SR-7100
Safari Network
User Guide

find
your
way

NavCom Technology, Inc.
20780 Madrona Avenue
Torrance, CA 90503
USA
Tel: +1 310.381.2000
Fax: +1 310.381.2001
sales@navcomtech.com
www.navcomtech.com

NAVCOM

A John Deere Company

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■ Reorient or relocate the receiving antenna.

■ Increase the separation between the equipment and receiver.

■ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

■ Consult the dealer or an experienced radio/TV technician for help.

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The SR-7100 complies with the FCC exposure limits. Users' and bystanders' heads are recommended to be a minimum of 20 cm away from the *Spread Spectrum Radio (SSR)* transmitting antenna when used in the basic configuration. If transmitting system is modified from basic setup, check FCC regulations for compliance with exposure limits.

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Use of this Document

This User Guide is intended to be used by someone familiar with the concepts of radio frequency transmitting equipment.

indicates additional information to make better use of the product.

indicates a caution, care, and/or safety situation.

Revisions to this User Guide can be obtained in a digital format from *support.navcomtech.com*

Chapter 1   Introduction

> The Safari Network™ SR-7100 System offers unique capabilities that make it an extremely versatile wireless communications solution. Whether you have a single point-to-point application or a sophisticated multi-point data network, the Safari Network can support your applications and requirements.

System Overview

The Safari Network is based on a Star topology cellular architecture. It supports simultaneous packet and circuit switched data communication. The Safari Network consists of three major components:

■ Network Control Unit (NCU)

   The NCU acts as the overall controller of the Safari Network, ensuring the most effective allocation of network resources, and providing a single point of control for all network components. The NCU also acts as the gateway between the Safari Network and other networking environments such as the Internet, wired LANs, and the public switched telephone network.

■ Subnetwork Control Units (SCUs)

   Subnetwork Control Units (SCU) are used to extend the range, or circumvent line-of-sight limitations. The SCU allows the network administrator to create an additional cell that manages its associated Remote Units (RUs) through channel assignment, frame synchronization, frequency synchronization, packet assembly and packet routing. In essence, the SCU creates semi-autonomous cells within a single Safari Network under full control of the NCU.

■ Remote Units (RUs)

Remote Units (RUs) deployed in a Safari Network can either operate solely within the coverage area of one NCU, or roam throughout the network without losing connectivity as they move from one SCU cell to another. RUs may be utilized in both fixed or mobile environments, and offer a multitude of physical user interfaces and protocols in support of applications. These components work together in various combinations to enable the implementation of multiple network topologies.

Applications

The Safari Network meets the requirements of a number of applications, including but not limited to:

■ Asset management

■ Automatic vehicle location services

■ Vehicle health monitoring

■ Data acquisition

■ Machine control

■ Telemetry

■ Mobile Local Area Networking

■ Wireless security monitoring

Unique Features

The Safari Network has many unique features to meet mobile communication needs:

■ Simultaneous Services

The Safari Network simultaneously supports multiple communication services, enabling network administrators to offer users a large array of communication alternatives. It can be customized according to user's needs to provide a mix of point-to-point, broadcast, multipoint-to-multipoint, and Ethernet LAN services. The Safari Network can also be configured to simultaneously support both circuit switched and packet switched data, thereby allowing users to give priority to latency-sensitive traffic such as voice, video and streaming data, while also supporting traditional LAN traffic such as file sharing, email and web browsing.

■ Multiple Data Rate Selection

System data rates of 512kbs, 240kbs, and 96kbs can be chosen. This allows the flexibility of choosing a data rate specifically for the projects' distance or throughput requirements. A lower data rate transmits a farther distance, but yields less Forward/Return bandwidth availability for the network. A higher data rate transmits a shorter distance, but yields higher bandwidth availability for the network.

■ Multiple Connectivity Options

Multiple ports are provided on each RU to conduct concurrent sessions of dissimilar services. Port & Protocol options for the SAFARI NETWORK are RS232/Async, RS422/Async, RS422/HDLC High Level Data Link Control, and 10BaseT/Ethernet. These user interfaces, combined with a powerful onboard microprocessor and user-selectable data rates, allow

for multiple, simultaneous services and offer users a variety of options for connecting to the Safari Network.

Current protocols under development are Vehicle CAN Bus, Circuit Switched Voice, USB, and Infrared serial data interfaces. These interfaces will be available in a near future release.

■ Dedicated Network

The Safari Network enables users to create an "always on" dedicated, private communication network for both fixed and mobile assets within a localized area. It provides network administrators with full control of all RUs, bandwidth, access, and services.

The ability to receive data from RUs at a central location allows superior management of personnel and assets. For example, productivity of field workers can be monitored to increase overall efficiency. Vehicle health information can be analyzed to predict and prevent vehicular failure.

The Safari Network provides a high degree of flexibility and control, allowing users to manage their resources effectively.

■ Rugged Design

The rugged design of the Safari Network components provides protection against harsh environments common to areas such as farms, construction sites, mines, and marine vessels. Units are watertight and sealed to protect against environmental hazards such as dust, moisture, vibration, and hot and cold extremes.

■ Safari Network Management System

The Safari Network management system design allows those with little or no technical background to manage the overall network configuration. It is equipped with both a simple text-based configuration structure (accessible from any of the ASYNC ports), and an intuitive browser-based configuration interface accessible via the Ethernet port (this interface will be available in a near future release). Network administrators can use either method to configure, reconfigure, and manage all RUs in their Safari Network.

System Advantages

The Safari Network has several major advantages over licensed and traditional cellular radio systems:

■ Safari Network is a license-free, no fee system. There are no implementation delays associated with frequency coordination and license applications. There are also no costs associated with annual license fees, no monthly connection charges, and no data volume charges.

■ Lower transmission power utilized in the system minimizes the DC power requirements.

■ The larger bandwidth available in the license-free ISM band permits the provision of data rates significantly greater than those supported by licensed and traditional systems.

Safari Network Components

A typical Safari Network is made up of several components interfaced together in order to achieve maximum productivity and range throughout a project.

The minimum requirements for a Safari Network are one Network Control Unit (NCU), and one Remote Unit (RU). A Safari Network must have at least one NCU, and can contain as many as 400 RUs and SCUs. Multiple NCUs could be synchronized to a master NCU for simultaneous interference-free operation to improve data throughput.

The Safari Network usually consists of two modules, a Radio Module (NCU, SCU, or RU) and a Port Expander. A systems integrator could opt to interface directly to J1 and J2 without using the Safari Network Port Expander.
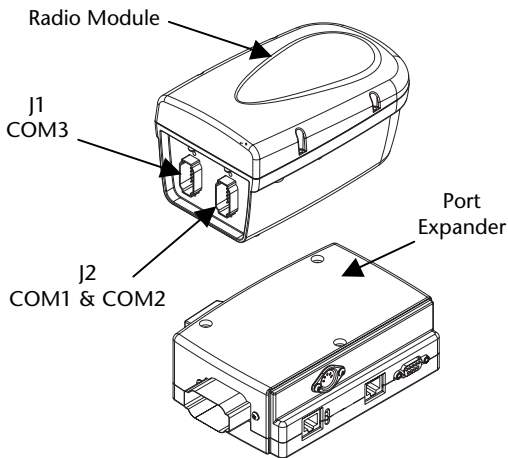
Figure 1-1: Safari Network Radio Module and Port Expander

Radio Modules (NCU, SCU, and RU)

All radio modules have the same form factor for convenient mounting; however, the internal configuration differs. The radio is typically mounted outside and preferably as high as possible to provide the best coverage. Its chassis is fully sealed and protected to withstand harsh environments. A plastic radome is provided to protect the radio and optional GPS antennas against impact. The radome can be removed when externally mounted antennas are required.

Each radio supports four communication ports (COM1 to COM4). Interface to the radio is through two rugged 12-pin connectors J1 (COM3) and J2 (COM1 & COM2), as shown in Figure 1-1 on page 1-6.

The radio is available in two different models

■ Model # 1 with COM1 set as Ethernet

■ Model # 2 with COM1 set as Serial

COM1 Serial Mode possible configurations are:

■ RS 232 ASYNC

■ RS 422 ASYNC

■ RS 422 SYNC

COM2 Serial Mode possible configurations are:

■ RS 422 ASYNC

■ RS 422 SYNC

COM3 Serial Mode possible configurations are:

■ RS 232 ASYNC

■ TTL ASYNC for internal GPS Engine interface.

COM4 is dedicated for a CAN Bus interface.

Port Expander

The Port Expander is used to provide a standard connector interface for access to COM1 & COM2 ports of the radio. The J2 connector of the radio module connects to the Port Expander module via a cable of up to a maximum of 300 feet.

The Port Expander is intended for installation in an office or vehicle cab. Although rugged in construction, it is not environmentally sealed.

In the basic configuration, the Safari Network RU is externally powered through J1. The radio then passes through a regulated voltage to the Port Expander. This is typically the case where the RU is used in a mobile environment and is powered by the vehicle battery.

Alternatively, the Port Expander can supply power to the radio through the J2 connector. An optional AC-powered Active Port Expander (Figure 1-2) should be used, which converts AC to DC for operating the radio. This configuration is desirable when an AC power source is available.
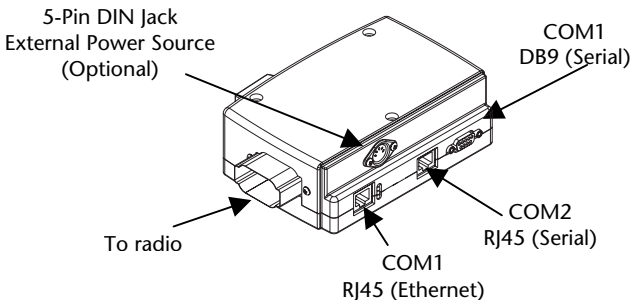
Figure 1-2: Safari Network AC Port Expander

Subnetwork Control Unit (SCU)

The SCU allows the administrator to create additional, semi-autonomous cells in the Safari Network that are managed by the NCU. These cells may be contiguous or non-contiguous. By deploying SCUs, the administrator can circumvent line-of-sight obstacles and extend the range of the Safari Network. The SCU also controls and manages its associated RUs. The SCU directs bandwidth utilization through channel assignment, frame synchronization, frequency synchronization, packet assembly and packet routing.

Each SCU is comprised of two radio modules synchronized to operate simultaneously without degradation in performance. Each radio module has its own independent antenna (see Figure 1-3). Depending on the traffic flow, the SCU may improve the overall network data throughput. Multiple levels of SCUs can be added to the Safari Network without adversely affecting the network operation.
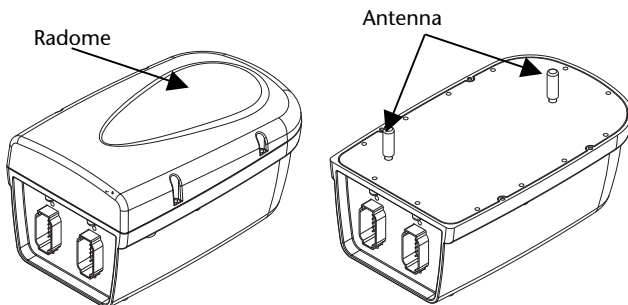
Figure 1-3: SCU with and without Radome

Safari Network Services

The Safari Network provides several network services, which can be configured for single applications, or simultaneous use in multiple applications. Each service listed is associated with a basic interconnectivity diagram detailing data flow.

■ Remote-to-Remote

Two-way dedicated serial communication between two RUs, and the NCU.
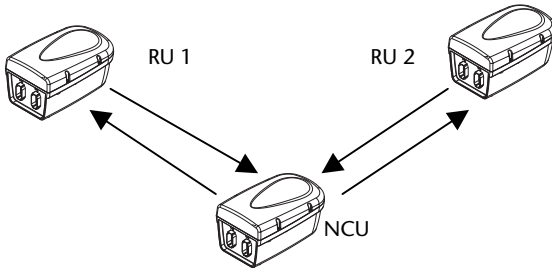
Figure 1-4: Bi-Directional NCU, RU to RU

■ Remote-to-NCU

Two-way dedicated serial communication between one RU and the NCU.
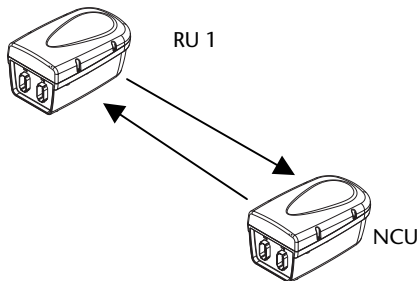
Figure 1-5: Bi-Directional NCU to Single RU

■ Broadcast from NCU

One-way serial communication from the NCU to multiple RUs.
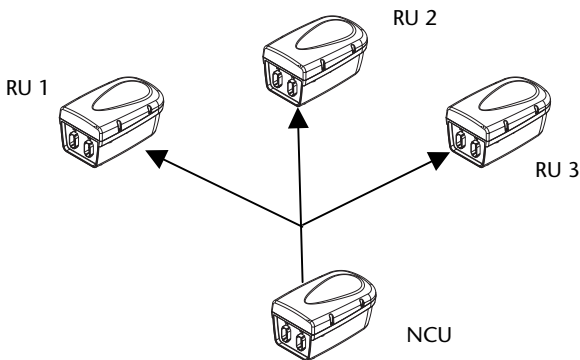
Figure 1-6: NCU Broadcaster

■ Broadcast from Remote

Relaying of one-way serial communication input from a single RU by the NCU, out to multiple RUs on a one-way serial communication link.
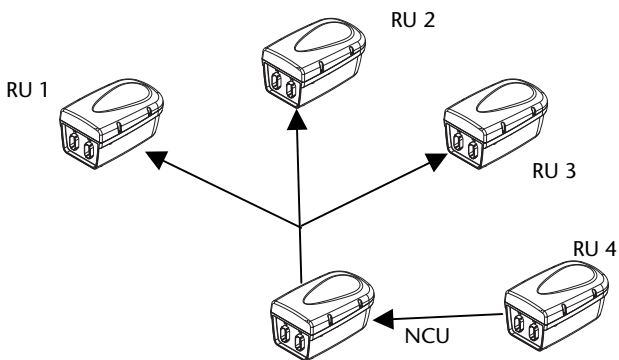
Figure 1-7: NCU Remote Broadcaster

■ Multipoint Network (with return)

Two-way serial communication between multiple RUs, and the NCU via the NCU. Radios can be configured to transmit data to a specific port, or broadcast data to all units that use this service. When broadcasting data the originating radio will receive the data as well.
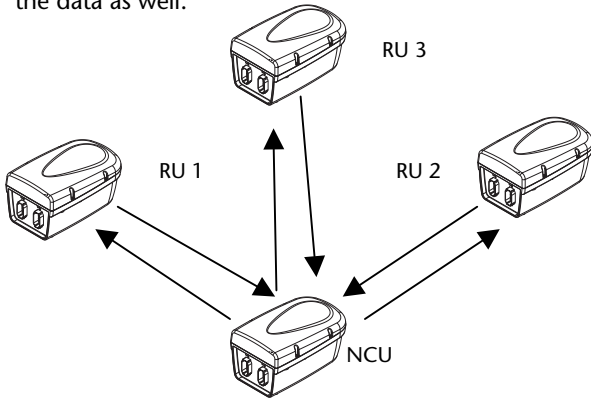
Figure 1-8: Bi-Directional NCU Multipoint Network

■ Ethernet Wireless LAN

Wireless bi-directional, full-duplex LAN capability among the RUs and the NCU using Ethernet port (COM1) of the radios. Provides an IP communication link between radios as well as a connection to the Internet via NCU.
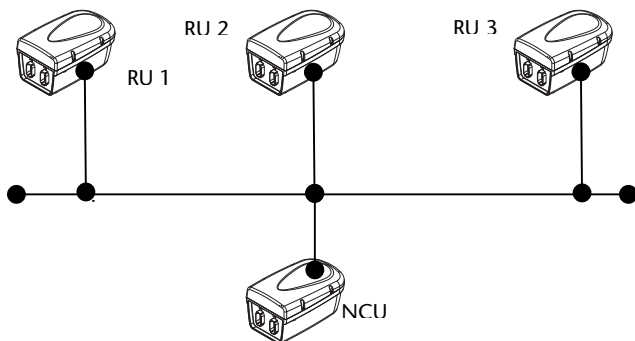
Figure 1-9: NCU Ethernet Wireless LAN

■ SCU Repeater

SCU devices may be used to create additional cells, extending the range to RUs or bypassing path obstacles.
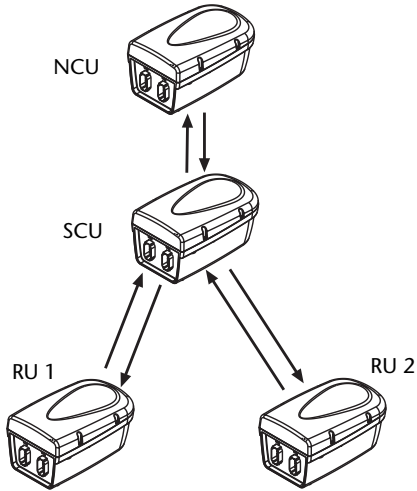
Figure 1-10: SCU Repeater

Chapter 2   Safari Network Planning

The key to successful implementation and management of your wireless Safari Network is planning—knowing in advance exactly what your requirements are, how you will make use of the network, and what settings will be required to accomplish your goals.

Planning Overview

It is recommended that this chapter be read in its entirety before attempting to install and configure your network components.

There are several steps involved in the planning of your Safari Network:

- Determine the location(s) of the RU(s), and assess the need for SCUs.

- Assign Radio Unit IDs.

- Determine radio frequency(s).

- Determine service(s).

- Determine throughput requirements for each service.

- Assign Channel numbers for each service.

- Determine port setup requirements.

Initial Planning

Determine your hardware requirements based on the number of RUs you will need, the distances between each RU and the NCU. Line-of-sight limitations (i.e., physical obstructions) should be assessed. It is advisable to have the NCU located at the highest elevation point in the network in order to overcome line of sight limitations. If this is not possible, an SCU can be added to the network to compensate.

Review your communications and networking needs and perform a site survey. Draw a map of the network that indicates how many units will be required, and their locations relative to the location of the NCU.

You will need to install Subnetwork Control Units in the network if any RU:

■ Will be more than 14-20 miles from the NCU (depending on data speed).

■ Will not have a direct line of sight to the NCU (such as obstruction from buildings, trees, mountainous or hilly terrain, etc.).
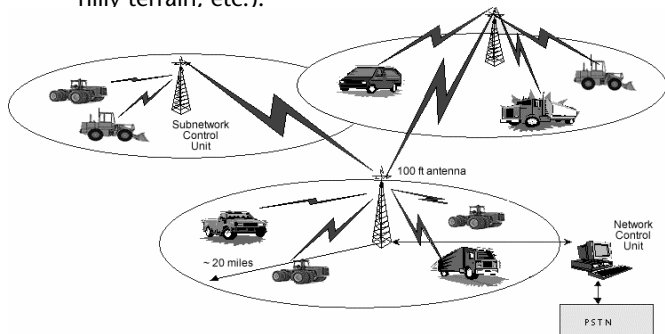
Figure 2-1: Safari Network

Network Management Port

All Safari Network functions and services are done via the Network Management Port (NMP). Choosing this port should be one of the first planning considerations. By factory default, the Safari Network radio module has COM2 set to the Network Management Port (NMP). All functions referred to in this chapter must be initiated via the NMP.

For Network Management, COM2 or COM3 should be selected. Network Management is not allowed via COM1. In order to simplify reconfiguration and diagnostics it is desirable to have a permanent connection at the NCU for Administrative functions. The port that Network Management is being initiated from can also be assigned services; however, these services will not function while the network is being administered. Chapter 4 Configuration details Network Management and Administration.

When Network Management is initiated, the service on that port will temporarily be disabled in order to allow the administration of the network via that port. After Network Administration is complete, a power cycle will restore the port to its configured service.

Unit IDs

Each Safari Network radio module has a serial number (physical ID), which is printed on a label attached to the unit. SCUs, which contain two radios, have two physical IDs, one for the upstream radio and one for the downstream radio.

You will need to assign a Unit ID to each radio from 100 to 600. Table 2-1 shows a typical Safari Network ID setup.

Network ID "100" is reserved for NCU only!

Radio Unit	Physical ID	Unit ID
NCU	0x06f12345	**100**
RU	0x06f28374	**201**
RU	0x06f03748	**202**
SCU		
(upstream)	0x06f50726	**301**
(downstream)	0x06f59374	**302**

Table 2-1: Safari Network Unit ID Matrix

NCU and SCU Radio Frequencies

NCUs and SCUs must have a radio carrier frequency assigned to each. The RUs automatically set themselves to the frequency of the NCU, or SCU within closest range.

In addition to the Unit ID for the SCU, there is an associated Parent ID. This ID simply refers to the ID that the SR-7100 SCU locks to on power up, and is set automatically.

See Appendix B, Radio Frequencies, for channel, frequency and throughput rates. Figure 2-2 illustrates the Frequency, Unit ID, and Parent ID affiliation.
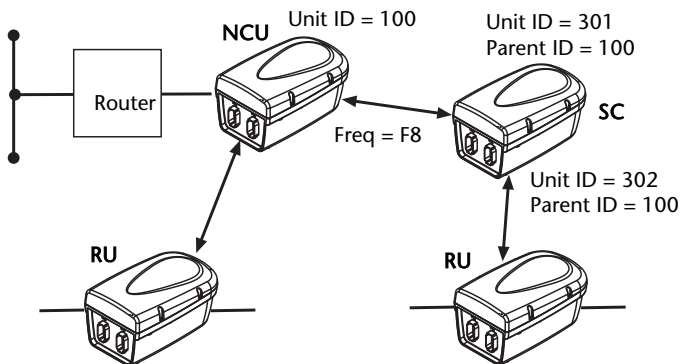
Figure 2-2: Safari Network NCU/SCU Example

Multiple SCUs

In Figure 2-3, the Safari Network uses three SCUs.
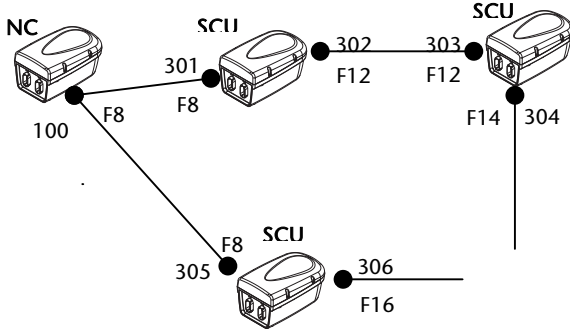
Figure 2-3: Safari Network NCU/Multiple SCU Example

Table 2-2 shows how the frequencies would be assigned.

NCU Frequency = F8			
SCU Frequencies Assigned			
Unit ID	Parent ID	Uplink	Downlink
301	100	F8 (auto)	
302	100		F12 (assigned)
303	302	F12 (auto)	
304	302		F14 (assigned)
305	100	F8 (auto)	
306	100		F16 (assigned)

Table 2-2: Safari Network NCU/Multiple SCU
Network Frequency Assignments

Network Services Planning

Once the IDs have been assigned to the Safari Network's radio units, and the frequency settings have been determined, a plan must be devised for the types of applications you will be using. This involves identifying:

- The service type(s), described in Chapter 1 and below.

- Which radio(s) will be sending data through that service.

- Which radio(s) will be receiving data through that service.

After identifying these three requirements, then you can determine the Channel assignments and port configurations for each radio unit in the network.

Network Services and Channel Assignments

As expressed in Chapter 1, various services can be configured singularly, or in a multitude of combinations. Below are some of the Safari Network configurations possible.

- Remote-to-Remote

- Remote-to-NCU

- Broadcast from NCU

- Broadcast from Remote

- Multipoint

- Ethernet Wireless LAN
  (requires radios factory pre-configured for Ethernet)

When services are setup in your Safari Network, you define communication paths, or logical "Channels," between the various radio modules in the network. To set up multiple services you assign distinct and separate Channels for each service. This is so that individual sessions of those services can occur simultaneously over the different Channels.

Once a Channel is assigned to a service (in some instances two Channels, one transmit and one receive), you then assign the same Channel value(s) to the communication ports of the radio modules that will be sending and receiving data through those services.

An example detailed in Table 2-3, Row 2 (Service/Broadcast From NCU), shows the NCU with a Radio ID of 100 (100 is always reserved for NCUs) set up to transmit data to the RUs on Channel 1 and COM1. Table 2-3 also details in Row 2 that the RUs (In this example Radio IDs 2xx) are set up by the NCU to receive the broadcast data from Channel 1, COM1 of the NCU on COM2 of the RUs at a bandwidth of 4.8 Kbps. In this example no data is returned from the RUs to the NCU.

Service	Radio ID	COM Port	Channel # Tx	Channel # Rx	Forward Band-width	Return Band-width
Broad-cast from NCU	100 (NCU)	COM1	1		4.8Kbps	0
	201, 202, 203, 204	COM2	1			

Table 2-3: Service/Channel Planning Example

This unique Channel/port flexibility allows for planning a multi-service, multi-session network by assigning different Channels to different services, and taking advantage of the Safari Network radio module's three COM ports.

Channel Assignments and Bandwidth

The term bandwidth in the context of the Safari Network simply means data rate, or capacity. The amount of data that is, or can be, sent through a given communications circuit per second. After assigning a Channel ID to a service, you must set the amount of forward and/or return bandwidth for that Channel. As bandwidth values are assigned, the total forward or return bandwidth is decreased by the same amount.

The total bandwidth of the Safari Network radio module is 512k, with 51.2k being allocated to network resources. The remaining 460.8k is split equally between Forward and Return. Forward bandwidth is the amount of data transmitted from the NCU to other destinations; Return bandwidth is the amount of data received by the NCU. The sum of all forward bandwidth assigned to services cannot exceed the forward radio bandwidth (230.4k), and the sum of all return bandwidth assigned to services cannot exceed the return radio bandwidth (230.4k). The preset bandwidth choices are detailed in Table 2-4.

Bandwidth vs. Throughput Matrix		
512K	240K	96K
230.4	108.0	43.2
204.8	96.0	38.4
179.2	84.0	33.6
153.6	72.0	28.8
128.0	60.0	24.0
102.4	48.0	19.2
76.8	36.0	14.4
51.2	24.0	9.6
25.6	12.0	4.8

Table 2-4: Safari Network Bandwidth/Throughput Options

Channels are assigned to services as values ranging from 1 to 254. A Channel number must be assigned to one or more of the radio module's communication ports (COM1, COM2, or COM3) in order for that port to use a service.

Table 2-5 details examples of service/Channel planning. These examples are further detailed in Figures 2-4 though Figure 2-7.

Service	Radio ID	COM Port	Channel # Tx	Channel # Rx	Forward Band-width	Return Band-width
Broad-cast from NCU	100 (NCU)	COM1	1		25.6K	0
	201 202 203 204	COM1	1			
Broad-cast from Remote	100 (NCU)	COM2	n/a		25.6K	25.6K
	204	COM2	2			
	201 202 203	COM2	2	2		
Remote-to-Remote	100 (NCU)	COM2	n/a	n/a	25.6K	25.6K
	202	COM2	3	4		
	203	COM2	4	3		
Multi-point	100 (NCU)	COM2	n/a	n/a	25.6K	25.6K
	205	COM2	5	5		
	206	COM2	5	5		
	207	COM2	5	5		

Table 2-5: Safari Network Service Examples

■ Channel 1 is used as a Broadcast from NCU service.
   Since transmissions are only from the NCU, there is
   no Return bandwidth setting. The Forward Bandwidth
   is set to 25.6k.
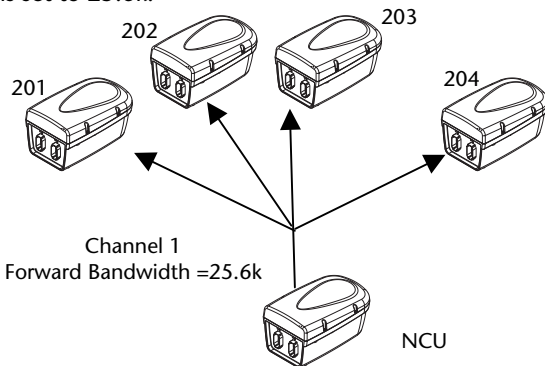
Figure 2-4: Safari Network Table 5 Broadcast from NCU

■ Channel 2 is used for a Broadcast from Remote
   service. The NCU receives, and retransmits data, thus
   the forward and return bandwidth must be set.
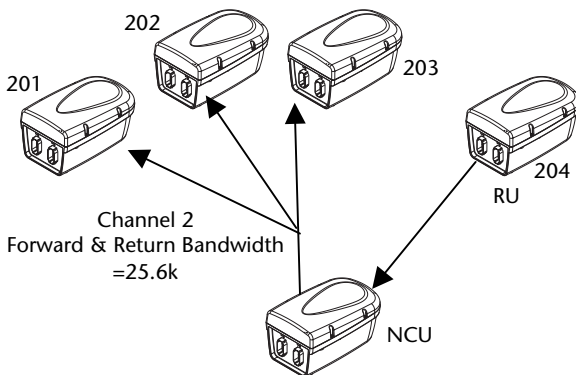
Figure 2-5: Safari Network Table 5 Broadcast From Remote

■ In the Remote-To-Remote configuration, Channel 3
(black) is the transmit Channel for SR-7100 Unit ID
202, and the receive Channel for SR-7100 Unit ID
203. The forward & return bandwidth for this
Channel is set to 25.6k. Channel 4 (gray) is the
transmit Channel for SR-7100 Unit ID 203, and the
receive Channel for SR-7100 Unit ID 202. The forward
& return bandwidth for this Channel is set to 25.6k.
The NCU receives, and retransmits data bi-
directionally, thus the forward and return bandwidth
must be set.
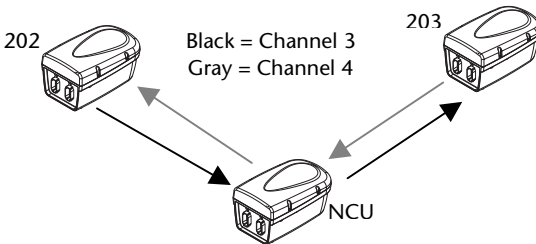
Figure 2-6: Safari Network Table 5 Remote-To-Remote

■ In the Multipoint configuration, Channel 5 is
configured as the transmit and receive Channel for
each RU in the network. The forward and return
bandwidth for this Channel is set to 25.6k. The NCU
manages all of the bi-directional data traffic of each
RU, thus the forward and return bandwidth must be
set for each RU.

Although the Multipoint configuration allows data to
be received and transmitted throughout the
established Channels, additional application software is
required to prevent collisions between the various data
exchanges.
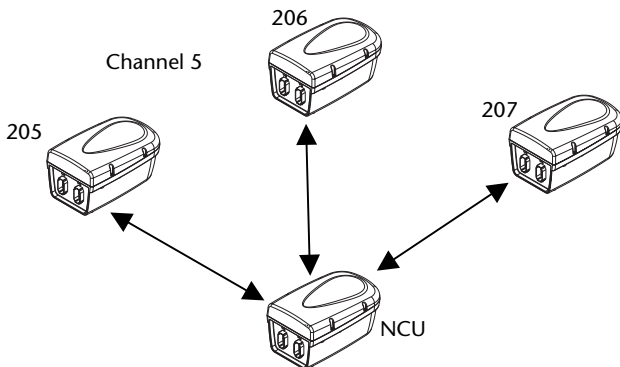
Figure 2-7: Safari Network Table 5 Multipoint

Ethernet Wireless LAN Service

You can create an Ethernet Wireless LAN service using Safari Network radio modules that have COM1 ports configured for Ethernet networking.

This configuration must be preset at the factory. Any Safari Network radio modules that are purchased without this option must be returned to the factory in order to be reconfigured.

The Safari Network extends the wired LAN network beyond the length of the cables, and acts as an Ethernet switch that filters and forwards packets between the devices for network segments. It can be configured to operate as part of an existing LAN network, as a private LAN connected to an existing LAN network, or to an ISP through a DSL/Cable router.

In the Ethernet mode, the Safari Network acts as an IP host where its IP address can be configured manually, or acquired automatically via Dynamic Host Configuration Protocol (DHCP). It then can be addressed using IP applications such as Ping.

To create an Ethernet service, assign a Channel to the Ethernet service. This Channel number will be assigned to COM1 of all radio modules that will make up the network (see Chapter 4: Configuration).

Table 2-6 is an example of Ethernet Service and Channel assignments for an Ethernet Wireless LAN service.

Service	Radio ID	COM Port	Channel # Tx	Channel # Rx	Forward Band-width	Return Band-width
Ethernet	100 (NCU)	COM1	1		230.4K	230.4K
	201 202 203 204	COM1	1			

Table 2-6: Ethernet Service/Channel assignments

■ Safari Network - Internet via DSL/Cable router.

If there is no existing network available, Figure 2-8 is a recommended setup. The NCU's Ethernet Port should be connected to the LAN Port of the DSL/Cable router. The WAN Port of the router connects to the DSL/Cable modem's LAN port. In this configuration the Safari Network belongs to a private LAN, and is hidden from external network intrusions via the Internet if the router is equipped with firewall protection. Although accessing the Internet from the Safari Network's private LAN is allowed, file and resource sharing are not possible on devices that reside on opposite sides of the router. An exception is if the router has a DMZ port.
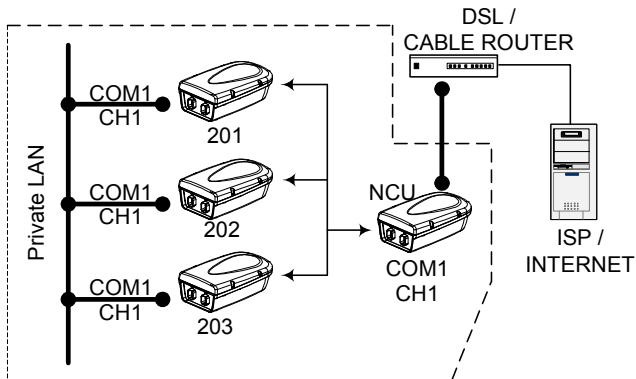
Figure 2-8: SR-7100 - Router - Internet Connection

■ Safari Network – Internal LAN - Internet via DSL/Cable router.

The connections for Figure 2-9 are exactly the same as in Figure 2-8 with respect to the Safari Network/Router interface. The difference is now we have added a Local Area Network of users on the WAN side of the router. As in the previous configuration (Figure 2-8), the Safari Network belongs to a private LAN, and is hidden from external network intrusions via the Internet, or any users on the Internal LAN if the router is equipped with firewall protection. Although accessing the Internet from the Safari Network's private LAN is allowed, file and resource sharing are not possible between devices that reside on the sides of the router. An exception is if the router has a DMZ port.
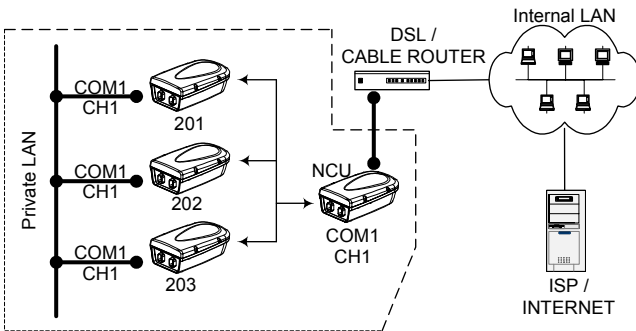
Figure 2-9: Safari Network – Router - Internal LAN – Internet

NAVCOM
TECHNOLOGY

■ Safari Network connects directly to an Internal LAN and becomes part of the LAN.

The connections for Figure 2-10 are exactly the same as in Figure 2-8, with respect to the Safari Network/Router interface. The difference is now we have added a Local Area Network of users, and removed the Router. In this configuration, the Safari Network no longer belongs to a private LAN, and is no longer hidden from external network intrusions via the Internet, or any users on the Internal LAN. Accessing the Internet from the Safari Network is allowed, while file and resource sharing is possible between all devices that reside on the Internal LAN. A software/hardware firewall solution is possible to protect the Internal LAN from Internet intrusions, but the Safari Network will not be protected from local users.
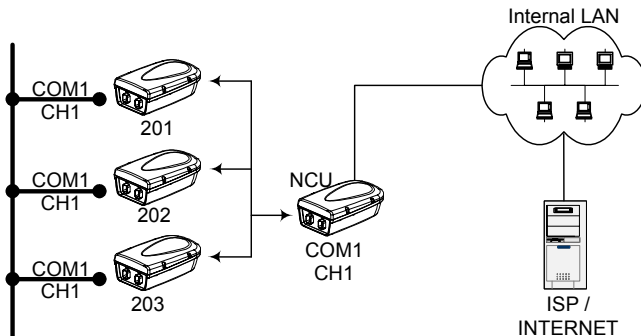
Figure 2-10: Safari Network – Internal LAN - Internet

Data Throughput vs. Port Speed

As previously discussed in Channel Assignments & Bandwidth, configuring a radio module's ports involves setting data throughput and port speed.

■ The data throughput setting is the over-the-air pass-through capability, and must correspond with the capacity needed for the chosen service of that port.

■ The port speed applies to the rate at which data is sent and received across the port to the attached device.

Port speed can be configured at a higher rate than the Channel throughput. However, if average throughput exceeds Channel throughput capacity, data will be lost.

Data Interception Protection

The Safari Network incorporates protection against intentional or unintentional interception, interference, or unauthorized access data on the network. The SR-7100 modulation uses a proprietary patented version of direct sequence spread spectrum. By spreading carriers at low energy across a wide bandwidth, it makes any type of radio interception, or interference difficult to implement.

Each radio module is manufactured with a unique hardware address. To enter any Safari Network every unit's address must be pre-approved by the network administrator. Each radio module must be specifically authorized by the network administrator to access any offered service.

The network administrator must set the radio module to a unique programmed spreading code common to each network. To communicate on the network, Safari Network radio modules must utilize a unique pre-pended training pattern set by the network administrator (called a Unique Word).

These parameters CANNOT be changed in any RU or SCU from the NCU. Each individual radio module in the network must be changed at the unit.

Additionally, data encryption such as triple DES or PGP can be employed at the application level to provide an extra level of security.

Multiple NCUs

As discussed in Chapter 1, Introduction, typically one NCU is used in a single network. However, there are instances where an application may require a redundancy of NCUs. A backup NCU (B-NCU) (or multiples) can be programmed to duplicate the primary NCU, and switched into backup service if needed simply by powering on the B-NCU.

Multiple coexisting networks can be established in order to expand the total bandwidth available. NCUs have been designed to operate synchronously to prevent jamming in this scenario. Synchronization of the NCUs can be accomplished by physically cabling them together via the J1 ports, or configuring one NCU as a synchronous transmitter, and the other NCUs as a synchronous receiver. This is accomplished with the external synchronization setting in the NCU setup. The primary NCU is set for transmit synchronization, and the secondary NCUs are set for receive synchronization.

Chapter 3   Installation

Once you have planned your network installation and
configuration you can physically install your network
components.

Installation Overview

This chapter provides instructions and information on
mounting the radio units, providing power, configuring
the antenna, and using the communication ports. It
discusses several safety and operational precautions with
which you must be familiar before attempting your first
power up of the Safari Network.

Safety and Operational Precautions

⚡ Cautions

■   The SR-7100 should be professionally installed due to
    antenna placement requirements and configuration
    of communication ports.

External Antenna Grounding

Make sure that the antenna and radio/controller system is
electrically grounded to provide some protection against
voltage surges and static charges.

Article 810 of the National Electrical Code, ANSI/NFPSA
70, provides information with regard to proper grounding
of the mast and supporting structure, grounding of the
lead-in wire to a discharge unit, size of grounding
conductors, location of antenna discharge unit,
connection to grounding electrodes, and requirements for
the grounding electrode.

Power Lines

Do not locate the antenna near overhead light or power circuits, or where it could fall into such power lines or circuits.

⚡ When installing or realigning an outside antenna system, extreme care should be taken to keep from touching such power lines or circuits. Contact with them could be fatal.
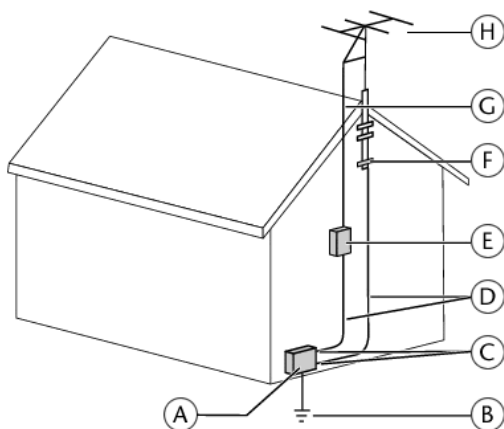
Figure 3-1: Antenna and Satellite Grounding

A   Electric service equipment
B   Power service grounding electrode system
      (NEC Art 250, Part H)
C   Ground clamps
D   Grounding conductors (NEC Section 810-21)
E   Antenna discharge unit (NEC Section 810-20)
F   Ground clamp
G   Lead-in Signal Cable
H   Antenna/Radio/Controller Combination

Additional Safety Cautions

■ It is recommended that users' and bystanders' heads be a minimum of 20 cm away from a unit's transmitting antenna when used in the basic configuration. If the transmitting system is modified from factory setup, check FCC regulations for compliance with exposure limits.

■ Do not directly connect units via an RF cable without enough proper attenuation. This will damage the system.

■ Do not disconnect the antenna cable when the radio has power applied. This will damage the RF transmitter and void the warranty.

■ When the radio is operating at full power, the maximum antenna gain allowed is 5.5 dBi per FCC regulation part 15.

If there is no standard J1 cable attached to the J1 connector on the radio, a J1 power jumper plug must be inserted. See Option 1, below.

Power Input

The SR-7100 radio module can be powered in two different ways:

■ Through the Port Expander to J2. This power configuration is recommended for the NCU and SCU since these units are typically mounted at a high elevation. With this configuration, the On/Off switch on the Port Expander will turn the system on and off.

■ Through the J1 connector on the radio. This power configuration is recommended for Remote Units because they are typically mounted vehicles with a DC voltage source. With this configuration, the On/Off switch on the Port Expander will turn the system on and off.

Providing AC Power through the Port Expander

This configuration, recommended for the NCU and SCU, requires the use of the Port Expander *with* the DIN connector for power input and the AC power supply.

1. Mount the radio unit in the selected location per your site planning. If using the internal antenna, be sure to mount the unit in the position shown in Figure 3-2 below, with the omni-directional radiation pattern along the horizontal plane.
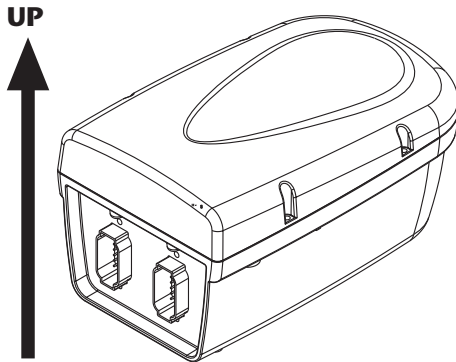
Figure 3-2: Correct Mounting Position for Internal Antenna

Option 1

2. Insert the J1 plug into the radio's J1 connector, and the J2 cable into the radio's J2 connector. The connectors are keyed to only fit one way.
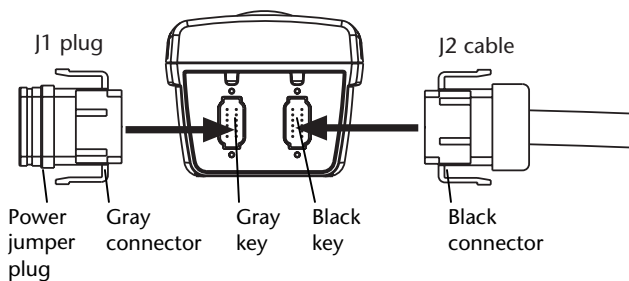
Figure 3-3: Use of J1 "Plug"

Option 2

3. Connect the J1 cable into the radio's J1 connector, and the J2 cable into the radio's J2 connector. The connectors are keyed to only fit one way.
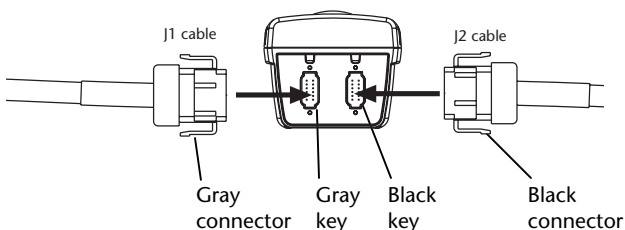
Figure 3-4: J1 Cable Connection

4. Connect the other end of the J2 cable to the end of the Port Expander (maximum distance 300 feet).
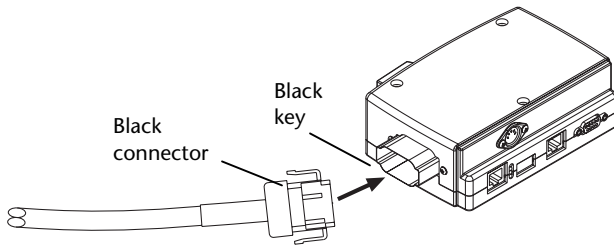
Figure 3-5: J2 to Port Expander Connection

5. Plug in the Port Expander's 5V/24V DC power supply to the DIN connector on the Port Expander, and to the AC power source.

6. Turn on the Port Expander. This will provide power to—and turn on—the radio.

Providing Power through the J1 Connector

This configuration, recommended for Remote units in vehicles, requires the use of the Port Expander *without* the DIN connector for power input.

1. Mount the radio unit in the selected location per your site planning. If using the internal antenna, be sure to mount the unit in the position shown in Figure 3-6 below, with the omni-directional radiation pattern along the horizontal plane.
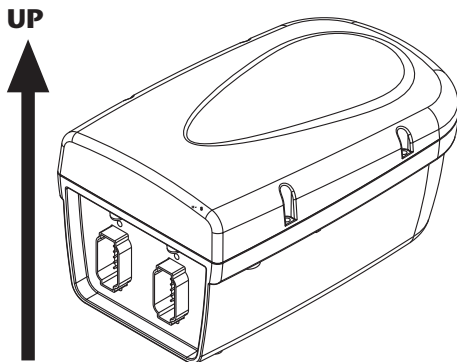
Figure 3-6: Correct Mounting Position for Internal Antenna

2. Connect the J1 cable into the J1 connector, and the J2 cable into the J2 connector. The connectors are keyed to only fit one way.
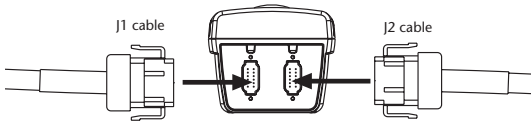
Figure 3-7: Use of J1 Cable

3. Connect the four 20 AWG wires at the other end of the J1 cable as follows:

   • Connect the red wire to the Vdc + of the voltage source.

   • Connect the green wire to the Ground of the voltage source.

   • Connect the white wire to the ignition signal. If there is no ignition signal, connect the white wire to the red wire at the voltage source.

   • Connect the black wire to the chassis ground.

4. Connect the other end of the J2 cable to the end of the Port Expander.
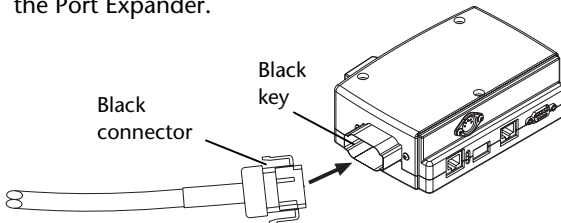
Figure 3-8: J2 to Port Expander Connection

5. Turn on the Port Expander. This will turn on the radio.

Antenna Configuration

There are two antenna configurations:

- A 0 dBi antenna is embedded in each NCU and Remote unit underneath the radome. Two 0 dBi antennas are embedded in each SCU. The antennas are vertically polarized with an omni-directional radiation pattern.

- For longer range RF transmission, an external 5.5 dBi antenna with RF cable has been included. The antenna is vertically polarized with omni-directional radiation pattern. This antenna configuration is recommended for NCUs and SCUs.

Using the External Antenna

To replace the 0 dBi antenna with the 5.5 dBi antenna, follow these steps:

1. Turn power off and remove the radome from the radio.
2. Unscrew the embedded antenna from the SMA connector on the radio.
3. Connect the right angle SMA connector on the 6dBi antenna's RF cable to the SMA connector on the radio.
4. Vertically mount the 5.5 dBi antenna.

Figure 3-9: 5.5 dBi Antenna Orientation

5. For an SCU, it is recommended to mount the two antennas with either 2 feet (min.) of vertical separation or 3 feet (min.) of horizontal separation to minimize intermodulation (if using 5.5 db antennas).
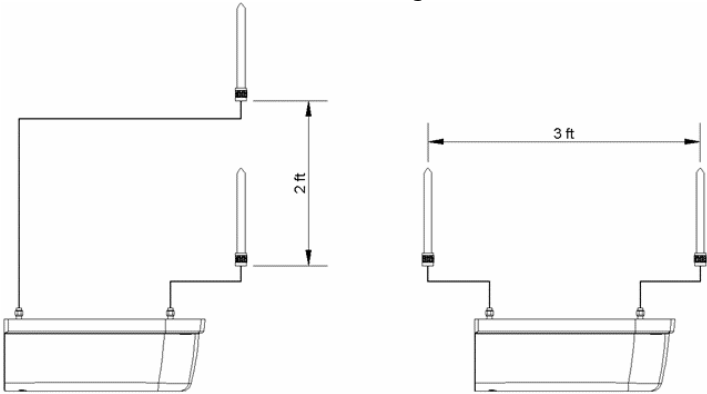
Figure 3-10: SCU Antenna Separation

Communication Ports

There are three external radio communication ports: COM1, COM2, and COM3. COM1 and COM2 are accessible from the Port Expander:
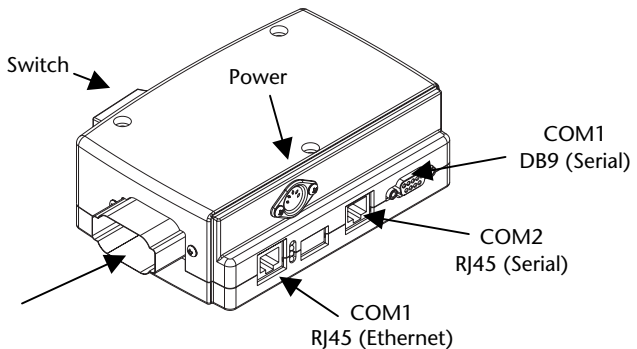
Figure 3-11: Communication Ports

COM1

COM1 is pre-configured at the factory as Serial or Ethernet based on the unit ordered.

■ The DB9 connector on the right side of the front panel of the Port Expander provides access to COM1 Serial port (which can be RS232 or RS422).

■ The RJ45 connector on the left side of the front panel of the Port Expander provides access to COM1/Ethernet.

COM2

COM2 is factory pre-configured as RS232 or RS422. The RJ45 connector in the middle of the front panel on the Port Expander allows access to COM2. An RJ45/DB9 converter cable is also provided to change COM2 to a DB9 connector.

COM3

COM3 is configured as RS232 protocol for all units. It is not accessible from the Port Expander, but can be accessed only through the J1 connector and cable.

The J1 cable composition is made up of one CAT5 cable with 4 twisted pairs for signals, plus 4 power wires.

For NCUs and Remote Units (J1):

Green CAT5 wire	RxD (pin 2 on DB9)
White/Green CAT5 wire	TxD (pin 3 on DB9)
Blue CAT5 wire	Ground (pin 5 on DB9)

Table 3-1: DB9 Pinouts, NCU and Remote (J1)

For SCUs (two signals, one for upstream, one for downstream):

Orange CAT5 wire	RxD (pin 2 on DB9)
White/Orange CAT5 wire	TxD (pin 3 on DB9)
Blue CAT5 wire	Ground (pin 5 on DB9)

Table 3-2: COM3/RS232 for SCU-Upstream (J1)

Green CAT5 wire	RxD (pin 2 on a DB9)
White/Green CAT5 wire	TxD (pin 3 on a DB9)
Blue CAT5 wire	Ground (pin 5 on a DB9)

Table: 3-3: COM3/RS232 for SCU-Downstream (J1)

J1 cable has two green wires. One is 20 AWG stranded and the other is 24 AWG solid, and is part of the twisted pair data cable. These wires should not be confused.

For a complete description of the J1 and J2 pin assignments, see the section *Cable Connections and Wiring* on the next page.

Proceed to *Chapter 4: Configuration* to configure the radio units in the network.

Cable Connections and Wiring

When a Port Expander will not be used, such as when a radio unit is mounted on a vehicle, refer to Table 3-4 for pin assignments and associated cable wiring.

Radio Unit (NCU or Remote)

J1	Signal name	Functions	Cable wiring
Pin 1	GND Chassis	Connect to chassis ground	Black, 20 gauge
Pin 2	Ext Vin	9-36 V DC power in	Red, 20 gauge
Pin 3	Auto On Disable	See note 1	White/Blue CAT 5
Pin 4	GND IO	COM3, ground	Blue, CAT 5
Pin 5	RS232 In	COM3, connect to TxD on DTE	White/Green CAT 5
Pin 6	RS232 Out	COM3, connect to RxD on DTE	Green, CAT 5
Pin 7	CAN L	CAN bus	White/Brown CAT 5
Pin 8	CAN H	CAN bus	Brown, CAT 5
Pin 9	NetSync B	For NCU synchronization, to NetSync B on other NCUs	White/Orange CAT 5
Pin 10	NetSync A	For NCU synchronization, to NetSync A on other NCUs	Orange, CAT 5
Pin 11	Vin RTN	Ground for 9-36 V DC power	Green, 20 gauge
Pin 12	IGN Main	See **Note 1** below	White, 20 gauge

Table 3-4: J1 Cable Connector, NCU and Remote

Note 1.	Radio status	Pin 12 high	Pin 12 low
	Pin 3 open	Power ON	Power OFF
	Pin 3 grounded	Power ON	Power ON

J2	Signal	Cable wiring
Pin 1	Multi Rx-	White/Blue, CAT 5
Pin 2	Multi Rx+	Blue, CAT 5
Pin 3	Multi Tx+	White/Green, CAT 5
Pin 4	Multi Tx-	Green, CAT 5
Pin 5	IGN Alt	Green, 20 gauge
Pin 6	IGN In	White, 20 gauge
Pin 7	PE6V	Red, 20 gauge
Pin 8	GND	Black, 20 gauge
Pin 9	R2P A	White/Brown, CAT 5
Pin 10	R2P B	Brown, CAT 5
Pin 11	P2R B	White/Orange, CAT 5
Pin 12	P2R A	Orange, CAT 5

Table 3-5: J2 Cable for NCU and Remote

Subnetwork Control Unit (SCU)

J1	Signal name	Functions	Cable wiring
Pin 1	GND Chassis	Connect to chassis ground	Black, 20 gauge
Pin 2	Ext Vin	9-36 V DC power in	Red, 20 gauge
Pin 3	Auto On Disable	See note 1	White/Blue, CAT 5
Pin 4	GND IO	COM3_SCU_upstream & COM3_SCU_downstream, ground	Blue, CAT 5
Pin 5	RS232 In	COM3_SCU_downstream, connect to TxD on DTE	White/Green, CAT 5
Pin 6	RS232 Out	COM3_SCU_downstream, connect to RxD on DTE	Green, CAT 5
Pin 7	CAN L	CAN bus	White/Brown, CAT 5
Pin 8	CAN H	CAN bus	Brown, CAT 5
Pin 9	RS232 In	COM3_SCU_upstream, connect to TxD on DTE	White/Orange, CAT 5
Pin 10	RS232 Out	COM3_SCU_upstream, connect to RxD on DTE	Orange, CAT 5
Pin 11	Vin RTN	Ground for 9-36 V DC power	Green, 20 gauge
Pin 12	IGN Main	See **Note 1** below	White, 20 gauge

Table 3-6: J1 Connector for SCU

Note 1.	Radio status	Pin 12 high	Pin 12 low
	Pin 3 open	Power ON	Power OFF
	Pin 3 grounded	Power ON	Power ON

J2	Signal name	Cable wiring
Pin 1	Multi Rx-	White/Blue, CAT 5
Pin 2	Multi Rx+	Blue, CAT 5
Pin 3	Multi Tx+	White/Green, CAT 5
Pin 4	Multi Tx-	Green, CAT 5
Pin 5	IGN Alt	Green, 20 gauge
Pin 6	IGN In	White, 20 gauge
Pin 7	PE6V	Red, 20 gauge
Pin 8	GND	Black, 20 gauge
Pin 9	R2P A	White/Brown, CAT 5
Pin 10	R2P B	Brown, CAT 5
Pin 11	P2R B	White/Orange, CAT 5
Pin 12	P2R A	Orange, CAT 5

Table 3-7: J2 Cable for SCU

Chapter 4   Configuration

Once you have planned your network installation and configuration, as discussed in Chapter 2, and physically installed your network components, as discussed in Chapter 3, you can specify services and configure the NCU, RU and SCU components to deliver the services you require.

This chapter describes version **3.3.0** of the configuration software.

The configuration software discussed in this chapter is text menu-based. A graphical, browser-based software interface—for networks configured as a wireless Ethernet LAN—may be available in a later release.

HyperTerminal Program Interface

HyperTerminal is a text–based communication program that can be used for sending Administrative commands to the SR-7100 radio. HyperTerminal Private Edition 6.3 (or higher), which has the best compatibility among different operating system platforms, is recommended. The program can be downloaded for free from www.hilgraeve.com/htpe/download.html.

■ Use the provided RJ45-DB9 converter cable to connect the COM2 port on the Port Expander that is connected to the NCU with a COM port on your administrative computer.

■ Launch a HyperTerminal program from the computer and set the following parameters for the HyperTerminal program:

- Baud = 57600 bps
- Data bits = 8
- Parity = NONE
- Stop bits = 1
- Flow Control = NONE

```
                    ┌─────────────┐
                    │   Launch    │
                    │  HyperTerm  │
                    │   Program   │
                    └─────────────┘
                           │
                           ▼
                    ┌─────────────┐
                    │   Display   │
                    │ "Admin.Page"│
                    └─────────────┘
```

Launch HyperTerm Program → Display "Admin.Page"

Sel. "Local Config" Config as NCU

Sel. "Net. Mgmt" Sel. "Svc Config" Set Up Svcs.

Sel: "Net Mgmt" Sel: "NCU Config" Config NCU

Sel: "Net Mgmt" Sel: "Remote Config" Config. Remote

Sel: "Net Mgmt" Sel: "SCU Config" Config. SCU
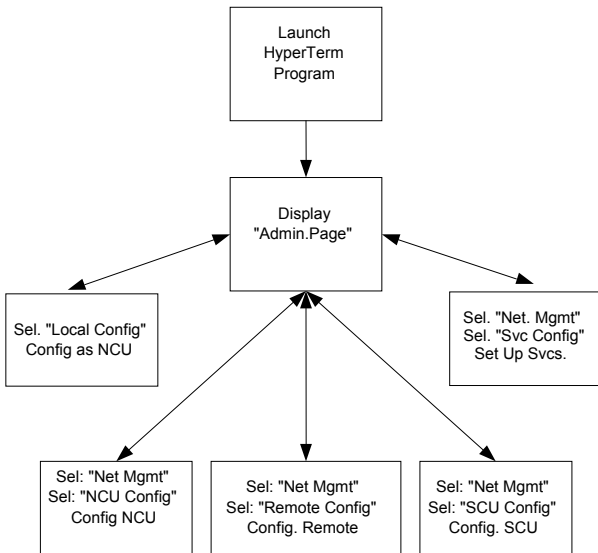
Figure 4-1: Set-up Process

Configuring as an NCU

The SR-7100 radio defaults to an RU (Remote Unit). Before you can use the radio as an NCU, you need to configure it as an NCU.

Initiate a HyperTerminal program and turn the radio ON through the Port Expander. Within 10 seconds, type the word "**admin**" in the HyperTerminal window and press the Enter key. The **Admin Page** appears like the following:

```
== NCT SR-7100 Admin Page v3.3.0 ==
1. Network Management Menu (NCU Only)
2. Software Download
3. Diagnostics
4. Local Configuration
5. Unit Reset
6. Quit Admin
7. Return to Factory Default Settings
Select :
```

Image 4-1: Admin Page

2. Software Download Only for use in upgrading Firmware. See additional Read Me files issued with any upgrade for specific instructions and download procedure.

3. Diagnostics For use in trouble-shooting and for obtaining certain performance parameters. See Appendix on Diagnostic Tools for detailed information (Future).

Select: **4. Local Configuration**
by typing **4** and pressing the Enter key. The Local Configuration window appears like the following:

```
N a v C o m   T e c h n o l o g y    Safari SR-7100   v3.3.0
              ==============================
              +     Local Configuration    +
              ==============================
              1) Unit Function
              2) Advanced Configuration

              x) Exit

              Select: _
```

Image 4-2: Local Configuration

Select: **1) Unit Function**

```
--------------------------------------------------
NCU <---> SCU-Uplink|SCU-Downlink <---> Remote
--------------------------------------------------
Currently Set As NCU
1) NCU, 2) SCU-Downlink, 3) SCU-Uplink, 4) Remote
Select Unit Function => _
```

Image 4-3: Unit Function

To set the radio as the NCU, select: **1) NCU**

A message will direct you to perform a unit reset. Press the Enter key again to return to the Local Configuration page.

Press **x** to return to the Admin Page. Press **5** plus enter, followed within 10 seconds with "admin".

Configuring the network

To illustrate the logic of network configuration, let's consider an example of a typical network system.
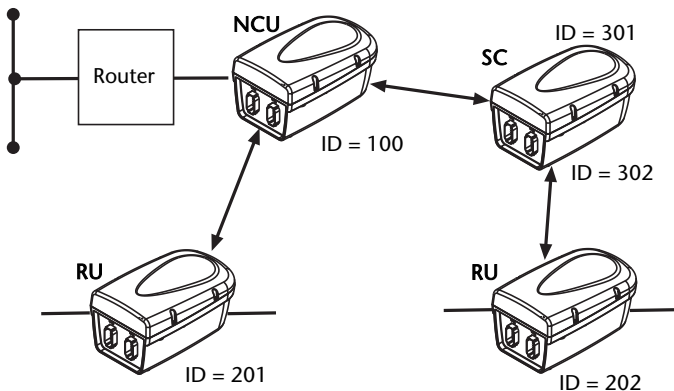
Figure 4-2: Sample Network

■ There is 1 **NCU** with a physical ID of 6F3A6E8. It will be automatically assigned Unit ID **100**.

■ There are 2 **RU**s:

RU	Physical ID	Assigned Unit ID
1	6F3FFFF	201
2	6F3EEEE	202

■ There is 1 **SCU** containing two radio modules named SCU uplink and SCU downlink.

SCU	Physical ID	Assigned Unit ID
SCU uplink	6F3DDDD	301
SCU downlink	6F3CCCC	302

■ A router is connected to a wired LAN and the COM1 on the NCU. The Internet will be accessible from the COM1 port on RU 201 or 202 or both. Therefore, a WLAN channel will be established and named Channel 1. The COM1 ports on NCU, RU 201 and RU 202 will all be assigned to Channel 1. The data throughput is set at 179.2Kbps for both upload and download.

■ Also, there will be a serial communication link between 201 COM2 and 202 COM2 with a throughput rate of 25.6Kbps. Therefore, a Remote-to-Remote service will be setup with forward channel 2 and return channel 3 on 25.6Kbps data rate. Note: Because the Remote-to-Remote passes both upstream and down, it consumes two times the data rate from the maximum throughput. Note: Com 3 (not used in this example) could be used for additional services such as GPS reporting. A special cable may be required in some applications.

■ The SCU is transparent to the service setup. The NCU in on frequency 4 and the SCU downlink is on frequency 2. The two RUs will automatically search for the best frequency to log onto the network**.**

All example screens in this chapter pertain to this example setup (illustrated in Figure 4-2 on the previous page).

Bring up the Network Management Menu

Initiate a HyperTerminal program and turn on the radio through the Port Expander. Within 10 seconds, type the word "**admin**" in the HyperTerminal window and press the Enter key. The Admin Page appears like the following:

```
== NCT SR-7100 Admin Page v3.3.0 ==
1. Network Management Menu (NCU Only)
2. Software Download
3. Diagnostics
4. Local Configuration
5. Unit Reset
6. Quit Admin
7. Return to Factory Default Settings
Select :
```

Image 4-4: Admin Page

Select option **1. Network Management Menu** by typing **1** and pressing the Enter key. The **Network Management Menu** appears like the following:

```
N a v C o m   T e c h n o l o g y    Safari SR-7100    v3.3.0
         ===============================
         *  Network Management Menu   *
         ===============================
         1) Service Configuration

         2) NCU Configuration

         3) SCU Configuration

         4) Remote Configuration

         5) Network Utility

         6) Network Restart

         x) Exit

         Select: _
```

Image 4-5: Network Management Menu

Service Configuration

At the **Network Management Menu**, select option
1) Service Configuration. The Service Configuration page
appears like the following:

```
N a v C o m   T e c h n o l o g y   Safari SR-7100   v3.3.0

================================
+ Service Configuration Menu +
================================
1) Add Service

2) Delete Service

3) List Services

4) Delete Service Table

x) Exit

Select: _
```

Image 4-6: Service Configuration Menu

At the **Service Configuration Menu**, select option
1) Add Service and you will be prompted to select the
type of the service, to assign service ID and to select the
data throughput for the services.

Types of services are:

- Broadcast from NCU
- Broadcast from Remote
- Remote to Remote
- Multipoint - Multipoint
- Wireless LAN
- Remote to NCU

After selecting the service type, you are prompted to enter
the Service ID for the selected service type. Values are 1 –
254. You will type the value and press the Enter key.

After entering the Service ID, you are prompted to choose the Forward Channel Bandwidth by entering one of the following options (Note: this list of speed options will be provided when the Total System Throughput is set at 512Kbps (factory setting). If you wish to change it to a lower rate of 240 or 96Kbps, see NCU Advanced Configuration (Data Rate Selection) on page 4-16 for instructions and select from the options provided.

Forward Channel Bandwidth	
0	NONE
1	25.6K
2	51.2K
3	76.8K
4	102.4K
5	128.0K
6	153.6K
7	179.2K
8	204.8K
9	230.4K

Table 4-1

If adding a Point to Point or Multipoint service, you will also be prompted to enter another service ID (for the return channel).

The following screen is an example of adding a WLAN channel with assigned channel ID of 1 and forward and return bandwidth of 179.2Kbps.

```
ID          Type        FWD_Band  RET_Band   Service1   Service2
          -----------------------------------------------------------

Available Bandwidth(Forward) : 230.4k
Available Bandwidth(Return)  : 230.4k


          ===============================================================
Select Channel Type =>
1) Broadcast From NCU      2) Broadcast From Remote  3) Remote to Remote
4) Multipoint to Multipoint  5) WirelessLAN          6) Remote to NCU => 5
Enter Channel ID (1 .. 254) : 1
Choose Forward Bandwidth =>
1)  25.6K  2)  51.2K  3)  76.8K  4) 102.4K  5) 128.0K
6) 153.6K  7) 179.2K  8) 204.8K  9) 230.4K : 7
Choose Return Bandwidth =>
1)  25.6K  2)  51.2K  3)  76.8K  4) 102.4K  5) 128.0K
6) 153.6K  7) 179.2K  8) 204.8K  9) 230.4K : 7
** Changes have been made to the system configuration  **
** Network Restart required for changes to take effect **
```

Image 4-7: Adding a WLAN Channel

The following screen shows steps of adding a Remote to Remote service with assigned forward channel ID of 2 and return channel ID of 3 and 25.6Kbps bandwidth in both directions.

```
1) Broadcast From NCU  2) Broadcast From Remote  3) Remote to Remote
4) Multipoint(Async)   5) WirelessLAN            6) Remote to NCU
7) Multipoint(Packet)
Select Channel Type => 3
Enter Channel ID (1 .. 254) : 2
Choose Forward Bandwidth =>
1)  25.6K  2)  51.2K  3)  76.8K  4) 102.4K  5) 128.0K
6) 153.6K  7) 179.2K  8) 204.8K  9) 230.4K : 1
Enter Channel ID (1 .. 254) : 3
** Changes have been made to the system configuration  **
** Network Restart required for changes to take effect **
```

Image 4-8: Adding a Remote to Remote Service

Repeat the steps in this section to add additional network services.

List Services

When all channels are added in the network, you can select:

3) List Services

from the Service Configuration menu to double check (as shown in the following example).

```
ID         Type       FWD_Band  RET_Band  Service1  Service2
----------------------------------------------------------------
 1  Wireless LAN        179.2k    179.2k      1         1
 2  Remote To Remote     25.6k     25.6k      2         3

Available Bandwidth(Forward) :   0.0k
Available Bandwidth(Return)  :   0.0k_
```

Image 4-9: List Services

Multipoint to Multipoint Service allows for the exchange of packetized data in applications such as AVL GPS traffic and for encapsulating information in addressable UDP packets. Details including APIs are available in the NCT SSR Technical Reference Manual. Contact the manufacturer for further details.

NCU Configuration

At the **Network Management** menu, select:
2) NCU Configuration

The NCU Configuration page appears like the following:

```
N a v C o m  T e c h n o l o g y   Safari SR-7100   v3.3.0
               ==============================
               +    NCU Configuration Menu    +
               ==============================
               1) NCU IP Configuration

               2) NCU Port Configuration

               3) View NCU Configuration

               4) Advanced Configuration

               5) View Advanced Configuration

               x) Exit

               Select: _
```

Image 4-10: NCU Configuration

If the network you are setting up does not include Ethernet services, skip this section and go directly to NCU Port Configuration.

If you are setting up a network including Ethernet services, select **1) NCU IP Configuration** from NCU Configuration menu and you will be prompted to answer IP address related questions.

The NCU unit needs to be assigned with DHCP-enabled or a fixed IP address. If DHCP is not enabled, then you have to select an IP address, Subnetwork Mask and Gateway IP address that is acceptable to your network. If using a Linksys router, the router has a default IP address of 192.168.1.1 which is the gateway IP address. Therefore it is convenient to assign NCU an IP address of 192.168.1.2. The subnet mask address is 255.255.255.0.

The following screens show the steps of this configuration process.

```
Unit Id = 100  Physical ID = 6f3a68a
Enable DHCP (Y/N): y
```

```
Unit Id = 100  Physical ID = 6f3a68a
Enable DHCP (Y/N): n
Enter IP Address : 192.168.1.2
Entered [192.168.1.2]:
Enter Subnet Mask : 255.255.255.0
Entered [255.255.255.0]:
Enter Gateway IP Address : 192.168.1.1
```
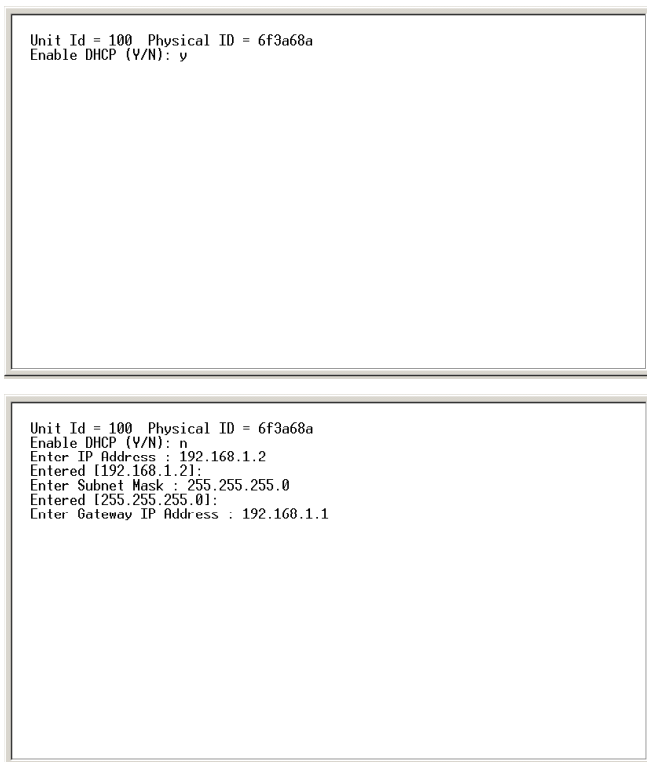
Image 4-11: Configuration Process

NCU Port Configuration

At the **NCU Configuration** menu, select:
2) NCU Port Configuration
and you will be prompted to configure the ports by selecting the protocol, the DCE/DTE transfer data rate and, in case of setting up serial communication ports, the Unit ID for the ultimate destination unit and the port ID on the ultimate destination unit.

The following screen is an example of NCU port configuration while the COM1 is set for Ethernet and COM2 is set for Diagnostics. Since Ethernet at the NCU is treated as broadcasting mode, there is no need to identify the ultimate destination. It is recommended to set COM2 at the NCU as the diagnostics interface for network management purposes (unless you elect to use the Browser interface via Ethernet). The data rate for the diagnostic port is always 57.6Kbps. Note: COM3 is available on J1 at the NCU by use of a special cable. COM3 could be used to broadcast differential corrections to GPS receivers or to report position messages in real time. Here it is left disabled.

```
NCU 100(0x06f3a84c) Output Power = 63   DHCP Enabled
-----------------------------------------------------------------------
Port Protocol   Baud  Type TxChnl RxChnl Destination/Port  CollType Interval
COM1 Ethernet   N/A ADATA   1      1      Broadcast COM1
COM2 Async     57.6K   DBG
COM3 Disabled   N/A   N/A


Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 2
Protocol 1-Async(RS422), 2-HDLC, 3-Disable => 1
115.2Kbps = 0, 57.6Kbps = 1, 38.4Kbps = 2, 32.7Kbps = 3, 19.2Kbps = 4,
  9.6Kbps = 5,  4.8Kbps = 6,  2.4Kbps = 7,  1.2Kbps = 8,   300bps = 9
Select Baudrate => 1
Enter Data Type (1-Asynch Data, 2-Diagnostics, 3-GPS)
               (4-SSR Encapsulation, 5-RTCM, 6-Data Over IP )
<Note : GPS Data Type includes CRM, NMEA, NCT> : 2
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 4_
```

Image 4-12: NCU Port Configuration

The service ID is the channel ID identified from the Service Configuration page and in this example service 1 is a WLAN type of service and assigned to COM1.

View NCU Configuration

At the NCU Configuration menu, select:
3) View NCU Configuration
and you will see the primary settings for the NCU.

```
NCU 100(0x06f3a84c) Output Power = 63   DHCP Enabled
-------------------------------------------------------------------
Port Protocol   Baud  Type TxChnl RxChnl Destination/Port  CollType Interval
COM1 Ethernet    N/A ADATA   1      1      Broadcast  COM1
COM2 Async      57.6K  DBG
COM3 Disabled    N/A   N/A
_
```

Image 4-13: NCU Configuration

NCU Advanced Configuration

The NCU Advanced Configuration menu is used to set network parameters for specialized cases. Changes made here may require reconfiguration of every RU and SCU in the network.

At the **NCU Configuration** menu, select:
4) Advanced Configuration.

```
N a v C o m   T e c h n o l o g y    Safari SR-7100   v3.3.0

           ==============================
           * NCU Advanced Configuration *
           ==============================
           1) Spread Sequence

           2) Unique Word Selection

           3) External Synchronization

           4) Data Rate Selection

           5) Set NCU Frequency

           6) Set Output Power Index

           x) Exit

           Select: _
```
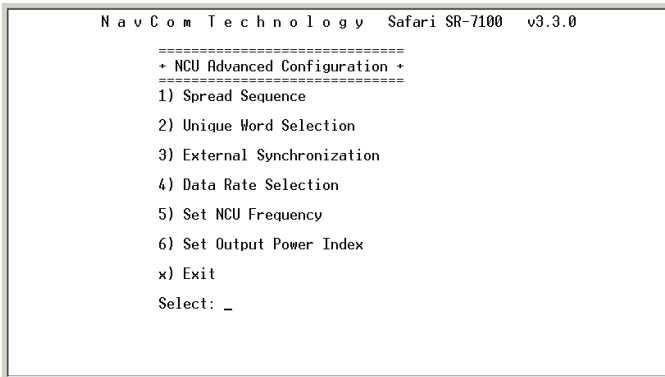
Image 4-14: NCU Advanced Configuration Menu

- **1) Spread Sequence (future option)**

  The Spread Sequence is a parameter used for security purposes. It is method of radio communication in which a spreading code is used to encode data onto a radio carrier frequency. Values are 1 – 6. The selected value must be common across the system. Type the value and press the Enter key. You will be returned to the Network Control Unit Setup menu.

- **2) Unique Word (future option)**

  The Unique Word is another parameter for security purposes. It is a pre-pended data pattern used as a training pattern signal to the intended data recipient for receiver signal acquisition. Values are 1 - 9. The assigned value will be common across the system. Type the value and press the

Enter key. You will be returned to the Network Control Unit Setup menu.

■ 3) External Synchronization

Options are Transmit and Receive. Normally, this would be set to Transmit. In situations where there will be two NCUs linked together, you would set one of the NCUs to Receive. Type the value (**t** or **r**) and press the Enter key. Then type **x** and press the Enter key. You will be returned to the Network Control Unit Setup menu.

■ 4) Total System Data Throughput Selection

This is the total over-the-air data transfer capacity of a system, in both directions (inbound plus outbound). For the SR-7100 System, this is 96, 240, or 512Kbps.

■ 5) Set Base Frequency

This is the system center radio frequency. Depending on the data rate, there are a different number of frequency channels available for operation. For the highest data rate, there are five non-overlapping channels that can be operated. (See Appendix A for a list of frequency values.) Type a value and press the Enter key. You will be returned to the Network Control Unit Setup menu.

■ 6) Set Output Power Index

This is the power level for radio transmissions from the NCU. Options are 0 – 63, with 0 representing minimum power as allowed by the FCC for each data rate, and 63 representing full power. Type a value and press the Enter key. You will be returned to the Network Control Unit Setup menu.

In our example, select Set Base Unit Frequency to set it to frequency 4, and select Set Output Power Index to set it to 63.

View Advanced Configuration

When done, select Exit to return to the Network Management Menu.

At the **NCU configuration** menu, select **5) View Advanced Configuration** and you will see the advanced settings for the NCU.

```
== NCU Advanced Configuration ==
1) External Sync => Transmit
2) Frequency     => 2 (2.424492000 GHz)
3) Power Level    => 63
4) Data Rate      => 512.0Kbps
```

Image 4-15: NCU Advanced Settings

Remote Configuration - Adding an RU

At the Network Management menu, select:
4) Remote Configuration

The Remote Configuration menu appears like the following:

```
N a v C o m   T e c h n o l o g y    Safari SR-7100   v3.3.0
            ==============================
            +  Remote Configuration Menu +
            ==============================
            1) Add Remote

            2) Delete Remote

            3) List Remotes

            4) Show Remote

            5) Change Remote Configuration

            6) Change Port Configuration

            x) Exit

            Select:
```

Image 4-16: Remote Configuration Menu

At the Remote Configuration menu, select:
1) Add Remote
and you will be prompted to enter the Unit ID (the logical radio ID) for the radio unit by typing its value and pressing the Enter key. For RUs, the Unit ID can be chosen from 101 to 599 (100 is reserved for NCU).

Then you will be prompted to enter the physical ID of the unit (as it is listed on the RU label).

When you are prompted whether or not to enable DHCP, enter **y** or **n** as appropriate. If you are using a router with its DHCP server enabled, enter **y** to enable the DHCP on remotes. If you enter **n**, you will be prompted to enter your assigned remote's IP Address and Subnet Mask.

Then you will be prompted to enter the Output Power level (which is usually the same as that set for the NCU). Use 63 for the maximum power level permitted by the FCC for each data rate. Lower power level can be set by using 62 - 0.

The following example screen shows the steps of adding the RU 201 (ID range 101-399).

```
Enter Remote ID : 201
Enter Physical ID in Hex => 6f3ffff
DHCP Enabled (** Because DHCP Is Enabled For NCU **)
Enter Output Power Level Index (0..63) : 63
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 4
```

Image 4-17: Adding an RU

Repeat this process to add all RUs included in the network. Note: Unit must be reset for changes to take place

RU Port Configuration

■ At the Remote Configuration menu, select:
6) Change Port Configuration
and you will prompted to enter the Unit ID for the RU to be configured. In our example, RU 201 is the first unit to be configured, so enter 201 and return.

■ Then you will be prompted to select a port to configure: COM1, COM2, COM3. In our example, COM1 is selected first for configuration.

■ After you select a port to configure, you are prompted to select the protocol for the port to communicate with the computer or other communication device. Options are different depending on the port selected. You can follow the on-screen prompt. In our example, COM1 is assigned for Ethernet and COM2 is assigned for Asynch.

■ Next you will be prompted to enter the baud rate for the port to communicate with the computer or other communication device across the DCE/DTE interface. (For Ethernet protocol, this step is skipped) Options are detailed in Table 4-2.

BAUD RATE	
115200	0
57600	1
38400	2
32768	3
19200	4
9600	5
4800	6
2400	7
1200	8
300	9

Table 4-2

In this example, COM2 is assigned with data rate of 19.2Kbps and COM1 is Ethernet.

■ Next enter the Data Type for the port. (This is skipped for Ethernet protocol.) Options are:

0-Data (Used to pass user data traffic)
1-Diagnostics (Used for administrative communications with NCU controller)

In this example, both COM1 and COM2 are for Data communication.

■ You will then be prompted to enter the Service ID for the port (this corresponds to the service ID configured in service configuration for the transmit channel). If required by the type of service, you may also be prompted to enter a second service ID (for the service's receive channel). For a Remote-NCU service,

there is just one channel ID for both transmit and receive.

In this case, COM1 is assigned with channel 1 and COM2 is assigned with forward channel 2 and return channel 3. Please refer to service example in Configuring the Network on page 4-5.

■ Then you will be prompted to enter the unit ID of the Ultimate Destination radio (This is skipped for Ethernet and Broadcasting type of services). In this example, the ultimate destination of unit 201 COM2 is Unit 202.

Enter the Ultimate Destination Port for the channel (COM1, COM2 or COM3), which is the port that will receive this port's transmission. In this example, the ultimate destination of unit 201 COM2 is Unit 202 COM2.

The following screen shows the steps of configuring the COM1 and COM2 on RU 201.

```
Enter Unit ID to modify : 201

Unit 201(0x00000001) Output Power = 63   DHCP Enabled
Gateway IP Address[192.168.1.1] Subnet Mask[255.255.255.0]
-----------------------------------------------------------------------
Port   Protocol   Baud  Type  TxChnl  RxChnl  Destination  DestPort
COM1   Ethernet   N/A   DATA    1       1         100         COM1
COM2   Async      4.8K  DATA    2       3         202         COM2
COM3   Disabled   N/A   N/A

Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 1
Protocol 1-Async(RS232), 2-HDLC, 3-Ethernet, 4-Async(RS422), 5-Disable => 3
Enter Service ID(0 .. 254, 0 - Local Loop Back) : 1
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 2
Protocol 1-Async(RS422), 2-HDLC, 3-Disable => 1
115.2Kbps = 0, 57.6Kbps = 1, 38.4Kbps = 2, 32.7Kbps = 3, 19.2Kbps = 4,
   9.6Kbps = 5,  4.8Kbps = 6,  2.4Kbps = 7,  1.2Kbps = 8,   300bps = 9
Select Baudrate => 4
Enter Data Type (1-Data, 2-Diagnostics, 3-GPS) : 1
Enter Service ID(0 .. 254, 0 - Local Loop Back) : 2
Enter Rx Service Id (1 .. 254) : 3
Enter Destination Id (101 .. 599) 202
Enter Destination Port (1-COM1, 2-COM2, 3-COM3) : 2
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 4
```

Image 4-18: Configuring Ports

■ You can now choose:

6) Change Port Configuration
again from the Remote Configuration menu to
configure the ports for Remote 202.

The following screen shows the steps configuring the
ports on RU 202. Please notice the sequence of service ID
for COM2 is the opposite to that of 201 COM2.

```
Enter Unit ID to modify : 202

Unit 202(0x06f3eeee) Output Power = 63   DHCP Enabled
Gateway IP Address[192.168.1.1] Subnet Mask[255.255.255.0]
------------------------------------------------------------------------
Port   Protocol   Baud   Type  TxChnl  RxChnl  Destination  DestPort
COM1   Ethernet   N/A    DATA    1       1         100        COM1
COM2   Async      19.2K  DATA    3       2         201        COM2
COM3   Disabled   N/A    N/A

Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 1
Protocol 1-Async(RS232), 2-HDLC, 3-Ethernet, 4-Async(RS422), 5-Disable => 3
Enter Service ID(0 .. 254, 0 - Local Loop Back) : 1
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 2
Protocol 1-Async(RS422), 2-HDLC, 3-Disable => 1
115.2Kbps = 0, 57.6Kbps = 1, 38.4Kbps = 2, 32.7Kbps = 3, 19.2Kbps = 4,
  9.6Kbps = 5,  4.8Kbps = 6,  2.4Kbps = 7,  1.2Kbps = 8,   300bps = 9
Select Baudrate => 4
Enter Data Type (1-Data, 2-Diagnostics, 3-GPS) : 1
Enter Service ID(0 .. 254, 0 - Local Loop Back) : 3
Enter Rx Service Id (1 .. 254) : 2
Enter Destination Id (101 .. 599) 201
Enter Destination Port (1-COM1, 2-COM2, 3-COM3) : 2
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 4_
```

Image 4-19: Configuring Ports

List RUs

At the Remote Configuration menu, select:

3) List Remotes

and you will see the configuration for all RUs.

```
Remote 201(0x06f28374) Output Power = 63   DHCP Enabled
---------------------------------------------------------------------------
Port Protocol   Baud  Type TxChnl RxChnl Destination/Port  CollType Interval
COM1 Ethernet    N/A ADATA   1      1        100    COM1
COM2 Async     19.2K ADATA   2      3        202    COM2
COM3 Disabled    N/A   N/A

Remote 202(0x06f03748) Output Power = 63   DHCP Enabled
---------------------------------------------------------------------------
Port Protocol   Baud  Type TxChnl RxChnl Destination/Port  CollType Interval
COM1 Ethernet    N/A ADATA   1      1        100    COM1
COM2 Async     19.2K ADATA   3      2        201    COM2
COM3 Disabled    N/A   N/A


Total 2 Remotes_
```

Image 4-20: RU Configuration
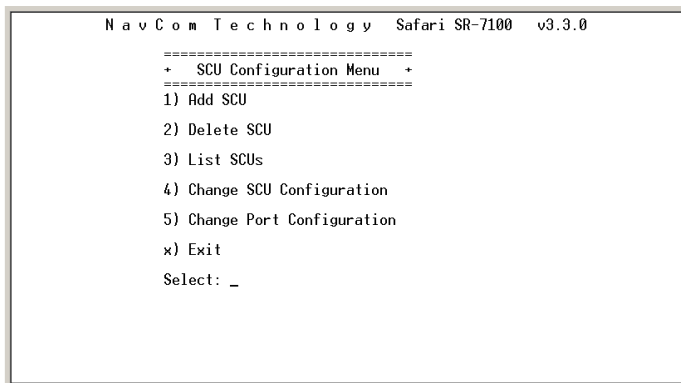
SCU Configuration

Bring up the Subnetwork Control Unit Setup menu:

At the Network Management menu, select:
3) SCU Configuration
The Subnetwork Control Unit Setup menu appears like the following:

```
N a v C o m   T e c h n o l o g y    Safari SR-7100   v3.3.0

         ==============================
         +   SCU Configuration Menu   +
         ==============================
         1) Add SCU

         2) Delete SCU

         3) List SCUs

         4) Change SCU Configuration

         5) Change Port Configuration

         x) Exit

         Select: _
```

Image 4-21: Subnetwork Control Unit Setup Menu

At the Subnetwork Control Unit Setup menu, select:
1) Add SCU
and you will be prompted to:

■ Enter the SCU-Uplink Unit ID. In our example, it is 301.

■ Enter the SCU Uplink physical ID, which is labeled on the outer case of the SCU unit. In our example, it is 6F3DDDD.

■ Enter the RF output power for the SCU Uplink. In our example, it is 63, the max power.

■ Enter the SCU-Downlink Unit ID. In our example, it is 302.

■ Enter the SCU Downlink physical ID that is labeled on the case of SCU unit. In our example, it is 6F3CCCC.

■ Enter the RF output power for the SCU Downlink. In our example, it is set at 63, the max power.

■ Enter the SCU Downlink frequency (should be different from the NCU frequency). In our example, it is frequency 2.

The following screen shows the steps of the SCU configuration.

```
-----------------------------------------------
NCU <---> SCU-Uplink|SCU-Downlink <---> Remote
-----------------------------------------------
Enter SCU-Uplink ID : 301
Enter Physical ID in Hex => 6f3dddd
Enter Output Power Level Index (0..63) : 63
Enter SCU-Downlink ID : 302
Enter Physical ID in Hex => 6f3cccc
DHCP Enabled (** Because DHCP Is Enabled For NCU **)
Enter Output Power Level Index (0..63) : 63
Enter SCU Frequency ID (1 .. 5) : 2
Select Port(1-COM1, 2-COM2, 3-COM3, 4-exit) ==> 4_
```

Image 4-22: SCU Configuration

Chapter 5   Monitoring & Changes

After you have configured your network services and added units to the network (as described in Chapter 4), you may occasionally need to monitor network usage and make changes to your network configuration. Here you will find descriptions of procedures for displaying network information, removing network services and components, and modifying configuration parameters. This chapter describes version **3.3.0** of the configuration software.

Displaying Network Information

The Safari Network configuration software enables you to display current configuration information as well as real time network usage information from the Network Management Menu.

To access the SR-7100 Network Management Menu:

1. Launch a terminal program (such as HyperTerminal) on the computer.

2. Turn on the NCU through the Port Expander. Within 10 seconds, type the word "admin" and press the Enter key.

3. At the NCT SR-7100 Admin Page, select:
   1. Network Management Menu
   by typing 1 and pressing the Enter key.

Real Time Network Usage information is very useful to monitor the health of the whole network and diagnostics for network abnormality. It is recommended to reserve COM2 port on the NCU for network management displaying real time RU status and to change network configuration if required.

To setup COM2 on NCU for network management, go to the Network Management menu, then the NCU configuration menu and then the NCU Port Configuration menu to configure COM2 as Async protocol, 57.6 Kbps baud rate and "diagnostics" for data type.

Since the COM2 port is readily available on the Port Expander which is located close to a PC, it is convenient to set NCU COM2 port for Network management.

Current Configuration

The following information can be displayed about the network within the Network Management Menu:

- NCU settings

- Network services

- RU settings (all or one at a time)

- Network SCUs

To display NCU settings:

1. At the Network Management menu, select:
   2) NCU Configuration.

2. At the NCU Configuration menu, select:
   3) View NCU Configuration
   to see the current setting for NCU communication ports, its physical ID.

3. At the NCU Configuration menu, select:
   5) View Advanced Configuration
   to see the current settings for the NCU's external sync, RF frequency, RF output power level and data throughput settings. Press the Enter key to return to the Network Management menu.

To display network services:

1. At the Network Management menu, select:
    1) Service Configuration.
2. At the Service Configuration menu, select:
    3) List Services
    to see all network services with forward and return bandwidth and available forward and return bandwidth.

> Adding services is discussed in Chapter 4. Deleting services is discussed later in this chapter.

To display RUs:

1. At the Network Management menu, select:
    4) Remote Configuration

2. At the Remote Configuration menu, select:
    3) List Remotes
    to see configuration for all RUs. The configuration information for each RU includes: unit logical ID, unit physical ID, RF output power level, DHCP status and three communication port configuration.

3. Or at the Remote Configuration menu, select:
    4) Show a Remote
    then enter the unit's ID at the prompt to see the configuration information for the RU.

> Adding RUs is discussed in Chapter 4. Reconfiguring RUs and ports is discussed later in this chapter.

To display SCUs:

1. At the Network Management Menu, select:
    3) SCU Configuration

2. At the SCU Configuration menu, select:
    3) List SCU's
    to view the configuration information for SCUs.

Real Time Network Usage

The following information can be displayed about real time network usage:

- Units logged on
- Units using services

To display units logged on:

1. At the Network Management menu, select:
   5) Network Utility

2. At the Network Utility menu, select:
   1) List Units Logged On

Any unit currently logged on to the network will be listed with its direct parent unit ID, signal to noise level (S/N) how many synchronization message received out of 1000, how many unique words received out of 1000 and how many correct data packages received out of 1000.

This information is important for evaluating an RU's status. When an RU is within the line-of-sight range from its direct parent (either the NCU or a SCU) and without strong in-band interference, the S/N displayed for the RU should be higher than level "3" and all three indicators should be 1000 out of 1000. If not, there are potential issues with the RF link. Enter **x** to return to the Network Utility menu.

To display units using services:

1. At the Network Management menu, select:
   5) Network Utility

2. At the Network Utility menu, select:
   2) List Units Using Services

   The RUs using each service are listed, by ID and port.

Press the Enter key to return to the Network Management submenu, then enter **x** to return to the Network Utility menu.

Deleting Network Components

Deleting a Service

1. At the Network Management menu, select:
   1) Service Configuration

2. At the Service Configuration menu, select:
   2) Delete Service
   to delete one service setting from the service table.

You are prompted to enter the Service ID.

BE SURE TO ENTER THE CORRECT SERVICE ID TO BE DELETED. THERE IS NO UNDO OPTION.

After the service is deleted, you are advised to perform a Network Restart—either a software restart from the Network Management Menu or hardware restart by turning off and on the Port Expander. The change will not take effect until a network restart.

Deleting All Services (Erasing the Service Table)

1. At the Network Management menu, select:
   1) Service Configuration

2. At the Service Configuration menu, select:
   4) Delete Service Table
   and erase all service settings.

You are prompted to enter y or n to confirm that you want to erase the service database. *Respond yes only if you are sure that you want to erase all services.*

After the Service Table is erased, you are advised to perform a Network Restart, either a software restart from the Network Management Menu or hardware restart by turning off and on the Port Expander. The change will not take effect until a network restart.

Deleting an RU

1. At the Network Management menu, select:
    4) Remote Configuration

2. At the Remote Configuration menu, select:
    2) Delete Remote

3. Enter the Unit ID (the network name) for the RU to be deleted by typing its value and pressing the Enter key.

> BE SURE TO ENTER THE CORRECT UNIT ID TO BE DELETED. THERE IS NO UNDO OPTION. Press the Esc. key to abort.

After the RU is deleted, you are advised to perform a Network Restart—either a software restart from the Network Management Menu or hardware restart by turning off and on the Port Expander. The change won't take effect until a network restart.

Deleting an SCU

1. At the Network Management menu, select:
    3) SCU Configuration

2. At the SCU configuration menu, select:
    2) Delete SCU

You are prompted to enter the Unit ID for either one unit in a SCU pair to delete this SCU pair from the network.

> Since there is no reconfiguration for an SCU, if you have configured an SCU with a mistake (such as the wrong physical ID number), you need to delete this SCU, and then add a new one with the correct settings.

After the SCU is deleted, you are advised to perform a Network Restart—either a software restart from the Network Management Menu or hardware restart by turning off and on the Port Expander. The change won't take effect until a network restart.

Deleting All Units in the Network (NCU, SCUs and RUs)

1. At the Network Management menu select:
    5) Network Utility

2. At the Network Utility menu, select:
    3) Delete Unit Table (NCU, SCUs, and RUs)

You are prompted to enter **Y** or **N** to confirm that you want to erase the Table. RESPOND YES ONLY IF YOU ARE SURE THAT YOU WANT TO ERASE ALL DATA ENTRIES.

Reconfiguring NCU, RUs, and COM Ports

The Safari Network configuration software enables you to reconfigure previously configured NCU and RUs and their communication ports from the Network Management Menu.

Reconfiguring the NCU's Basic and Advanced Configuration

If you only need to reconfigure the port settings on the NCU unit, go to Reconfiguring the NCU Port Configuration on the next page.

1. At the Network Management menu, select:
    2) NCU Configuration

2. At the NCU Configuration menu, select either:
    1) NCU IP Configuration
    for changing the IP address setting for NCU or select:
    4) Advanced Configuration
    for changing the advanced settings such as operating frequency or network data rate.

Some of the setting change requires a network restart to take effect.

Reconfiguring the NCU Port Configuration

1. At the Network Management menu, select:
   1) NCU Configuration

2. At the NCU Configuration menu, select:
   2) NCU Port Configuration
   The new setting overwrites the existing settings.

Reconfiguring an RU

If you only need to reconfigure a port setting on an RU, go to Reconfiguring an RU's Port(s) on the next page.

1. At the Network Management menu, select:
   4) Remote Configuration

2. At the Remote Configuration menu, select:
   5) Change Remote Configuration

3. Enter the Unit ID for the RU by typing its value and pressing the Enter key.

4. The current configuration is displayed. Enter the physical ID of the RU (as it appears on the radio).

5. When prompted whether or not to enable DHCP, enter **Y** or **N** as appropriate. If you enter No, you will be prompted to enter the RU's IP Address.

6. Enter the Output Power level index (which is usually the same as that set for the NCU).

The change will take effect when the RU logs on.

Reconfiguring an RU's Port(s)

If you need to reconfigure other settings on the RU, use the procedure in Reconfiguring an RU on the previous page.

1. At the Network Management menu, select:
   4) Remote Configuration

2. At the Remote Configuration menu, select:
   6) Change Port Configuration

3. Enter the Unit ID for the RU by typing its value and pressing the Enter key.

4. The current configuration is for the RU is displayed, and you are prompted to select a port to configure:

   - 1-COM1
   - 2-COM2
   - 3-COM3
   - 4-exit

5. Enter the port using the number value (1 – 3). The option to exit (4) is provided for when you have completed configuring the RU's ports.

6. After you select a port to configure, you are prompted to enter the protocol for the port. Available protocols are different among the three COM ports. An example is:

   - 1-Async (RS232)
   - 2-HDLC
   - 3-Ethernet
   - 4-Async (RS422)
   - 5-Disable

7. Enter the protocol using the number value (1 – 5).

8. Next you are prompted to enter the baud rate for the port. Options are:

- 115.2 Kbps = 0
- 9.6 Kbps = 5
- 57.6 Kbps = 1
- 4.8 Kbps = 6
- 38.4 Kbps = 2
- 2.4 Kbps = 7
- 32.7 Kbps = 3
- 1.2 Kbps = 8
- 19.2 Kbps = 4
- 300 bps = 9

9. Enter the baud rate using the number value (0 – 9).

10. Next enter the Data Type for the port. Options are:

- 1-Data
- 2-Debug
- 3- GPS

11. Enter the data type using the number value (1,3). This is normally set to Data.

12. You will then be prompted to enter the Service ID for the port (this corresponds to the service ID configured in service configuration for the transmit channel).

13. For a Remote to Remote service, you will also be prompted to enter a second service ID (for the service's receive channel).

14. Enter the Ultimate Destination ID for the port, which is the RU ID that will receive this port's transmission.

15. Enter the Ultimate Destination Port for the port (COM1, COM2 or COM3), which is the port on the Destination ID that will receive this port's transmission.

You can now choose to configure another port, in which case repeat steps 1 through 10, or select **4) exit** when done. The change will take effect after the RU logs on.

Appendix A   Troubleshooting

Routine operation of the Safari Network should generally be straightforward; however, problems with communications can sometimes occur, and these problems will need to be diagnosed and corrected. This chapter discusses potential problems that may be experienced by network users, along with the possible causes and the appropriate corrective actions.

Types of Problems

The types of problems that may occur in the network are:

- A radio is not communicating at all (see below).

- A radio is communicating, but there are errors with—or omission of—data (see page A-5).

- A radio is communicating, but the signal-to-noise (S/N) level is less than 3 (see page A-6).

If a radio is not communicating

Confirm that the radio is not communicating (using the configuration software on the NCU) by listing all units logged onto the network:

1. Launch a terminal program (such as HyperTerminal). If you have reserved COM2 on the NCU as a Network Management port, go to Step 5.

2. Power up the NCU through the Port Expander. Within 10 seconds, type the word "admin" and press the Enter key.

3. When the NCT SR-7100 Admin Page appears, select: **1. Network Configuration Menu**.

4. At the Network Configuration Menu, select:
   5) Network Utility.

5. At the Network Utility menu, select:
   1) List Units Logged On.

6. If the radio in question is not logged on (you may need to try this repeatedly over a period of time), proceed to the table on the next page.

Review the following tables to determine the cause of the problem, and then attempt to resolve it with the suggested corrective action(s).

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

■ Reorient or relocate the receiving antenna.

■ Increase the separation between the equipment and receiver.

■ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

■ Consult the dealer or an experienced radio/TV technician for help.

Possible Cause	Corrective Action
The radio is out of range of the NCU or an SCU.	Relocate the radio to within 20 miles of the NCU or an SCU (14 miles @ 512 Kbps). If the radio needs to operate outside this range, install and configure an SCU in the network that is within range of the radio. ■ To install an SCU, refer to *Chapter 3: Installation*. ■ To configure an SCU, refer to *Chapter 4: Configuration*.
The radio does not have a clear line of sight to the NCU or to an SCU.	Relocate the radio so that it has a clear line of sight to the NCU or an SCU. A clear line of sight means no obstruction from terrain or structures on the ground between the radio and the NCU or SCU. If the radio cannot be relocated so that it has a clear line of sight to the NCU or SCU, install and configure an SCU in the network to bypass the obstruction. ■ To install an SCU, refer to *Chapter 3: Installation*. ■ To configure an SCU, refer to *Chapter 4: Configuration*.

Possible Cause	Corrective Action
The radio's output power is insufficient.	Reconfigure the RU's output power from the NCU, using the maximum setting (63). Confirm that the NCU's output power is also maximized, and do the same for any SCU configured between them. ■ To configure an NCU, refer to *Chapter 4: Configuration*. ■ To configure an SCU, refer to *Chapter 4: Configuration*. ■ To reconfigure an RU, refer to *Chapter 5: Operation*.
Transmit and receive antennas are cross polarized.	Reposition the units and/or external antennae so that they are all oriented properly and perpendicular to the ground.
The radio was configured with an incorrect ID.	Check the physical ID of the radio. Reconfigure the RU so that the correct physical ID is used. ■ To reconfigure an RU, refer to *Chapter 5: Operation*.
The radio's ports and channel assignments were not configured properly.	Review the port assignments of all RUs to verify that each source and destination channel IDs match up. ■ To review port assignments, refer to *Chapter 5: Operation*. ■ To assign channel Ids, refer to *Chapter 4: Configuration*.

Possible Cause	Corrective Action
Radio is misconfigured as NCU or SCU	Go to local setting and set the Radio as RU.
Radio is not powered on.	Check source power, cabling, switch position.

If data transmission is incomplete or in error

If a radio is communicating with the network but there still is a high rate of missing data during transmissions, a possible cause is that the data throughput exceeds channel throughput. Reconfigure the radio's port so that the data transfer is equal to or less than the data throughput of the channel assigned to the port.

1. Launch a terminal program (such as HyperTerminal).

2. Turn on the NCU through the Port Expander. Within 10 seconds, type the word "admin" and press the Enter key.

3. At the NCT SR-7100 Admin Page, select:
   1. Network Configuration Menu

4. At the Network Configuration Menu, select:
   4) Remote Configuration

5. At the Remote Configuration Menu, select:
   6) Change Port Configuration

6. Enter the Unit ID to be modified (such as 201, 202, etc.).

7. All of the unit's ports will be displayed. Enter the port to be reconfigured.

8. Go through each step to change the configuration of the port. Be sure to enter a data baud rate that is equal to or less than the data throughput of the channel assigned to the port. Also be sure that the port speed does not cause more data to be transferred than can be handled by the assigned channel's throughput. A mismatch here could result in data loss.

9. Exit to the Configuration Menu.

10. Restart the RU to receive a new configuration.

If the Signal-to-Noise (S/N) ratio is too low

If a radio is communicating with the network but its error rate is excessive, there are three possible causes:

- Check for loose and broken antenna connections.

- Check transmission path for a proper line of sight and suitable distance.

- Check for interference from outside the network, such as from another 2.4 GHz system.

If there is another 2.4 GHz system causing radio interference, change the NCU or SCU frequency:

1. Launch a terminal program (such as HyperTerminal).

2. Turn on the NCU through the Port Expander. Within 10 seconds, type the word "admin" and press the Enter key.

3. At the NCT SR-7100 Admin Page, select:
    1. Network Configuration Menu

4. At the Network Configuration Menu, select:
    2) NCU Configuration

5. At the NCU Configuration menu, select:
    4) Advanced Configuration

6. At the Advanced Configuration Menu, select **5)Set NCU Frequency**

7. Change the frequency assignment

8. Exit the Configuration Menu and perform a network restart.

If, however, there are SCUs in the network, you may also need to change the uplink frequency assignment for those SCUs that communicate directly with the NCU. Use the procedure for reconfiguring units, described in *Chapter 5: Operation*.

Appendix B   Radio Frequencies

Frequencies are assigned in number values from 0 to 20, depending on maximum throughput rate. Frequencies F0 through F20 have the following center frequencies:

Channel	96Kbps	240Kbps	512Kbps
F0/CH1	2.402568	2.404836	2.409372
F1/CH2	2.406348	2.412396	2.424492
F2/CH3	2.410128	2.419956	2.439612
F3/CH4	2.413908	2.427516	2.454732
F4/CH5	2.417688	2.435076	2.469852
F5/CH6	2.421468	2.442636	
F6/CH7	2.425248	2.450196	
F7/CH8	2.429028	2.457756	
F8/CH9	2.432808	2.465316	
F9/CH10	2.436588	2.472876	
F10/CH11	2.440368		
F11/CH12	2.444148		
F12/CH13	2.447928		
F13/CH14	2.451708		
F14/CH15	2.455488		
F15/CH16	2.459268		
F16/CH17	2.463048		
F17/CH18	2.466828		
F18/CH19	2.470608		
F19/CH20	2.474388		
F20/CH21	2.478168		

Appendix C   Glossary

Asynchronous: a communications system in which data transmission may start at any time and is indicated by a start bit, e.g. RS-232.

Bandwidth: the difference between the highest and lowest frequencies of a transmission channel (the width of its allocated band of frequencies). The term is often used to mean data rate or capacity - the amount of data that is, or can be, sent through a given communications circuit per second.

Network Control Unit (NCU): a radio that exerts control of the system through supervisory control and system timing. This radio also stores the system configuration, and relays those settings to the other radios in a system.

Channel: a frequency band selection. The SR-7100 System offers the choice of up to 21 Channels within the 2.4 GHz spectrum. May also be used to describe a virtual path between two network ports.

Channel ID (or Service ID): a number used to uniquely identify a specific data exchange.

Data Throughput: the data pass-through capability for a Service in a particular direction. For example, a point-to-point Service may be configured to have a Data Throughput of 19.2 Kbps in one direction and a Data Throughput of 9.6 Kbps in the other direction.

DHCP: Short for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without the hassle of manually assigning it a unique IP address. Many ISPs use dynamic IP addressing for dial-up users.

Ethernet: a system of connecting computers together to facilitate intercommunication, commonly known as a Local-Area-Network (LAN).

Ethernet WLAN: Ethernet Wireless Local Area Network. Employing Ethernet via a radio system.

Frequency: radio carrier frequency used to deliver information.

Gateway: A node on a network that serves as an entrance to another network. In enterprises, the gateway is the computer that routes the traffic from a workstation to the outside network that is serving the Web pages. In homes, the gateway is the ISP that connects the user to the internet.

In enterprises, the gateway node often acts as a proxy server and a firewall. The gateway is also associated with both a router, which use headers and forwarding tables to determine where packets are sent, and a switch, which provides the actual path for the packet in and out of the gateway.

HDLC: Short for *High-level Data Link Control*, a transmission protocol used at the data link layer (layer 2) of the OSI seven layer model for data communications. The HDLC protocol embeds information in a data frame that allows devices to control data flow and correct errors. HDLC is an ISO standard developed from the Synchronous Data Link Control (SDLC) standard.

Inbound: toward the system NCU.

Interface Standard: a description of a port's configuration for handling data. The SR-7100 supports the following port Interface Standards: Asynchronous RS232, Asynchronous RS422, Synchronous RS422, and Ethernet.

Local Area Network (LAN): A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it also is able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

Outbound: away from the system NCU.

Port Expander Module: the device used to present the radio user with indicators, control switches, and data interface ports. This device is usually connected to the Radio Module.

Port Speed: the rate at which data is sent and received across a port. A Port Speed of 19.2 Kbps indicates a send rate of 19.2 Kbps and a receive rate of 19.2 Kbps. Port Speed is independent of the Data Throughput of the Service.

Radio Module: the device used to transmit and receive signals over radio frequencies. This device is usually connected to the Port Expander Module.

Remote Unit (RU): a radio used in a remote location or vehicle. It is programmed and controlled by the Network Control Unit.

Service: the ability to exchange data among two or more units within a system.

Service (or Channel) ID: a number used to uniquely identify a specific data exchange.

Service Type: a particular variety of data exchange. The SR-7100 System offers four different Service Types. They are: point-to-point, broadcast, multi-point network, and Ethernet WLAN.

Spread Sequence: a method of radio communication in which a spreading code is used to encode data onto a radio carrier frequency.

Subnet: A portion of a network that shares a common address component. On TCP/IP networks, subnets are defined as all devices whose IP addresses have the same prefix. For example, all devices with IP addresses that start with 100.100.100. would be part of the same subnet. Dividing a network into subnets is useful for both security and performance reasons. IP networks are divided using a subnet mask.

Subnetwork Control Unit (SCU): Controls and manages its associated remotes and bandwidth utilization through channel assignment, frame synchronization, frequency synchronization, packet assembly and packet routing to create semi-autonomous cells. Dynamic bandwidth assignment allows unutilized channels to be reassigned based on channel routing requirements, semi-independent operation for traffic within the SCU cell, internet access point for the cell allowing multiple internet access points in a single network, and seamless roaming of remote units between cells.

Synchronization: the condition where a common timing source is used to regulate the occurrence of actions or events.

Total System Data Throughput: The total data transfer capacity of a system, in both directions (Inbound plus Outbound). For example, a Total System Data Throughput of 115.2 Kbps may be configured to offer 57.6 Kbps Outbound and 57.6 Kbps Inbound.

Unique Word: a pre-pended data pattern used as an attention signal to the intended data recipient. There are 9 Unique Words.

Wide Area Network (WAN): A computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more local area networks (LANs).

Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet.

Appendix D   Specifications

NCU, RU, SCU

Frequency   2.4000 - 2.4835 GHz

Spreading Code   Direct Sequence

Range, Line of Sight   20 miles

Transmitter:
  Output Power   500 mW
  Output Power Control   63 steps
  Modulation   Patented M-ARY GMSK
  Bandwidth per Channel   3 MHz @ 96 Kbps

Receiver:
  Sensitivity   -108 dBm @ 10E-6 at
                                       throughput of 96 Kbps

Data Transmission:
  Forward Error Correction   K=7 Rate 1/2 Viterbi Decoding
  Error Detection   16 bit CRC
  Access Authentication   48 bit Unique ID
  User Selectable Data Rates   512 Kbps, 240 Kbps, 96 Kbps

Processing Gain   18 dB

On Board Memory   2 MB Flash Memory
                                       1 MB RAM expandable to 2 MB

Power Requirements   9 to 36 VDC

Power Consumption   8 Watts max.

Connectors:
  Interface to Port Expander   2 12-pin Connectors
  2.4 GHz Antenna Connector   SMA
  Optional GPS Antenna Connector   SMA

Operating Modes   Point-to-Point
                                       Point-to-Multipoint
                                       Multipoint Network
                                       Wireless LAN

Operating Environment   -40ºC to +70ºC

Enclosure   Watertight and Ruggedized

Antennas	1½" 0 dBi Dipole Optional External Antennas up to 5.5 dBi
Dimensions	5.00"H x 6.02"W x 9.64"L
Weight	1.5 lb
FCC Compliance	FCC Part 15

Port Expander Module

Power Consumption	4 Watts
Interfaces	RJ-11 -------- Telephone RJ-45 -------- Ethernet 802.3 RJ-45 -------- RS232/RS422 DB-9 --------- RS232 USB ---------- USB Infrared ----- IrDA
Indicators	4 LEDs On/Off Switch for System
Operating Environment	-40ºC to +70ºC
Dimensions	1.98"H x 4.25"W x 5.93"L
Weight	1.0 lb