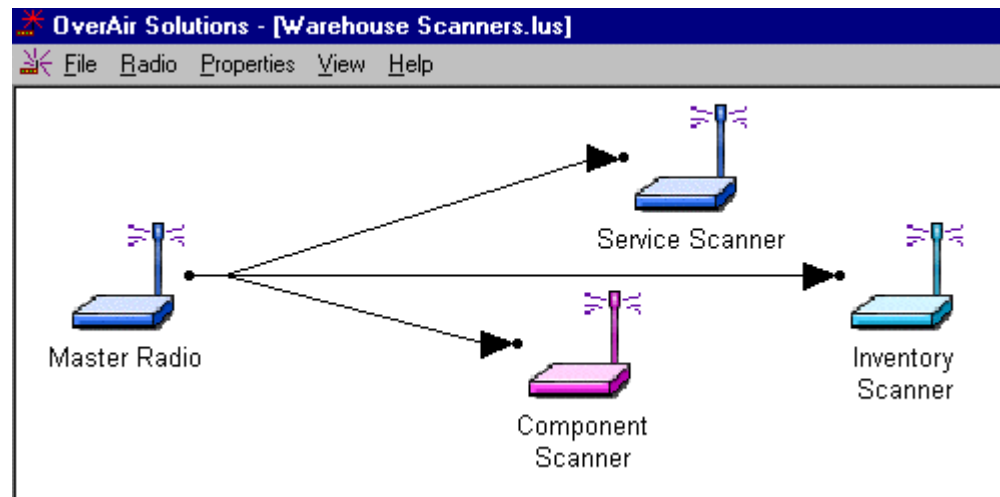
### POINT-MULTIPOINT

In **Point-Multipoint** networks one Master Radio is in communication with at least two Remote Radios. The Remotes can only communicate with their Master. Remotes cannot communicate with each other directly, the data must be passed through the Master. For this reason, a Point-Multipoint network will not work with an application which requires **peer to peer communication**.

The OS2400 Point-Multipoint network can only be used with devices that are designed to use the Modbus communication protocol. In a Modbus network each device has its own Modbus address. In the network configuration process, each radio's address must be correlated with the Modbus address of the device cabled to it.

It may be that the data throughput rate is not as high as in a point-to-point network. In a point-to-point network the data path is predefined. There are no choices. There is only one destination. In a point-multipoint network the destination must be determined, the address information must be resolved before the transmission can proceed.





## Installation Planning

### SITE SELECTION

A network's performance can be impacted by attributes of the installation site. An optimal installation provides for:

- ?? **protection** from direct exposure to weather
- ?? **power source**, both adequate and stable
- ?? less than **256 radios** per channel
- ?? radios placed **within 20 miles** of each other
- ?? **line of sight** between the Master and each Remote antennas, provides the most reliable communication link
- ?? **portable Remote** radio requirements, maintain a line of sight
- ?? **proximity of massive structures** off of which radio signals can bounce, metal walls
- ?? **sources of RF interference**, electrical equipment (arc welding, switching power supplies, etc.)
- ?? antennas types
- ?? **cabling losses**, signals lose power over cabled distance

Mounting the antenna on a tower or rooftop can provide a line-of-sight path if the site contains obstructing terrain or structures. The line-of-sight consideration becomes more important as the transmission path becomes longer. It is most important as the transmission path approaches the limiting 20 mile specification.

Though radio frequency communication is reliable, sometimes its performance can be impacted by intangibles. It is suggested that the network installation planning include time and resources for performance testing and installation changes.

It is suggested that the **installation plan be tested** before the network is finally installed.

## ANTENNA SELECTION

### WHIP ANTENNAS

Only certain whip antennas have been **approved** for use with the OS2400 radio modem.

½? Straight Whip or ½? Articulating Whip (2dBi)

- ?? Most commonly used antenna
- ?? Length approximately 5 inches
- ?? Likely to be connected to a remote radio (connected directly to the radio enclosure)
- ?? Does not require a ground plane
- ?? Function of articulating, the same as unarticulating. Articulating antenna bends at the connection.

¼? Whip Antenna (2dBi)

- ?? Shorter than the ½? whip (2.5")
- ?? Requires a ground plane, mounted below the antenna and over the top surface of the radio
- ?? Needs to remain vertical (does not radiate well out the top of antenna)
- ?? Works well for belt mounted remote radios



We need some pictures here.

RE

RE

RE

1. Disc Antenna (2dBi)  
Low profile antenna (0.25" to 0.45" high)

RE Requires a ground plane

☞ Same requirements as the 1/4 wave whip antenna

☞ SubTypes (2 versions)

?? Self contained w/ ground plane and connector

?? Other versions are meant to be mounted to a circuit board which provided connection and ground plane

2. 9dBi Gain Antenna (7-9dBi)

☞ Highest gain antenna allowable for point - multipoint networks

☞ Radiates uniformly around the antenna (Azimuth)

☞ Has limited elevation angle

☞ Used mostly as a master radio in the network

3. 15dBi Gain Antenna

☞ Restricted to point-point network only

☞ Used when long distances are needed

☞ Can be used by both the master and remote of the network

☞ SubTypes;

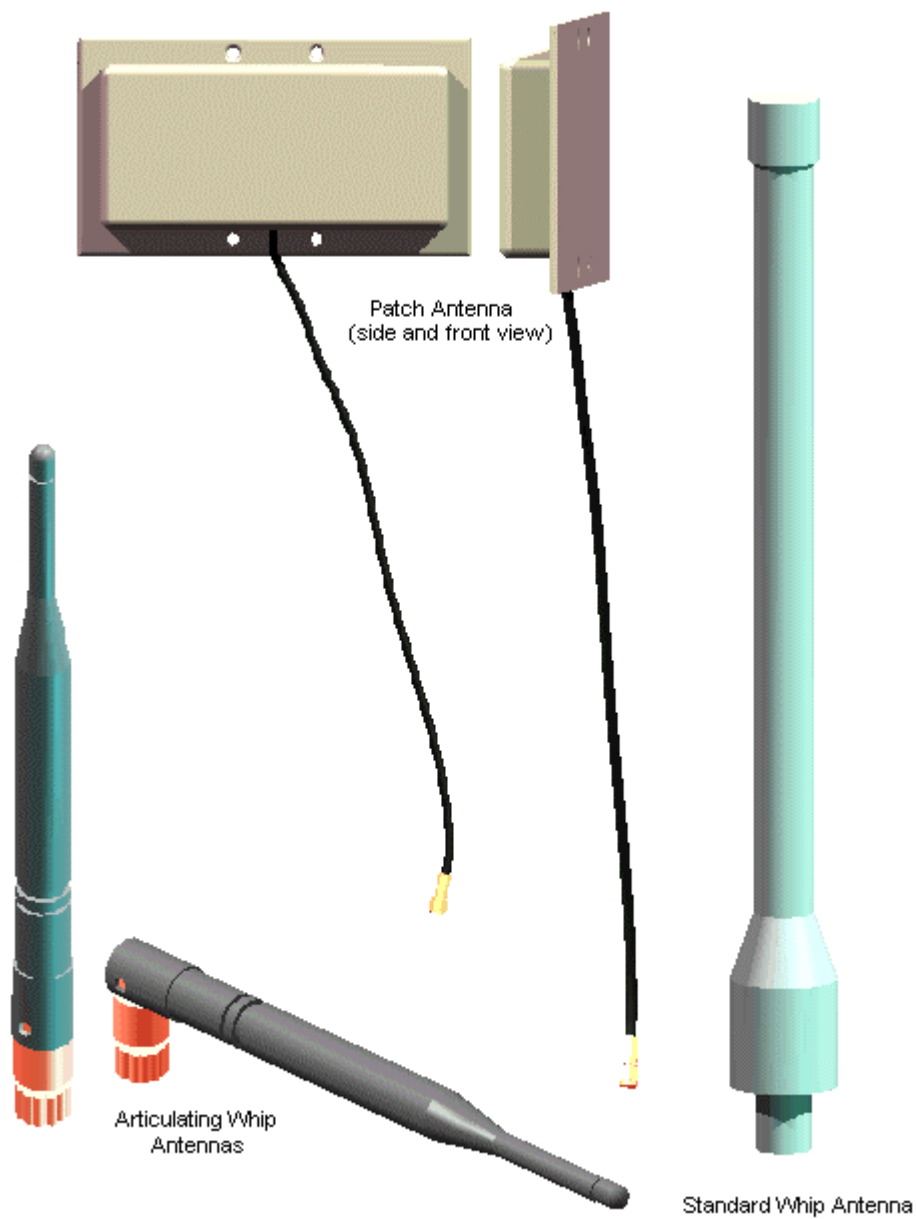
?? Plate – are generally 2ft. square and several inches thick, they mount vertically and the face of the plate points in the direction of radiation

?? Yagi / Tube – range from 18” to 32” in length, and about 2” in diameter. They mount horizontally and point in the direction of radiation.

?? Corner reflector / small radiating element with an L-shape reflector behind the antenna.

?? Parabolic / square reflector and shaped to form a pseudo-parabola with a radiating element in the center

## ANTENNA TYPES ILLUSTRATED

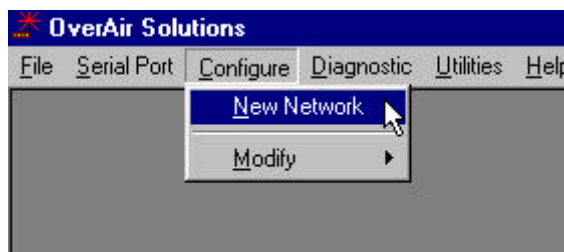


## Configuring the Network

### DEFINE NETWORK NAME, TYPE, CHANNEL

From the main menu of the OS2400 Setup Application select:

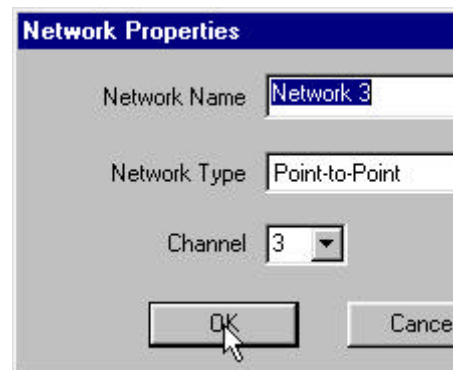
- ?? CONFIGURE
- ?? NEW NETWORK



A Network Properties dialog box is displayed. Using this dialog box, the basic parameters of the new network is defined:

- ?? **Network Name:** Use up to 20 alpha/numeric characters. The OS2400 Setup Application will use this assigned name in all subsequent references to this network. **The network name cannot easily be changed. It is recommended that the user choose a descriptive name that all who may be involved in the network's maintenance will recognize.**

- ?? **Network Type:** From the drop down list select "Point-to-Point" or "Point Multipoint". See [Network Types](#) in this Help system for an illustration of the available network types.



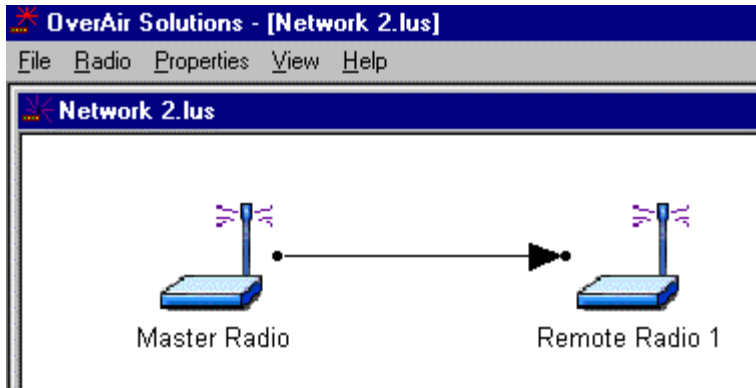
- ?? **Network Channel:** Network channel selection is used to allow the operation of up to 32 different networks in the same location. For network functionality these channel requirements must be adhered to:

- ?? The Master Radio and Remote Radio (or Radios) of each network must be assigned to the same channel.
- ?? Networks in close proximity must be assigned to different channels. If the same channel is selected for two networks that are close to each other, the networks will interfere with each other, and may not communicate at all.

OK: to confirm/enter the selected network configuration and proceed to the [graphical layout screen](#).

CANCEL: to close the Network Properties dialog box, discarding any changes made to the network properties.

### GRAPHICAL LAYOUT SCREEN



When the settings of the **Network Properties** dialog box are accepted, a graphical illustration of a basic two radio network with its communication path (RF link) is displayed. This is the default layout screen for either a Point-to-Point or Point MultiPoint Modbus network.

This is extent of the configuration of a **Point-to-Point network**.

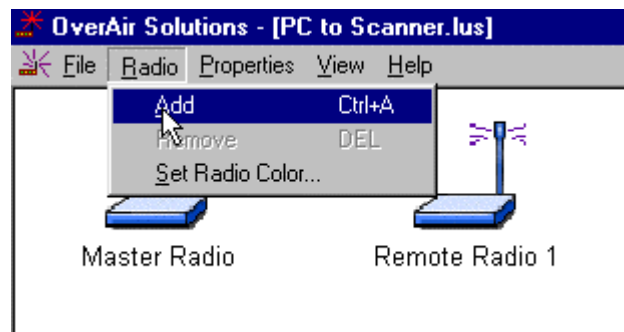
For a **Point-Multipoint** design, additional Remote Radios are added with the **Add Radio** function.

Note: Any radio can be **moved**.  
Any radio can be **renamed**.

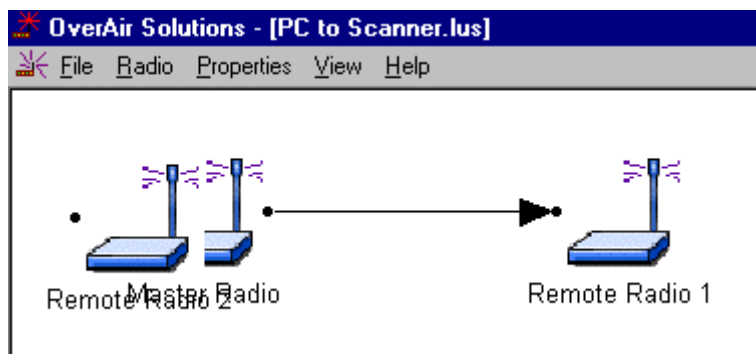
## ADDING RADIOS FOR POINT MULTIPOINT

Select:

- ?? RADIO
- ?? ADD



An additional radio appears, supimposed on the Master.

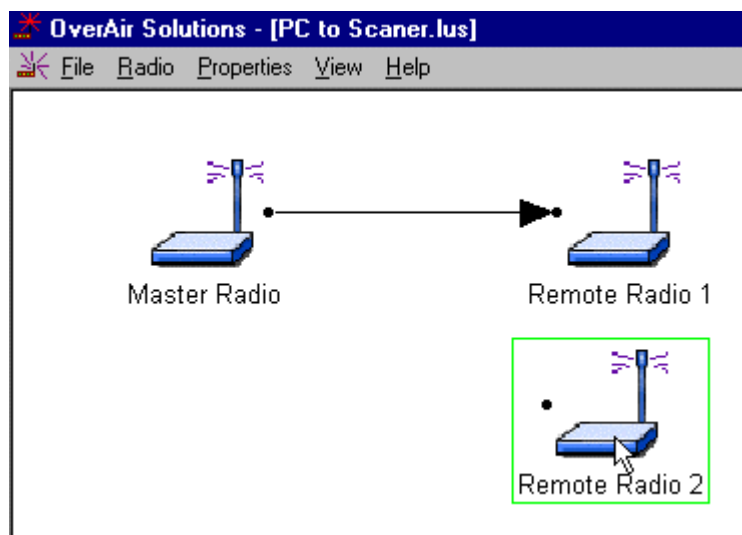


The additional Remote Radio must be **moved**.

Note:

The radios can be displayed in different colors. The color of a radio does not affect the function of the network, however, there may be an application that can be more clearly represented if the radios are represented with different colors in the graphical layout screen. The **color** must be defined before the radio is added.

## MOVE RADIOS

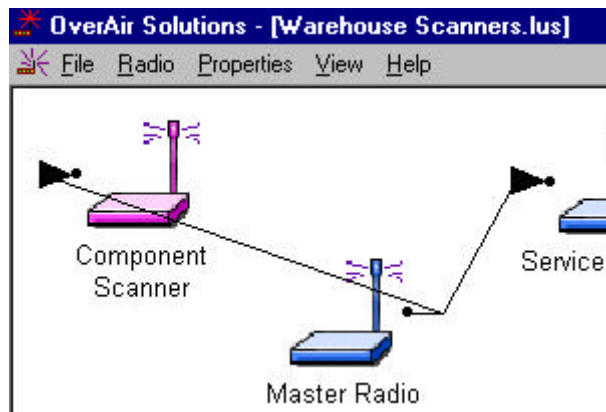


To move a radio, select it with the left mouse button.

Holding down the button, drag the radio to the location which best indicates the topography of the network.

Communication connections will stretch and shrink like “rubber bands”. Moving radios does not alter the function of the network.

Note: In general, the network configuration as displayed here is not the best topographical model of a network's layout. This layout was devised for illustration only.



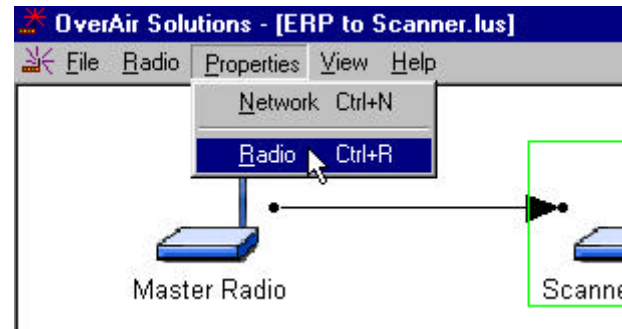
The default radio **names** can be changed.

## RENAME RADIOS

To rename an existing radio the Radio Configuration dialog box must be accessed. Type the Radio's new name into the “Radio Name” field.

This dialog box can be accessed in either of two ways:

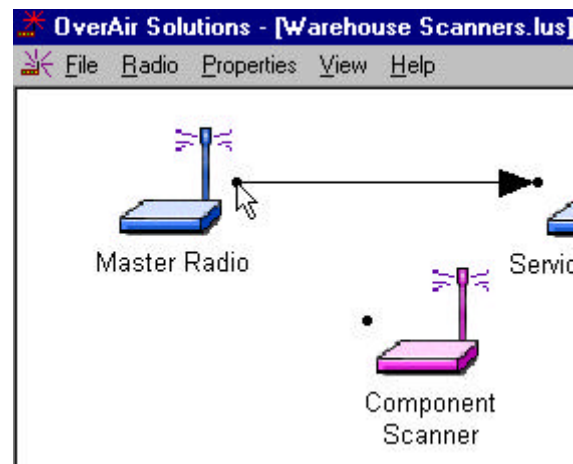
- ?? Using the left mouse button, quickly double click on the Radio's icon.
- ?? From the Graphical Layout Screen, select:
  - ?? ? PROPERTIES
  - ?? ? RADIO



## GRAPHICALLY DEFINE THE RF LINK

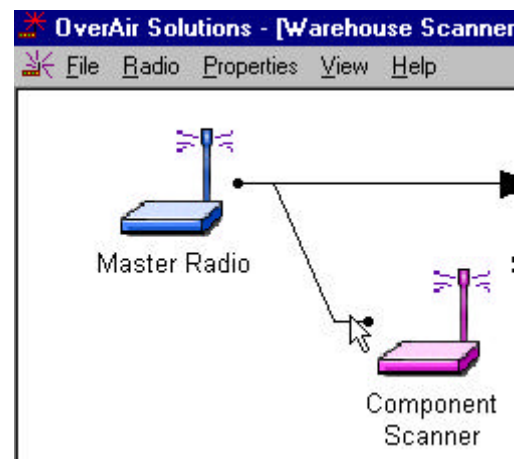
Drag the cursor to the black dot to the right of the Master.

Click down the left mouse button and hold it down.



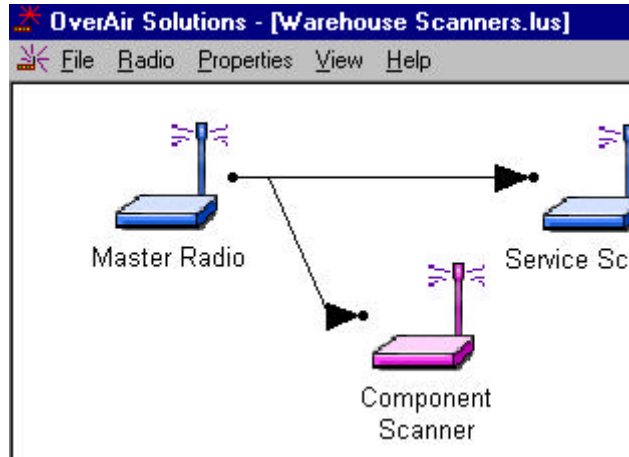
With the left mouse button held down, drag the cursor to the dot at the left of the Remote.

A line will appear between the Master and the Remote.



Release the mouse button go.

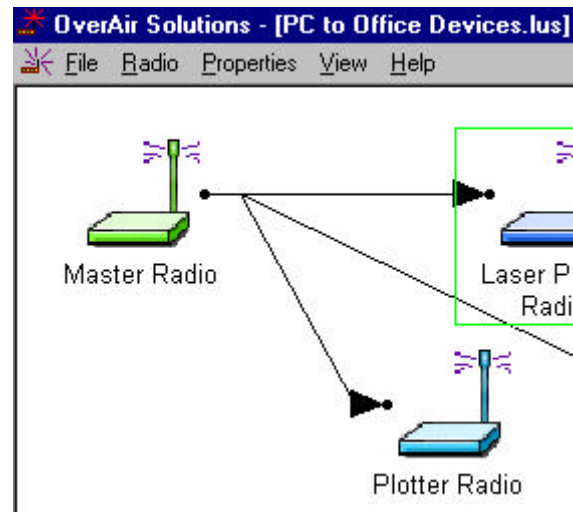
An arrow head will appear at the Remote.



## DELETE A RADIO

From the network's Graphical Layout Screen select:

?? (highlight) the radio to be deleted.

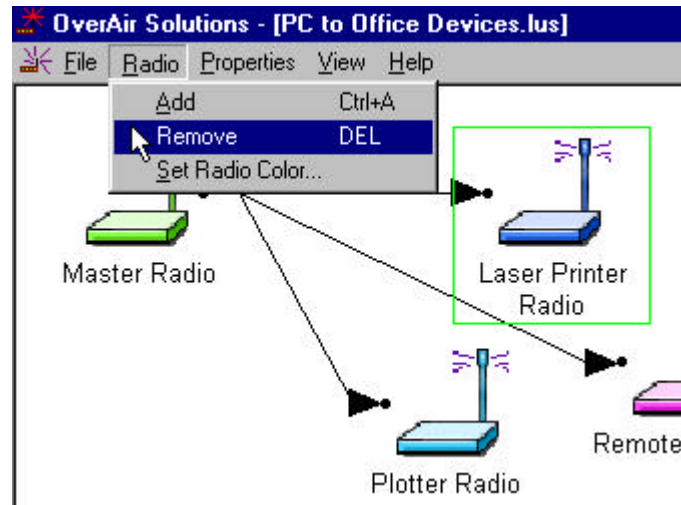


?? RADIO

?? REMOVE

**OR**

Select the keyboard's DELEte key



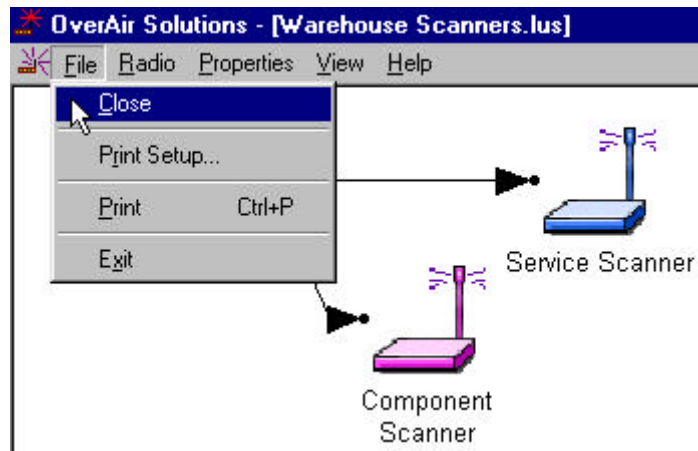
## SAVE THE NETWORK'S DEFINITION

Save the Network's definition in these two situations:

- ?? if a new network has been defined
- ?? if changes have been made to the network's definition

From the Graphical Layout Screen select:

- ?? FILE
- ?? CLOSE (or EXIT)



The standard Windows Save As dialog box will be displayed. The network name can be accepted as it is or it can be edited here, but note:

**THIS IS THE LAST TIME THAT THE NETWORK'S NAME CAN BE CHANGED.**

Select:  
?? SAVE

**NOTE:** DO NOT change the default directory. The OS2400 Setup/Diagnostic Application uses the default directory to maintain network related data.



The Network's Definition can be **printed**.

## Configuring the Radios

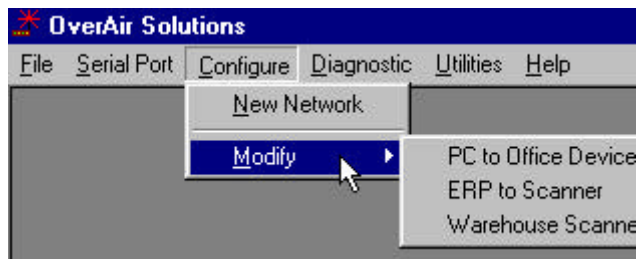
### CONFIGURE THE RADIOS

Once the network is designed, the radios themselves must be configured.

Radios are configured one at a time using the Configuration PC (the one in which the OS2400 Setup/Diagnostic Software has been installed).

Using the **specified cable**, connect the radio to the Configuration PC.

**Note:** Connect the radio to the PC's COMmunication port as specified in the **PC's serial port dialog box**.



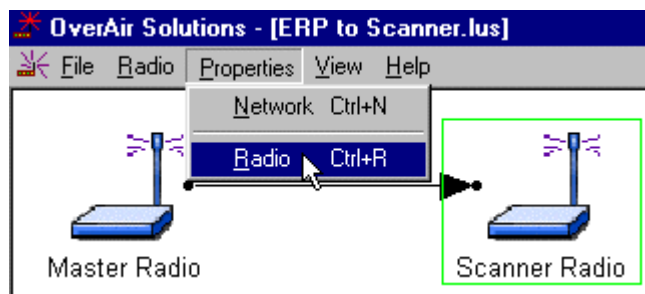
From the Main OS2400 Menu, select:

- ?? CONFIGURE
- ?? MODIFY
- ?? the network by name

From the Graphical Layout Screen select:

- ?? (highlight) the radio to be configured
- ?? PROPERTIES
- ?? RADIO

The Radio Configuration Dialog box is displayed:



**Note:** The Radio's serial port settings (baudrate, parity, data bits and stop bits) must match those of the Configuration PC's.

**Note:** A good initial transmit power is 100mW. The power may need to be adjusted as part of the installation optimization process.

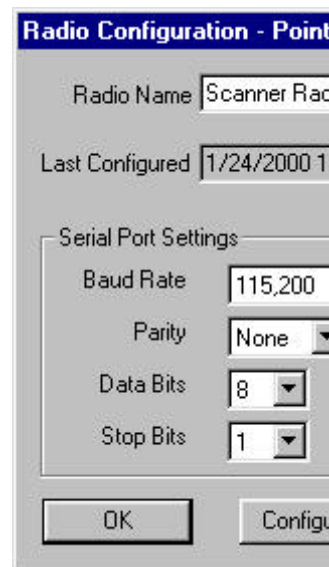
To complete the radio's configuration select:

?? CONFIGURE RADIO

CONFIGURE RADIO button causes the download of radio parameters from the Configuration PC to the radio. Once the configuration is complete **save the configuration** as prompted by the OS2400 Setup / Diagnostics Application Software.

**Note:** Once a radio is configured, it is recommended that the radio be labeled with its role in the network (Master or Remote), baud rate, channel, etc. Labeling can lessen confusion in the future.

If the radio's configuration fails, consult the [Diagnostics – Troubleshooting](#) section.



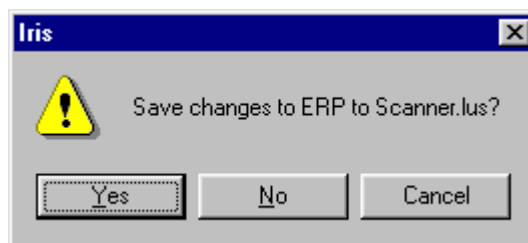
## SAVE THE RADIO'S CONFIGURATION

Once the radio has been configured, select:

?? FILE

?? CLOSE

This dialog box will appear. The name of the network is incorporated into the filename. The \*.lus is the filename extension of each network's database file. The radio has just been configured. This information must be added to the database file to keep the database current.



**Note:** It is for this reason that all network design and radio configuration be done using the Configuration PC. When networks are modified, the OS2400 Setup Application depends upon the retrieval of the network's configuration history.

## Physical Installation and Network Verification

### Test the Installation Plan

It is suggested that a proposed installation be tested before the installation is finalized.

Once the network has been configured and the radios have been configured:

- ?? install the Master radio in the proposed permanent location
- ?? cable the Configuration PC to the Master radio
- ?? place the Remote radios in their proposed locations
- ?? temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be by hand, however, then this testing is at least a two person operation. The system's diagnostics must be performed from the Configuration PC.

From the Diagnostic screen of the Configuration PC determine each radio's **Signal Quality**.

To improve the signal quality of each Remote's communication experiment with:

- ?? increasing the height of the antenna's placement
- ?? use higher gain antennas
- ?? increase the radio's transmission power, cable the radio to the Configuration PC and **reconfigure it**
- ?? select a new location for the Remote radio and/or its antenna
- ?? decrease the length of antenna cable
- ?? determine and mitigate sources of "electrical" **noise** which may be interfering with the OS2400 transmission

## Sources of Interference

Radios are designed to detect specific radio frequencies. “Noise” is defined as an unwanted signal which has been transmitted at the same frequency as the radio was designed to detect. There are many man-made and natural sources of “noise”. (lightning, power lines, switching power supplies, fluorescent lighting, microwave ovens, ...)

Due to the spread spectrum and frequency hopping techniques, the OS2400 operates more efficiently than a radio which operates using conventional technology.

- ?? Networks installed in rural areas will encounter less man-made noise than in suburban or urban areas.
- ?? If possible, use a directional (high gain) antenna at the Remote locations.
- ?? Verify that each network operating in close proximity to each other has BEEN ASSIGNED TO A DIFFERENT CHANNEL.
- ?? A network’s output power can be changed:
  - ? ? raise the power to “drown out” the competing noise
  - ? ? lower a network’s output power if it is interfering with another network in the vicinity

## Modifying an Existing Network

The radios within an existing network can be edited in several ways:

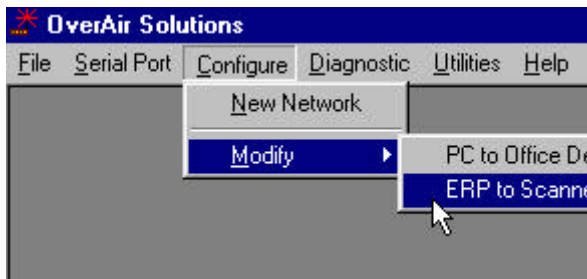
- ?? new radios can be ADDED to a point-multipoint network.
- ?? a radio's settings can be changed (baud rate, output power, channel, etc)
- ?? radios can be moved on the Graphical Layout Screen.
- ?? radios can be renamed.
- ?? radios can be deleted from a network.

From the Main Menu select:

- ?? CONFIGURE
- ?? MODIFY

A drop down list will appear with the names of the existing networks.

Note: When a network must be modified or its function diagnosed, it becomes apparent that assigning a good descriptive name when the network is initially set up, is indicative of good network design.



Only the channel of an existing network can be changed. Its type and name cannot be changed.

## Viewing (and Changing) a Radio's Settings

The settings of a radio can be viewed through the Radio Configuration Dialog box.

To view the settings of a particular radio select:

?? (highlight) the radio

?? PROPERTIES

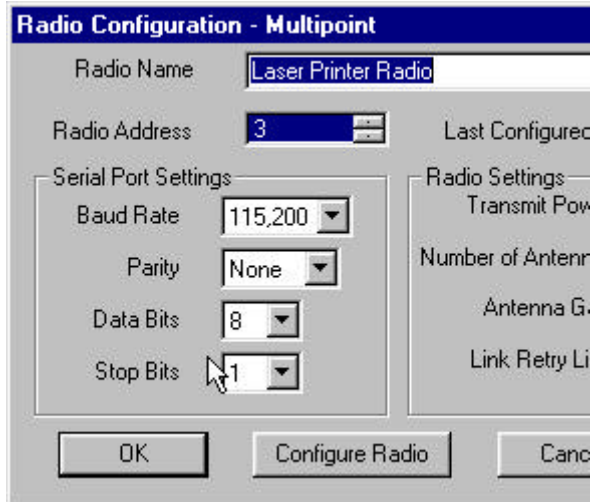
?? RADIO

OR

?? quickly double click on the radio's icon with the left mouse button

**Radio Name:** As it appears in this field, the radio's name will appear as a label under the radio's icon. The name can be any combination of up to 100 alphanumeric characters and spaces.

**Last Configured:** The date and time reported here indicates the last time that the configuration parameters were modified and saved, or when the radio was configured, configuration data was downloaded to the radio.



**Serial Port Settings:** the serial port settings of the radio radio, (not the PC's serial port).

**Note:** The settings of baud rate, parity, data bits (data word size) and stop bits **must** match the settings of the device which will be cabled to the radio during normal network operation.

**Radio Address:** each radio in the network is automatically assigned a unique address. If a radio's address is manually changed to an address already assigned to another radio in the same network, neither radio will communicate over the network. It is recommended that this addressing scheme not be changed by the user.

**Note:** In general, ACCEPT THE DEFAULTS.

The Radio Settings adjust the over the air performance of the radio network:

**Transmit Power:** This value should be set as low as possible and yet give a reliable over the air connection to the receiving radio. A higher power setting than necessary could increase the distance required between two networks operating on the same channel.

**Number of Antennas:** This is sometimes referred to as "antenna diversity". The use of two antennas allows the radio to cancel out noise. "Noise" is defined as an unwanted signal which has been transmitted at the same frequency as the radio was designed to detect. There are many man-made and natural sources of "noise".

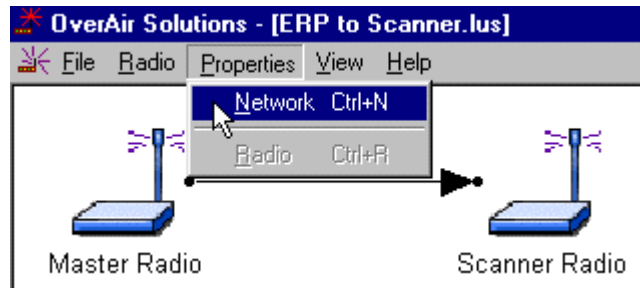
**Link Retry Limit:** If there is an error in transmission, the transmitting radio will re-send the data as many times as set with the Link Retry Limit slider switch. In normal transmission, the receiving radio "acknowledges" that the data has been received with no detected errors. If the transmitting radio does not get an acknowledgement, it will re-transmit until the retry limit has been met. Moving the slider to the right will

allow more retries. In a Point Multipoint network a high retry limit may slow down data transmission from another radio in the network.

## Change a Network's Channel

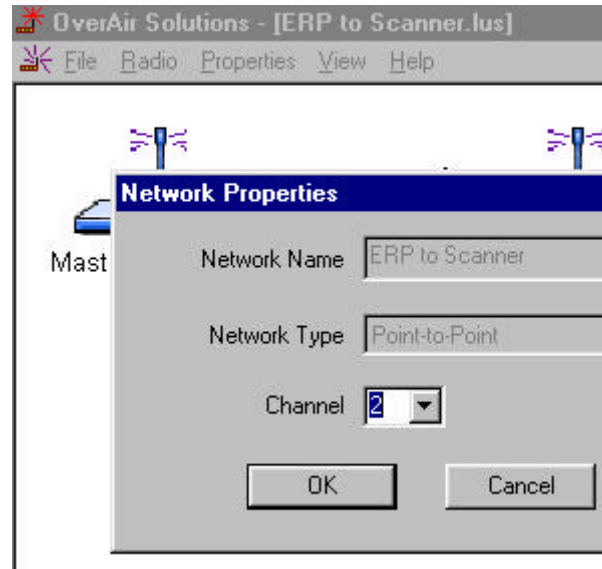
From the **Graphical Layout Screen** of an existing network select:

- ?? PROPERTIES
- ?? NETWORK



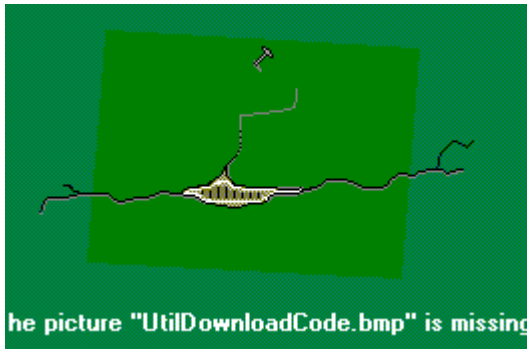
Note that these fields are "greyed" out. These network parameters cannot be changed:

- ?? Network Name
- ?? Network Type



## Upgrade Software - Download Code

The download code utilities allow the user to upgrade the firmware of the radio. This is done when updates to the features of the radio are implemented. To start a firmware download, connect the radio to be upgraded to the COM port specified in the [serial port configuration](#). Select the Download Code option under the Utilities menu in the main window.



Once this option is selected, the setup application program will automatically install the firmware to the radio. This option is available only if the firmware setup and installation have been executed on the setup application computer. If the firmware setup and installation has not been performed, the Download code option in the Utilities menu will be grayed out and cannot be executed.

The Download Code function is available under these circumstances. If either of these conditions is missing the Download Code function will be unavailable (greyed out).

- ?? the Download Code CD is in the Configuration PC's CD drive
- ?? at least one network has been configured

The Download Code function

# Miscellaneous Options

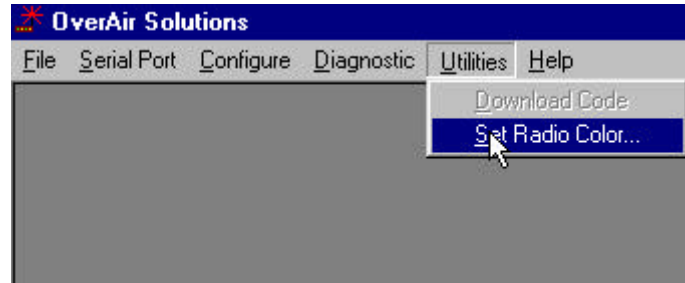
## Select Radio Color

The radio color can be set for the whole network from the Main Menu.

Select:

?? UTILITY

?? SET RADIO COLOR

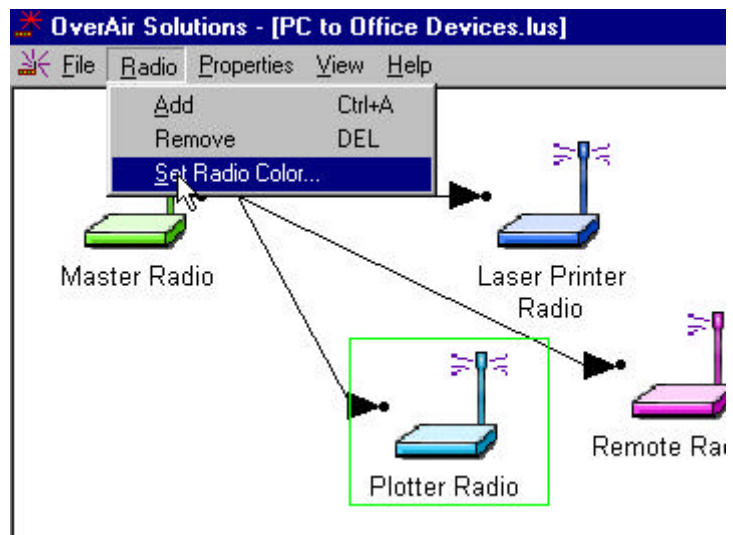


The colors of individual radios can be set at the time that a radio is added to a Point-MultiPoint network.

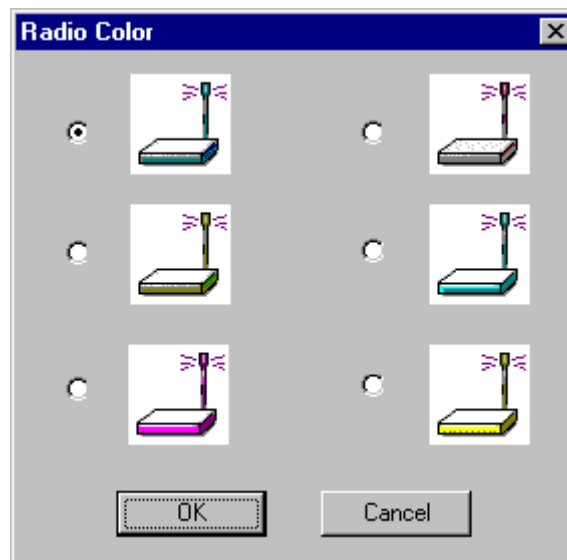
Select:

?? RADIO

?? SET RADIO COLOR



The SET RADIO COLOR function causes this selection box to appear.



## Radio's Address-an explanation

**Note:** It is suggested that the automatically set radio addresses not be changed. This is an explanation to soothe the curious.

This Dialog box reflects the settings of a radio which is the Remote of a Point-to-Point network.

In a Point-to-Point network this dialog box reports both a Radio address and a Destination address. The Destination Address is the address of the radio to which the selected radio will transmit all data.

By default:

- ?? Master is assigned to address 1
- ?? Remote is assigned to address 2

For the Master and Remote the Source and Destination addresses are the inverse of each other:

|             | Master | Remote |
|-------------|--------|--------|
| Address     | 1      | 2      |
| Destination | 2      | 1      |

If the addresses are to be manually changed, this inverse relationship must be maintained.

The dialog box is titled "Radio Configuration - Point-to-Point". It contains the following fields and settings:

- Radio Name:** Scanner Radio
- Last Configured:** 1/24/2000 12:37:36 PM
- Serial Port Settings:**
  - Baud Rate: 115,200
  - Parity: None
  - Data Bits: 8
  - Stop Bits: 1
- Radio Settings:**
  - Transmit Power: (field partially visible)
  - Number of Antenna: (field partially visible)
  - Antenna Gain: (field partially visible)
  - Link Retry Limit: (field partially visible)

Buttons at the bottom: OK, Configure Radio, Cancel.

This is the Radio Configuration Dialog box of a radio which is a component of a Point-Multipoint network.

In a Point-Multipoint network, all Remote radios communicate with the Master and the Master communicates with all Remotes. The point-multipoint configuration dialog does not have a Destination Address field.

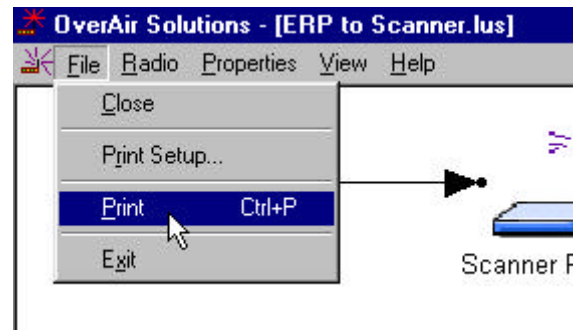
The dialog box is titled "Radio Configuration - Multipoint". It contains the following fields and settings:

- Radio Name:** Laser Printer Radio
- Radio Address:** 3
- Last Configured:** (field partially visible)
- Serial Port Settings:**
  - Baud Rate: 115,200
  - Parity: None
  - Data Bits: 8
  - Stop Bits: 1
- Radio Settings:**
  - Transmit Power: (field partially visible)
  - Number of Antenna: (field partially visible)
  - Antenna Gain: (field partially visible)
  - Link Retry Limit: (field partially visible)

Buttons at the bottom: OK, Configure Radio, Cancel.

## Print the Network's Configuration

Two different network configuration reports can be printed. One is from the Configure screen and the other is from the Diagnostics screen.

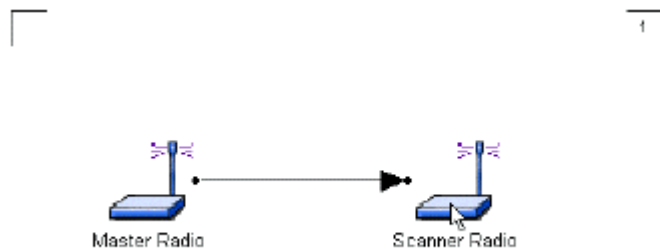


From the Configuration screen:

This function generates a list of network parameters which have been stored in the OS2400's internal database. This list becomes important for troubleshooting.

| Name          | Address | Power | Baud Rate | Parity | Databi |
|---------------|---------|-------|-----------|--------|--------|
| Master Radio  | 1       | 1mW   | 115200    | N      | 8      |
| Scanner Radio | 2       | 1mW   | 115200    | N      | 8      |

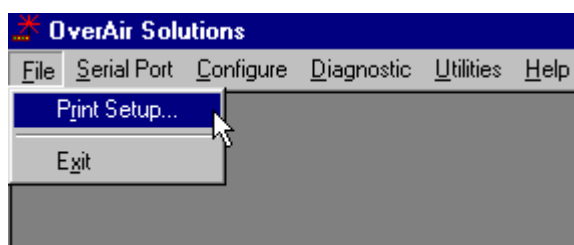
From the Diagnostic screen:



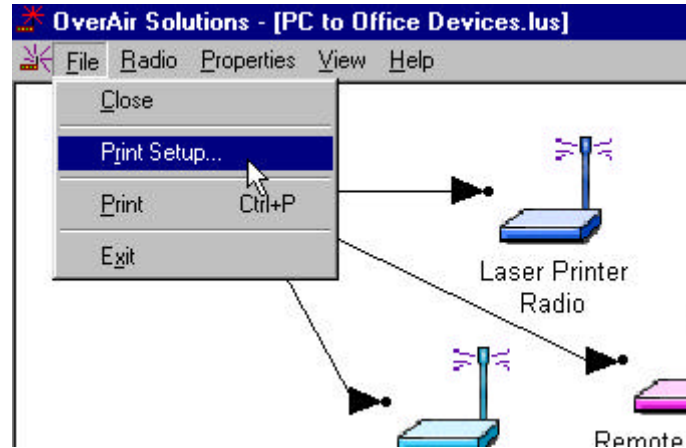
## Printer Settings

For setup of the printer the PRINT SETUP function can be accessed from:

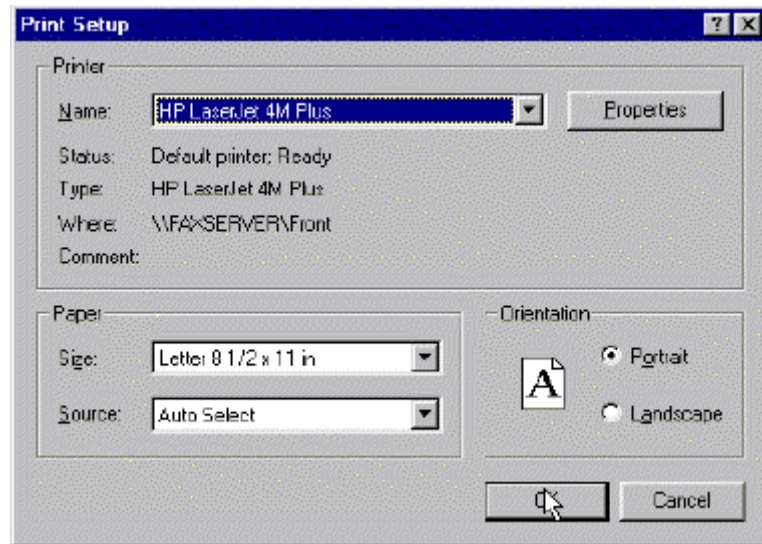
?? the Main screen:



?? the Configuration or Diagnostic screen:



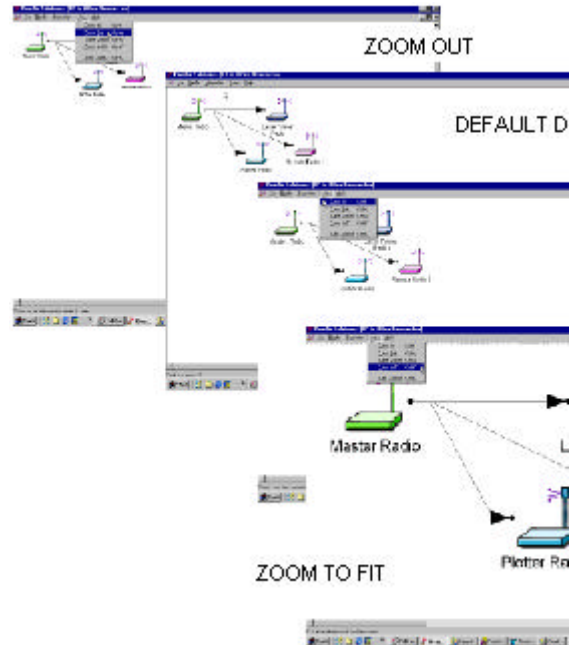
A standard printer set-up dialog box is displayed.

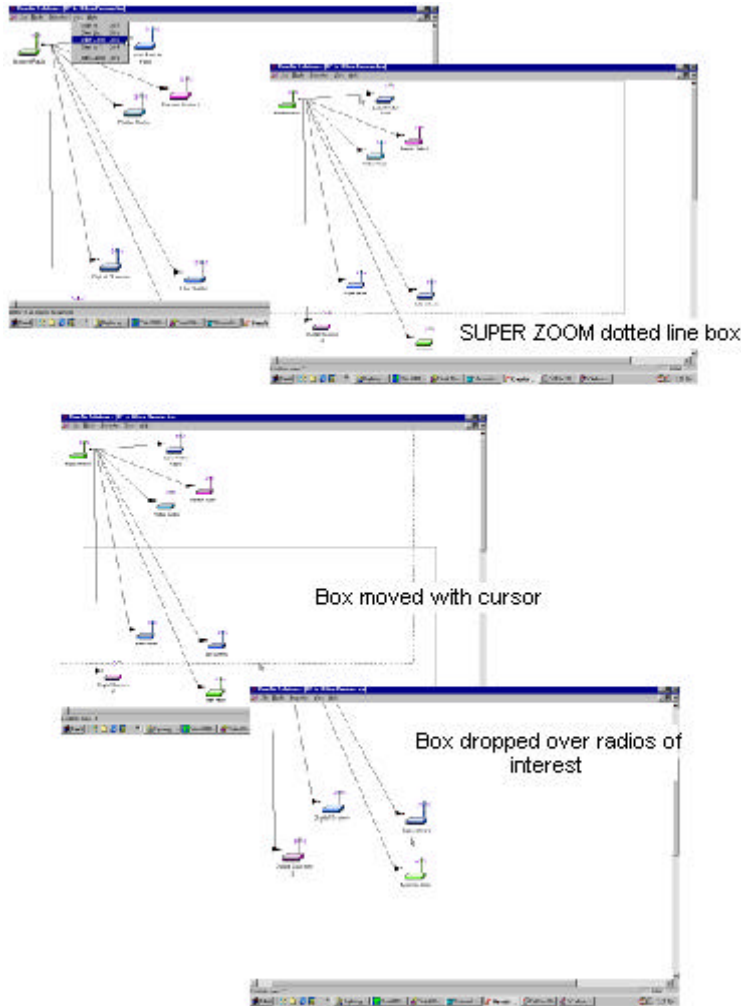


## Zoom View of Graphical Layout

In some cases it may be easier to manipulate the configuration of a network if the graphical display of the network is either smaller or larger than the default display. The ZOOM feature is useful for networks with a large number of radios.

- ?? ZOOM OUT: causes the display to “zoom farther away”. The radios look smaller, more overall space is displayed.
- ?? ZOOM IN: causes the display to “zoom closer” to the user. The radios look larger, less overall space is displayed
- ?? ZOOM TO FIT: causes the displayed network to take up all of the screen, causes all of the network to take up one screen.





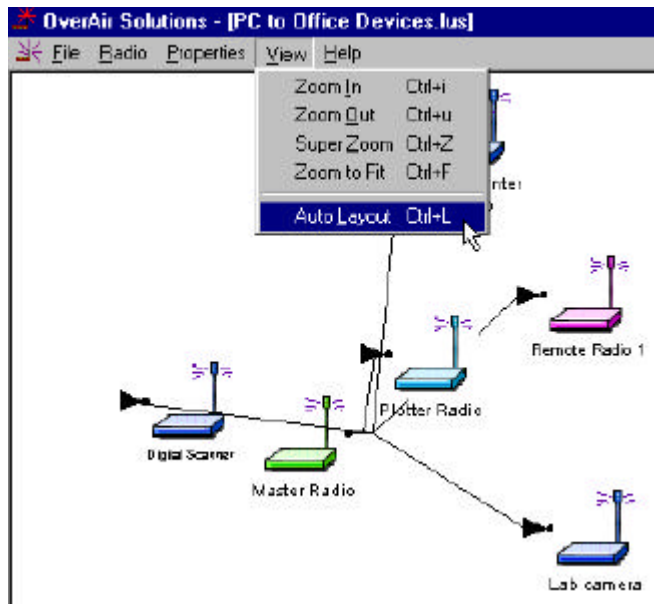
?? SUPER ZOOM: is used when the network covers more space than one default screen.

When SUPER ZOOM is selected the whole network is displayed with a dotted line box surrounding the space occupied by the default display.

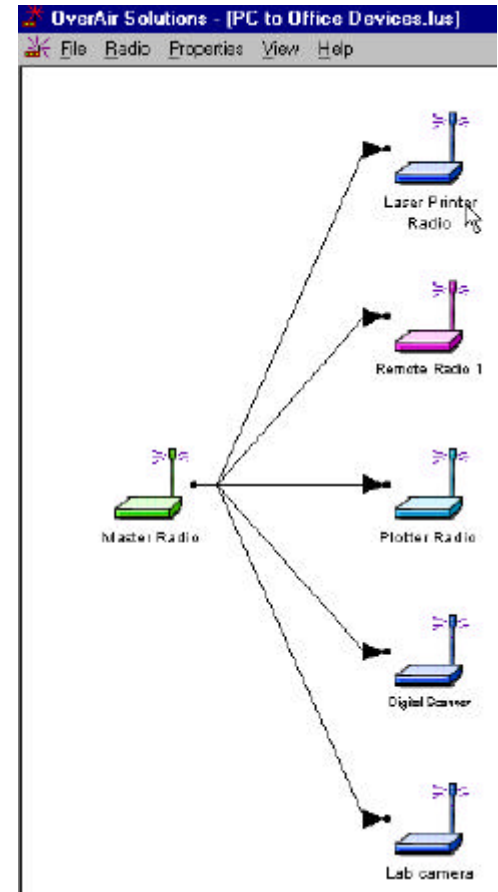
When the cursor is moved from the area of the default display the dotted line box becomes a solid line box and moves, following the placement of the cursor.

Once the box has been placed over the section of network to be viewed more closely, select the left mouse button. The box "drops" and the selected section of the network is "zoomed in" to the display.

## Automatic Arranging of Network Icons



If for some reason, someone has defined a graphical network rat's nest, the AUTO LAYOUT function can be used to automatically redraw the network in a hierarchical structure based on the connections between the master radio and the remote radios. This structure is also based on the order on which the radios were added in to the network in the diagnostic window.



# Diagnostics - Troubleshooting

## System Diagnostics, an Overview

Using the DIAGNOSTICS function :

- ?? a graphical representation of the overall function of a **network** can be viewed
- ?? an **individual radio** can be queried, and its operating parameters displayed

The information obtained from the diagnostics function can be used to:

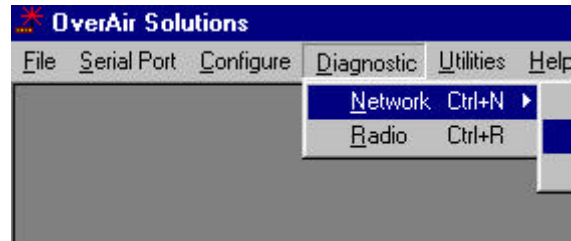
- ?? optimized network function
- ?? determine the source of failed communication

## “Viewing” a Network’s Function

To view a graphical representation of a network’s communication links, a Radio must be **cabled** to the Configuration PC’s **selected COM port**.

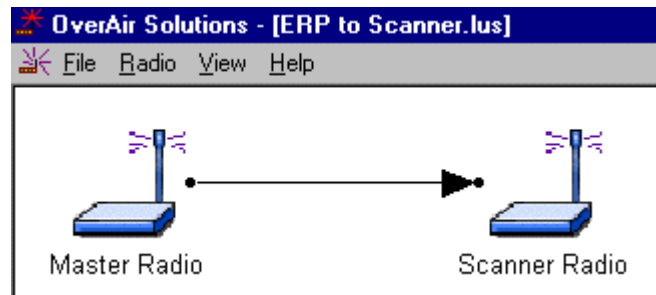
From the Main OS2400 menu select:

- ?? DIAGNOSTIC
- ?? NETWORK
- ?? select the network by name from the displayed list of configured networks

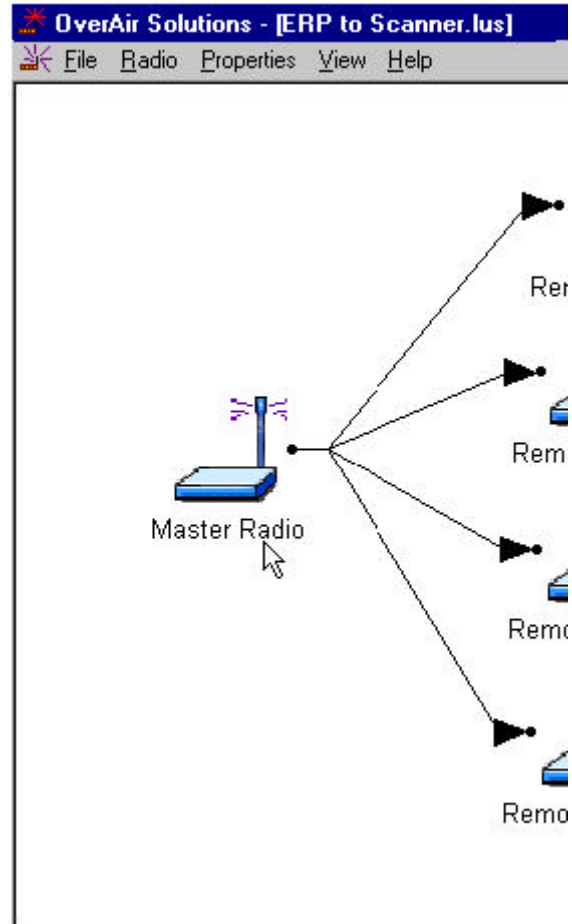


This is the OS2400’s graphical representation of a Point-to-Point network with intact communication links.

The RF link line is represented with a solid black line.



This Point-Multipoint network is functional. All RF links are represented with solid black lines.

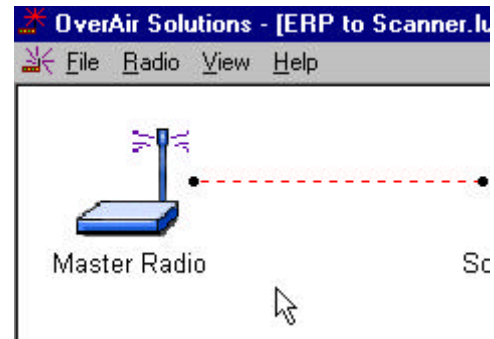


## Broken Links in Point-to-Point

Either the Master or a Remote can be cabled to the Configuration PC for network diagnosis.

In a Point-to-Point application, the displayed representation of a failed communication link is not dependent upon which radio is cabled to the PC.

In this example, the communication link has been broken. The PC can communicate with the radio to which it is cabled. The cabled radio cannot communicate with the remotely placed radio.



This error message is displayed if the Configuration PC cannot communicate with the radio cabled to the PC.



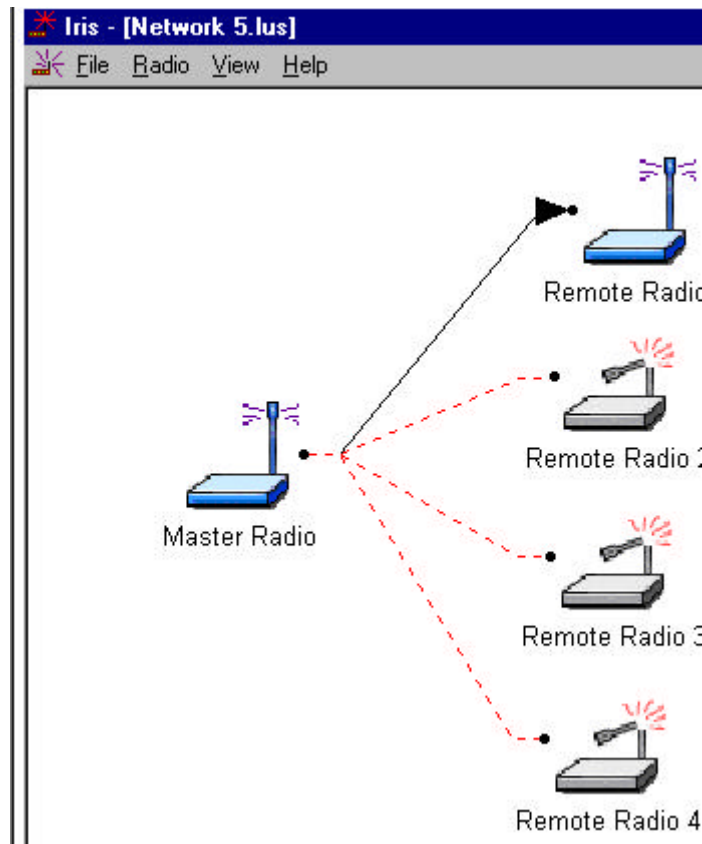
There are several **sources of error** that should be considered.

## Broken Links in Point-Multipoint Network

Either the Master or a Remote can be cabled to the Configuration PC for network diagnosis. In a Point-Multipoint application, the displayed representation of a failed communication link is dependent upon which radio is cabled to the PC.

If the COM port is cabled to:

- ?? the Master radio, all radios in the network will be displayed.

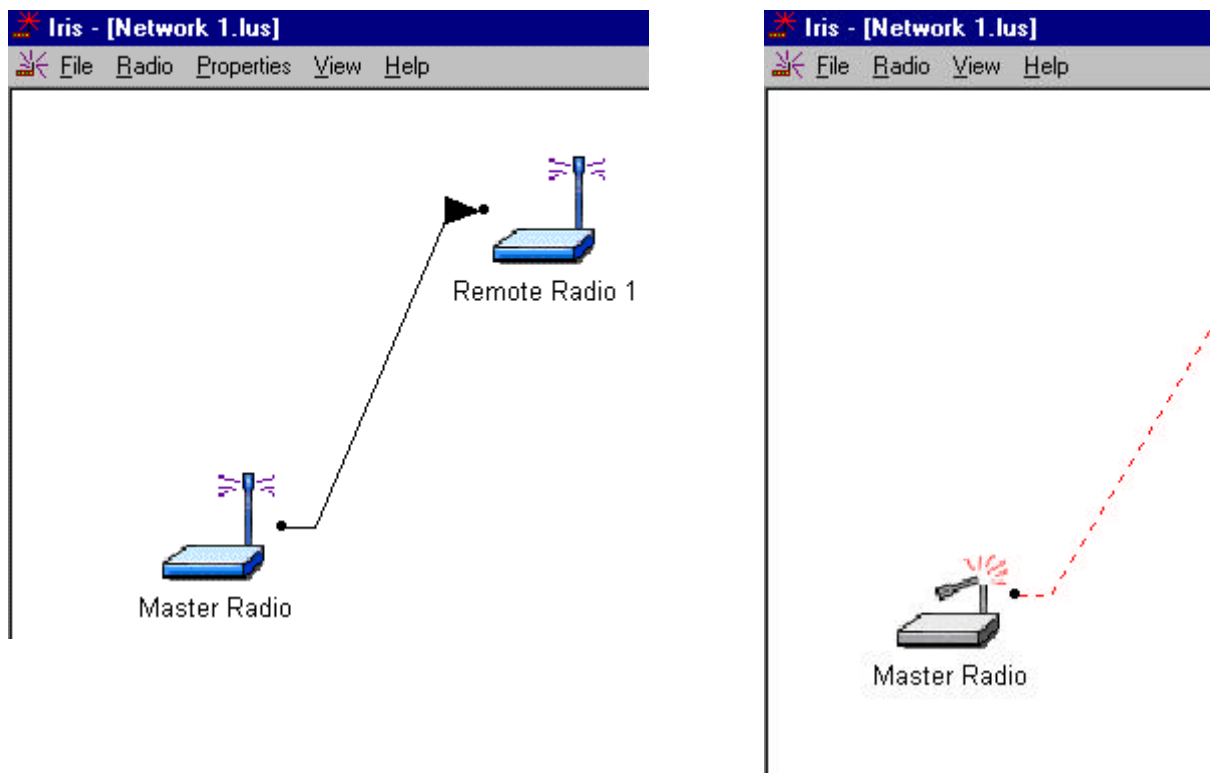


If the COM port is cabled to:

- ?? a functional Remote, only the representations of the Remote radio and the Master radio will be displayed. In this example, the only operational link is between the Master and Remote Radio 1. The Remote radio cannot poll other Remote radios in the network for diagnostic information. Remotes can only communicate with its Master.

If the COM port is cabled to:

- ?? a **NON**functional Remote, only the representations of the Remote radio and the Master radio will be displayed. The link between the Master and remote 1 is not operational, however, the Remote is able to communicate with the PC.



There are several **sources of error** that should be considered.

## Query a Radio Directly

A radio can be queried so that it reports its settings to the Configuration PC.

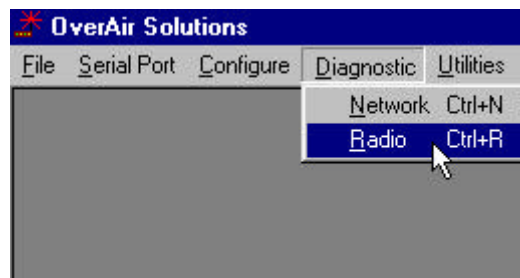
This can be done either directly through a cable or **remotely** through communications with the Master cabled to the Configuration PC. **Check** the serial port settings to determine which COM port is configured for the OS2400 system, if necessary.

To directly query a radio, it is **cabled** to the Configuration PC.

From the Main screen select:

?? DIAGNOSTIC

?? RADIO



This dialog box will appear. No radio data is reported until the GET DATA function is actuated.

This is an example of the settings a radio will report.

| Radio Parameters                                                            |   |
|-----------------------------------------------------------------------------|---|
| Serial Number                                                               | 0 |
| Channel Number                                                              | 0 |
| Source Address                                                              | 0 |
| Destination Address                                                         |   |
| Transmit Power                                                              |   |
| Network Type                                                                |   |
| Number of Antennas                                                          | 0 |
| Baud Rate                                                                   | 0 |
| Parity                                                                      |   |
| Data Bits                                                                   | 0 |
| Stop Bits                                                                   | 0 |
| <input type="button" value="Get Data"/> <input type="button" value="Done"/> |   |

| Radio Parameters                                                            |                |
|-----------------------------------------------------------------------------|----------------|
| Serial Number                                                               | 266            |
| Channel Number                                                              | 2              |
| Source Address                                                              | 2              |
| Destination Address                                                         | 1              |
| Transmit Power                                                              | 1 mW           |
| Network Type                                                                | Point to Point |
| Number of Antennas                                                          | 1              |
| Baud Rate                                                                   | 115200         |
| Parity                                                                      | None           |
| Data Bits                                                                   | 8              |
| Stop Bits                                                                   | 1              |
| <input type="button" value="Get Data"/> <input type="button" value="Done"/> |                |

The GET DATA function retrieves the data from the radio that is cabled to the COM port. Generally a radio is queried if there is a network failure. If there is no communication between the cabled radio and the Configuration PC an error dialog box will appear..

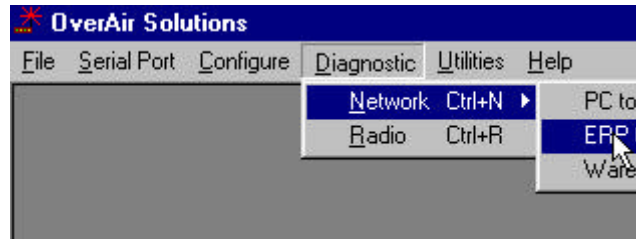
The DONE button closes the radio parameters dialog.

## Query a Radio Remotely

If the **manufacturer** is contacted, Locus Customer Service will ask for software and hardware revisions and the radio's serial number. These values are displayed through the Diagnostic function.

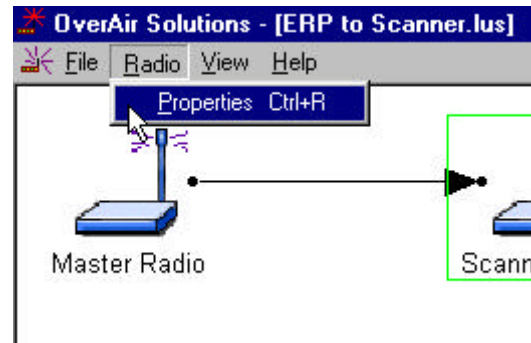
With the Master radio **cabled** to the Configuration PC select:

- ?? DIAGNOSTIC
- ?? NETWORK
- ?? the network by name



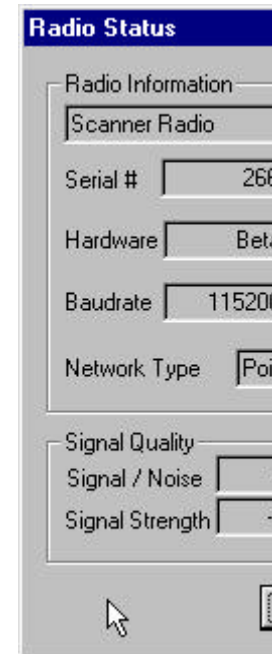
From the Diagnostic Menu select:

- ?? (highlight) the graphical representation of the Remote
  - ?? RADIO
  - ?? PROPERTIES
- OR**
- ?? quickly double click on the radio's icon with the left mouse button



These parameters are displayed in the Radio Status box:

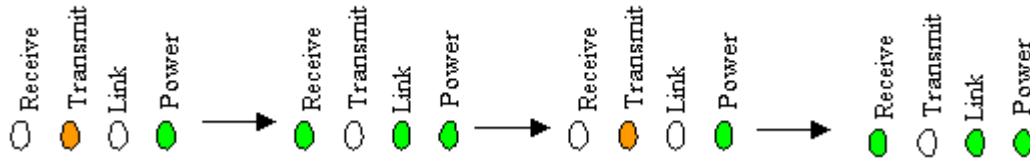
- ?? **Radio Name:** as defined during **network configuration**.
- ?? **Address:** the **radio's address** as automatically set during network configuration.
- ?? **Serial #:** the radio's serial number as programmed by the manufacturer.
- ?? **Firmware:** the version number of the software code embedded in the radio.
- ?? **Hardware:** the version number of the radio's hardware.
- ?? **FPGA:** the version number of the Field Programmable Gate Array logic in the radio. This logic determines the hardware characteristics of the radio.
- ?? **Baudrate:** the baud rate of the radio's serial port as set during **radio configuration**.
- ?? **Channel:** the **channel** of the network of which the radio is a component.
- ?? **Network Type:** as set during **network configuration**.
- ?? **Signal Quality:** parameters which indicate how well the network is operating. The Remote radio calculates the strength (Signal Strength) of the signal from the Master. It also calculates the strength of the background noise (**interference**). The Signal/Noise value is the ratio of Signal Strength to Noise Strength. Monitoring how these values change when antennas are moved during **installation verification** can ensure that the installation configuration has been optimized. The larger the Signal/Noise ratio, the better performance of the network.



## Radios do not communicate

?? Radio is in “bootloader” mode:

If the cause of the problem is that the radio is in bootloader mode the diagnostic LEDs on the radio will flash in the following sequence.



Software must be re-loaded from the Download Code CD. See [Download Code](#) for instructions.

?? The correct radio parameters have not been downloaded into the radio. The OS2400 Setup/Diagnostic Application keeps track of all network and radio configurations in a database that is embedded in its software. If there is a mismatch between the parameters in the database and those embedded in the radio, network function may fail. To check that these two lists match:

?? [print the network's configuration](#) from the Configure screen

?? [query the network's radios directly or remotely](#)

These values must match: channel, source address and destination address. If they do not, the radio must be [re-configured](#).

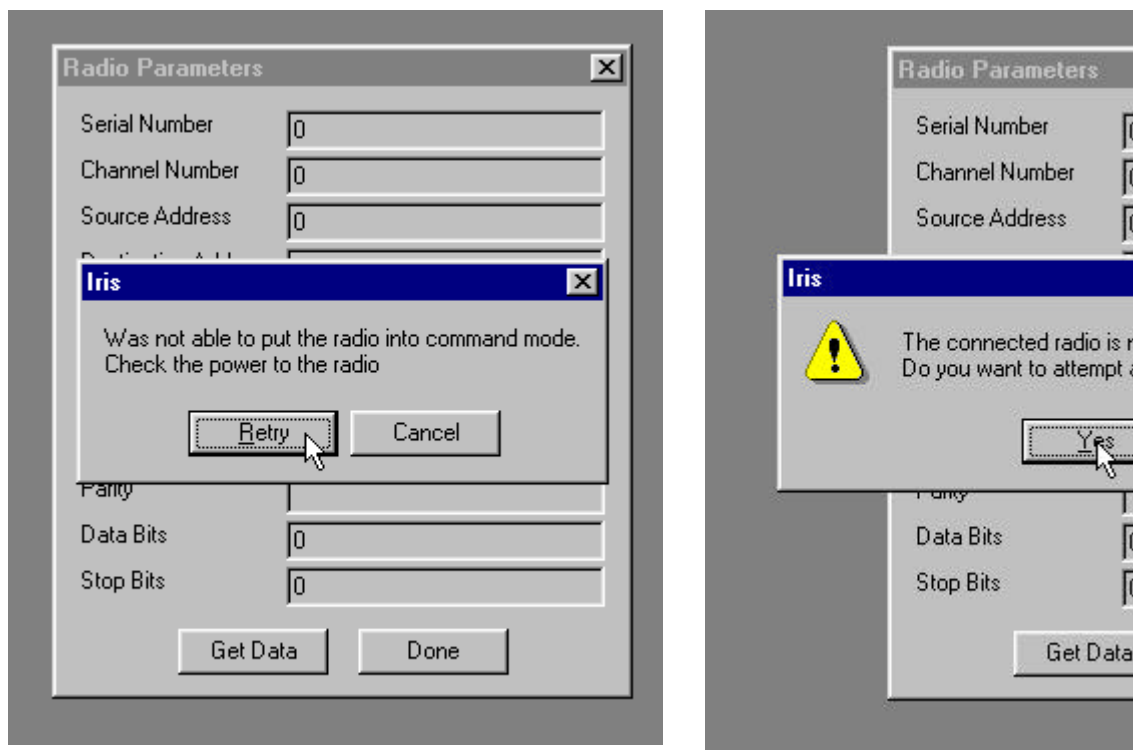
?? A radio is locked in “Command Mode”. Power cycle the radio.

?? The Serial Port Settings of the Configuration PC are not the same as those of the radio cabled to it.

If the serial port settings are not the same there can be no communication between the two devices.

The first error message will question whether the DC power connection to the radio is intact.

When RETRY is selected, the OS2400 diagnostic function will suggest that it perform an [auto detection sequence](#).



## Automatic Serial Port Check

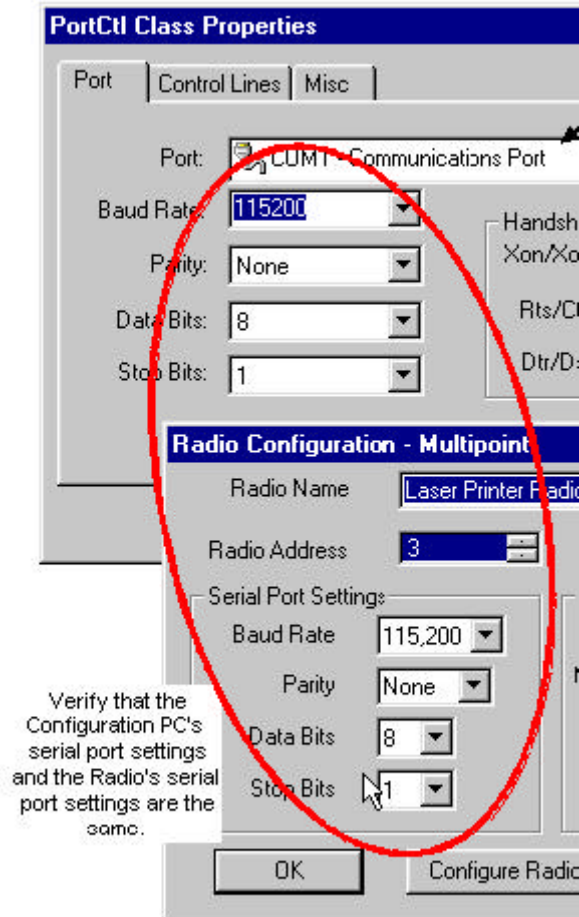
If the auto detection sequence is invoked, the OS2400 diagnostic function will attempt to communicate with the radio using all available serial port parameters. Because there are so many serial port parameters and therefore many available combinations the auto detection sequence is very time consuming. If the correct serial port parameters are known for the particular radio, set the Configuration PC's serial port to match that of the radio. Don't rely on the auto detect sequencing process to reset the radio. Once communication is reestablished, the radio can be reconfigured as required. The new serial port settings become the current settings after the radio is reset (or power cycled).

## Can't Configure a Radio

If either of these error dialog messages appear during CONFIGURE RADIO, check that the green POWER LED is lit on the radio.



If the power connection to the radio is intact, compare the [Radio's serial port settings](#) to that of the [Configuration PC's serial port](#).



## Contact the Manufacturer

The Manufacturer can be contacted if customer support is needed.  
Before contacting the manufacturer, please have this information ready.

- ?? the radio's serial #
- ?? firmware version
- ?? hardware version
- ?? FPGA version

To obtain this information the radio must be **queried**.

Put Logo here

Locus, Inc.  
Fitchburg Center  
Madison, Wisconsin 53711  
USA  
phone: 608-270-0500  
fax: 608-270-5257

## Reference Information

### Help on Windows Help

### Serial Port Basics

## Glossary

### **Broadcast Point-Multipoint Network**

This is network type where a single master radio sends data to every remote radio in the network. This is done repeatedly until every remote receives and acknowledges the data individually. Each remote sends pending data to the master which receives and acknowledges data sent from each remote. There are multiple remotes for a single master in this configuration.

### **Modbus Point-Multipoint Network**

This is network with a single Master Radio and multiple Remotes. The devices cabled to the radios communicate through the Modbus standard protocol. The Master sends data to a Remote based on the Modbus address of the Modbus device. The data is only sent to the one Remote device based on its address. Each Remote sends its data only to the Master. The Master and Remotes acknowledge that the data was received correctly.

### **Peer to Peer Network**

In a Peer-to-Peer network each radio has the ability to receive data from and transmit data to any other radio in the network.

### **Point to Point Network**

A network consisting of a single master and a single remote radio. All data from the Master is received and acknowledged by the one Remote. All data from the one Remote is received and acknowledged by the Master radio.

## On-Line Help Options

For further information on the help system itself, merely type F1 after selecting the help topics option to bring up information on the operation of the help system.

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