

BAE SYSTEMS

14290B

OPERATION AND MAINTENANCE MANUAL

UNIT LEVEL MAINTENANCE

FOR THE

AN/VRC-99A AND AN/VRC-99B
RADIO Set

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1. INTRODUCTION

1.1 GENERAL

This manual contains the operation and maintenance instructions for Unit Level maintenance of the AN/VRC-99A and AN/VRC-99B Radios. Also included in this manual are the principles of operation, installation instructions, preparation for use, and storage information.

The AN/VRC-99A and AN/VRC-99B Radios differ only with respect to the frequency band supported; in all other respects, the radios are identical. This manual refers to both radios as the AN/VRC-99A Radio except when discussing specific differences.

1.2 PURPOSE AND DESCRIPTION

The AN/VRC-99A Radio provides automatic networking of terminals for data communication. Refer to figure 1-1.

The front panel provides controls, indicators and system interconnection receptacles. In addition, a replaceable battery pack is located behind an access cover in the front panel.

The rear panel provides a receptacle for primary power input, the Network Processor (NP) maintenance port, a remote platform interface port, and the primary power fuse and spare fuse.

The AN/VRC-99A Radio is designed for a standard 3/4 ATR mounting tray that carries taper pins to mate with sockets in the rear panel and hold-down hooks on the front panel. The mounting tray may be vibration isolated for use in severe environments.



Figure 1-1 Radio, Secure, Network AN/VRC-99A

The AN/VRC-99A Radio contains one each of the following plug-in modules that mount to a central mother board assembly:

- Input/Output Processor (IOP) CCA
- COMSEC CCA (or optional COMSEC Bypass CCA)
- Red Power Supply CCA
- Network Processor (NP) CCA
- Matched Filter/Non-Coherent Recursive Integrator (MF/NRI) Module
- RF/IF Module
- Black Power Supply Module

In addition, the following subassemblies are mounted to the system chassis:

- Power Amplifier
- RF Bandpass Filter
- Power Conditioner CCA

An AN/VRC-99A(C) Radio is an AN/VRC-99A Radio that has a COMSEC CCA installed. This manual refers to a radio with a COMSEC CCA or with a COMSEC Bypass CCA as an AN/VRC-99A Radio except when discussing key loading and similar operations.

1.3 PERFORMANCE CHARACTERISTICS

Table 1-1 contains the technical characteristics of the AN/VRC-99A Radio.

1.4 EQUIPMENT SUPPLIED

The equipment supplied and the principal functional subassemblies are listed in Table 1-2.

1.5 ANCILLARY EQUIPMENT

The AN/VRC-99A(C) Radio requires an AN/CYZ-10 Version 3 Code Loader, supplied with a DS-101 Interface using the JTIDS DTD KMS Version 3, in order to load cryptographic keys in the COMSEC module.

1.6 SPECIAL TOOLS AND TEST EQUIPMENT

There are no special tools or test equipment required for either the operation or maintenance of the AN/VRC-99A Radio.

Table 1-1. Technical Characteristics

Parameter	Characteristic
Ambient Operating Temperature	-40°C to +55°C
Operating Altitude	Sea level to 10,000 feet
Platform Input Power	+28 ±4 VDC
Power Dissipation	70 Watts
Dimensions:	
Height	7.62 inches
Width	7.5 inches
Depth (w/o handles)	12.62 inches
Weight	25 lbs

Table 1-2. AN/VRC-99A Radio Functional Subassemblies

Assembly	Part Number
AN/VRC-99A Radio	1050700G
Input/Output Processor CCA	1023589G
COMSEC CCA	0N649140
COMSEC Bypass CCA	1050373G
Red Power Supply CCA	1050396G
Network Processor CCA	1050343G
MF/NRI Module	1050706G
RF/IF Module	1050346G
Black Power Supply Module	1050358G
Power Conditioner CCA	1050331G
Power Amplifier For AN/VRC-99A Radio	1050386P
For AN/VRC-99B Radio	1051047P
RF Bandpass Filter For AN/VRC-99A Radio	1050356P
For AN/VRC-99B Radio	1051073P

2. PREPARATION FOR USE AND INSTALLATION INSTRUCTIONS

2.1 GENERAL

This section contains the outline dimensional drawing of the AN/VRC-99A Radio (figure 2-1) and instructions for installing the equipment into a platform.

2.2 UNPACKING

There are no unusual unpacking procedures to be followed.

2.3 INSPECTION

Visually inspect the equipment for dents, scratches, and loose or broken front or rear panel switches, connectors, or indicators.

2.4 INSTALLATION

For proper installation, the AN/VRC-99A Radio requires the following:

- 3/4 ATR Short Mounting Tray (Typical sources: Emteq, p/n MT4-6319-101; Barry Controls, p/n 404-75-S-0-0; verify part numbers at time of purchase)
- Power Cable to connect 28 VDC power and ground to the DC POWER receptacle (J6) on the rear panel of the radio
- Ethernet cable for data interface to the host computer or router
- Antenna cable for interface to the platform antenna

Follow this procedure:

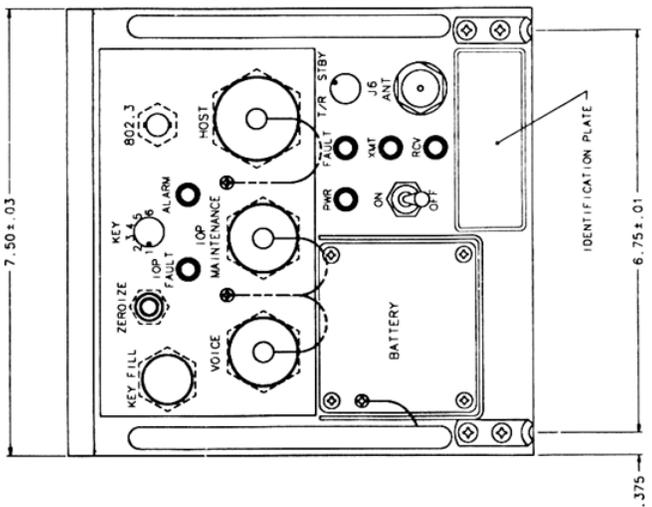
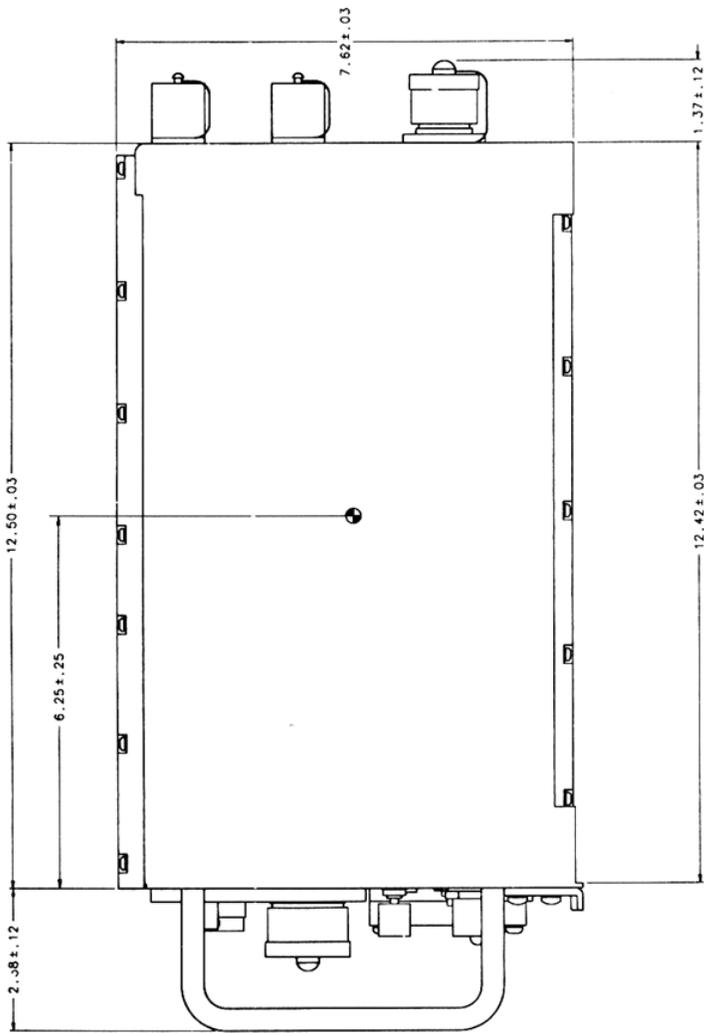
- a. Mount the radio in the tray.
- b. Connect the tray to a ground point within the vehicle or platform to provide grounding for the AN/VRC-99A chassis.

Note: If the radio is not mounted in a tray that is bonded to platform ground, bond an appropriate ground to the bare metal area at the bottom rear of the radio.

- c. Make certain that the ON/OFF switch on the front panel of the radio and the primary +28 VDC source are set to OFF. Connect the host +28 VDC power cable to the DC POWER receptacle (J6) at the rear of the radio.
- d. Connect the Ethernet cable to the 802.3 connector.
- e. Connect the Antenna cable to the ANT (J6) receptacle on the front panel.

2.5 ALIGNMENT

There are no adjustments or alignments necessary before, during, or after installation of the AN/VRC-99A Radio.



3. PRINCIPLES OF OPERATION

3.1 GENERAL DESCRIPTION

The AN/VRC-99A Radio provides data communication between various platforms by means of an automatically-maintained radio communications network. Once initialized, each radio automatically executes the operations necessary to join an existing AN/VRC-99A Radio network, or to set up a network if none exists.

All AN/VRC-99A Radio communications utilize pseudo-noise (PN) coding of the transmitted waveform to provide low probability of intercept (LPI) communications with jamming resistance. Data interleaving and Forward Error Correction (FEC) provide additional jamming resistance. An embedded cryptographic capability provides cryptographic security for all data.

3.1.1 Networking Overview

An AN/VRC-99A Radio provides a gateway between a wired Ethernet local area network (LAN) and an over-the-air (OTA) network of AN/VRC-99A Radios. The OTA network connects the radios, and thus indirectly connects the LANs, as shown in figure

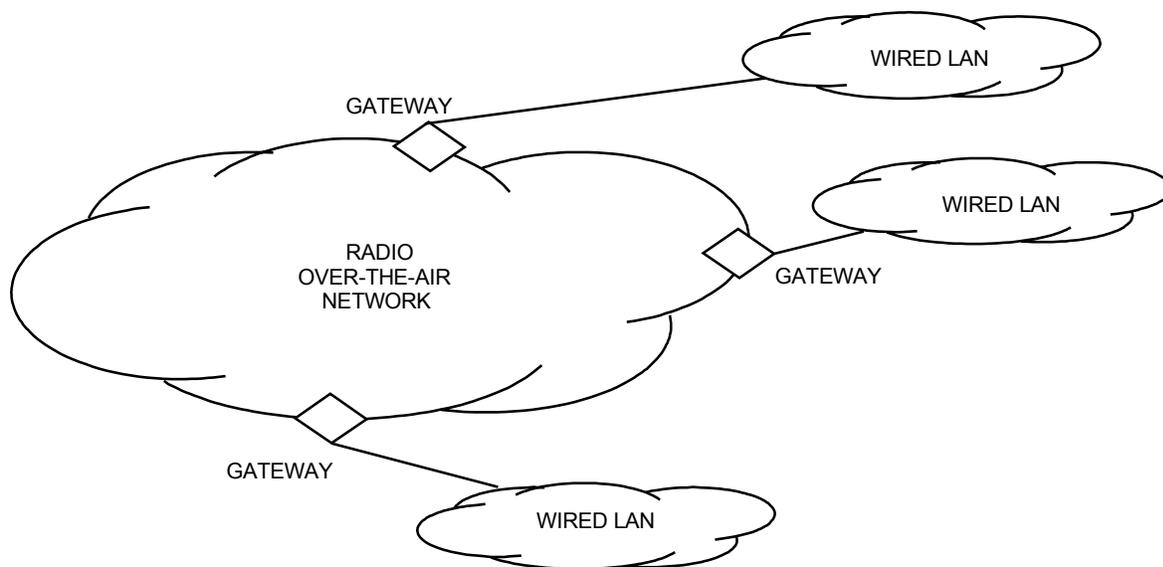


Figure 3-1 Over-the-Air Network Connects Wired LANs

3-1.

Each AN/VRC-99A Radio gateway thus has two sides, one side that connects to the LAN, and one side that connects to the OTA network, as illustrated in figure 3-2. The

LAN side of the gateway is an Internet Protocol (IP) router or bridge that tunnels through the OTA network to connect with the IP routers or bridges at remote gateways.

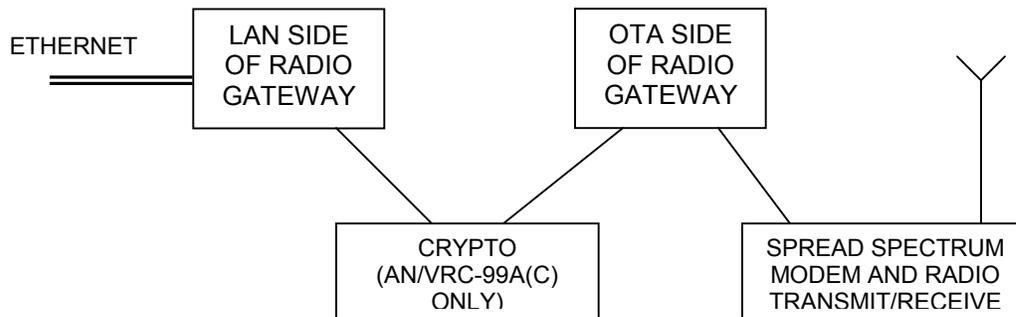


Figure 3-2 Radio Gateway Has LAN Side And OTA Side

The OTA side of the gateway is an OTA network router. The OTA network does not use IP addressing or IP protocols. It is similar in many respects to an IP network, but is tailored to operate efficiently as a small network using a broadcast radio medium. The OTA network tunnels IP packets from the LAN side of one radio to the LAN side of another radio.

3.1.2 Functional Overview

The functional elements of the AN/VRC-99A Radio are outlined in figure 3-3.

The radio functions may be divided into 7 major groupings, as follows:

- LAN interface and IP bridge/router
- Encryption/decryption
- Over-the-air networking
- Transmitter
- Receiver
- Power supplies
- Chassis, with controls, indicators, connectors, and wiring

Each of these functional elements is discussed in the following paragraphs to provide an understanding of the basic operations carried out by the radio.

Section 4 describes the operations to set up the radio to provide automatic routing of messages to the desired destinations.

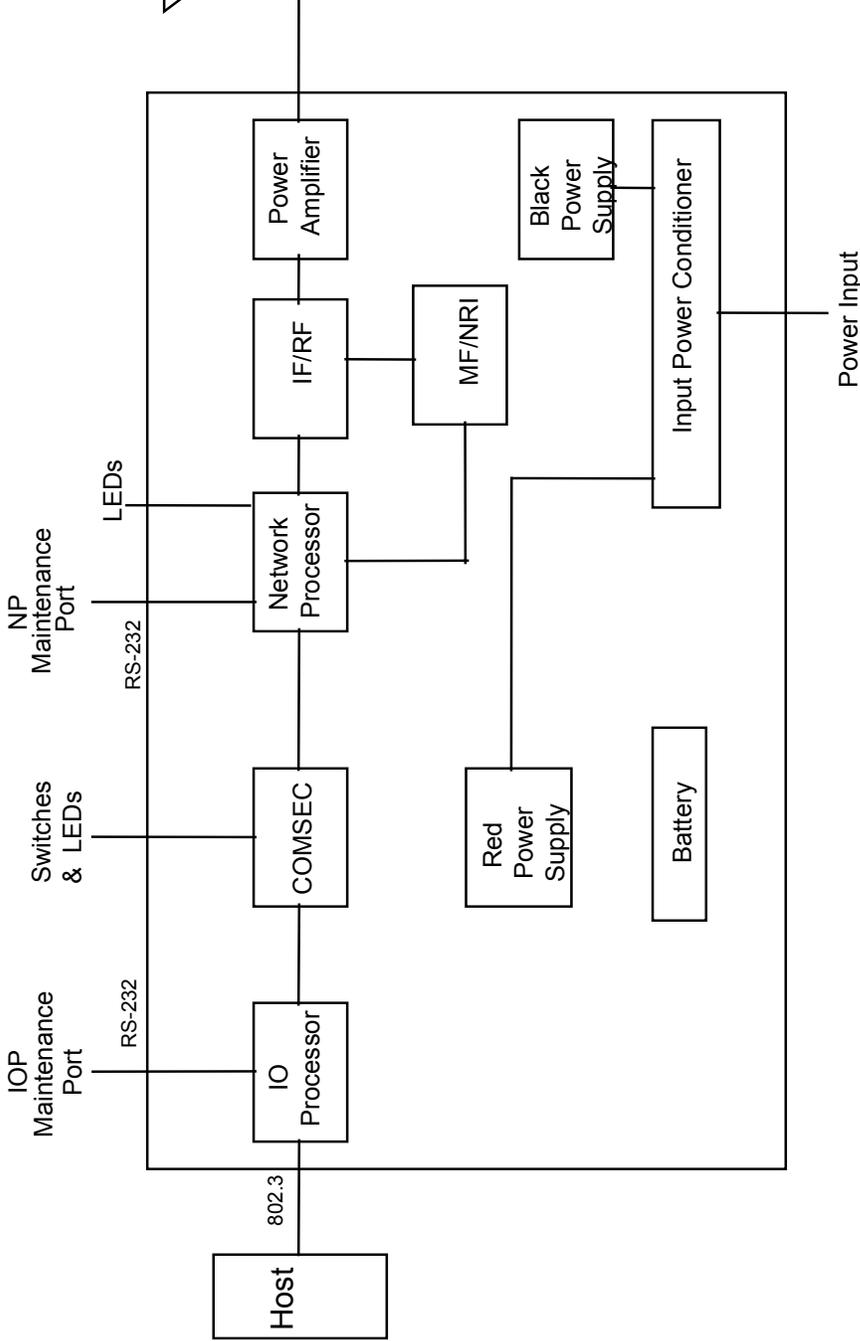


Figure 3-3. AN/VRC-99A Radio Block Diagram

3.2 LAN INTERFACE AND IP BRIDGE/ROUTER

The AN/VRC-99A Radio provides a thinwire 10Base2 Ethernet interface for data communication to host computers or routers. The front panel provides an 802.3 connector.

All data sent on the wired LAN to or from the radio must be formatted as an Ethernet packet containing an IP datagram.

The LAN side of the gateway can be configured as:

- An IP bridge, with no routing capability
- An IP router, in which routing tables are automatically generated using the Open Shortest Path First (OSPF) routing protocol
- An IP router, with operator-entered static routes

All radios in the network must be configured the same way.

When the radio is configured as an IP bridge, a message received on the Ethernet interface of one radio is output (including the original MAC header) on the Ethernet interface of another radio, as if the two Ethernet segments were joined together. The radio provides the following additional bridging features:

- Smart forwarding of IP messages (“learning bridge”). The radio examines the traffic stream to learn and store information about which MAC addresses are handled by which remote radio. When a datagram is to be sent over the air, if the radio has information about the destination MAC address, the datagram is sent only to the associated remote radio. When no information is available, the datagram is sent to all remote radios.
- Proxy ARP. The radio also records the IP address for MAC addresses that it records. When an ARP request is to be sent over the air and the radio has the MAC address information, it instead responds with an ARP reply.
- The radio has an IP address so that (even as a bridge) it can process ping (ICMP echo), Telnet and ARP request messages addressed to it.

IP multicast datagrams are broadcast to each remote radio and LAN.

The IP bridge or IP router operations are performed by the Input/Output Processor (IOP) CCA.

3.3 ENCRYPTION AND DECRYPTION

The COMSEC module of an AN/VRC-99A(C) Radio provides secure encryption and decryption of all messages passing through the radio. Information required for

datagram routing and control, bypasses the encryption process. All data submitted to the radio network for transmission is fully encrypted.

The radio provides a receptacle on the front panel to permit loading and selection of encryption codes in accordance with conventional code management procedures. Section 4 describes the connection and operation of the code loading devices.

When the COMSEC Bypass CCA is installed, data is not encrypted, and the front panel controls related to encryption are not operational.

3.4 OVER-THE-AIR NETWORKING

Over-the-air networking in the AN/VRC-99A Radio is performed by the Network Processor (NP) CCA.

3.4.1 Automatic Network Formation

The AN/VRC-99A Radio automatically joins an existing OTA network, or initiates the formation of an OTA network. The presence of other radios is communicated via network management packets that are automatically generated by the radios.

3.4.2 Adaptive Transmit Rates

The AN/VRC-99A Radio can be configured to always transmit over the air at the same data rate, or it can be configured to transmit at any of several data rates.

When a radio uses a single rate, if its transmissions cannot be received reliably at a remote radio, the link to that remote radio is lost.

When a radio uses multiple rates, it will attempt to use the highest rate to each remote radio that can reliably be received at that radio. The link is continually tested at all configured rates to dynamically choose the correct transmit rate to each remote radio. The link to a radio is lost when transmissions cannot be reliably received at the lowest configured transmit rate.

3.4.3 Routing in the OTA Network

Each AN/VRC-99A Radio maintains a list of all the radios in the network and determines a complete map of the link connections among the radios. OTA routing tables are formed based on this network information. This allows the radio to route messages to remote radios, using relaying radios when required.

Changes in the network link connections are automatically detected, and the routing tables are updated as required. No operator intervention is required in order to

establish, maintain, or respond to changes in connectivity between radios in the network.

Routing in the OTA network is performed entirely within the OTA side of the radio gateway. A message enters the OTA network from the LAN side of one radio, and exits the OTA network to the LAN side of another radio. All routing and relaying of a message in the OTA network is performed on the OTA side of the radios it passes through.

OTA routing uses a link state routing algorithm (similar in many respects to OSPF). The cost metric for each link is based on the transmit rate on that link, as follows:

<u>Link Transmit Rate</u>	<u>Link Cost</u>
10 Mbps	5
5 Mbps	6
2.5 Mbps	7
1.25 Mbps	8
0.625 Mbps	9

The total cost for a route to a destination radio is the sum of the costs of all the links in the route. The lowest cost routes to each remote radio are recorded in the routing table.

3.4.4 Fragmentation

The maximum size packet supported by the AN/VRC-99A Radio is the size limit imposed by Ethernet. That is, the radio supports datagrams containing up to 1500 bytes (including the IP header).

The number of bytes that will fit into a single over-the-air transmission depends on the transmit rate currently being used on the link. Refer to Appendix B for the relationship between transmit rates and packet size.

When a datagram is too large for a single transmission, it is fragmented into multiple transmit packets. The fragments are carried through the OTA network, and are reassembled at the end destination radio. The fragmentation and defragmentation take place on the OTA side of the gateway, and are transparent to the LAN side of the gateway.

3.4.5 Bundling

When an AN/VRC-99A Radio over-the-air transmission can hold more than a single packet, multiple data and control packets are automatically bundled together into a single transmission, and are separated into separate packets by the receiver.

The packets in a bundle may be addressed to different receiving radios. A radio transmission can be received by multiple radios, and so a bundle can contain packets for different radios. When a radio receives a bundle, it discards any packets not destined for it.

When a bundle is sent to a single radio, it is sent using the transmit rate for that link. When a bundle is sent to multiple radios, it is sent at an appropriate transmit rate so that it can be received by all the radios that need it.

3.4.6 Transmit Slots

The AN/VRC-99A Radio OTA network uses Time Division Multiple Access (TDMA) to allow the radios in the network to share the available bandwidth.

The TDMA frame length is 154 msec, and consists of 32 slots that are allocated to the radios. A radio is allowed to transmit during a slot that is allocated to it; in all other slots, it listens to other radios. A radio that is allocated multiple slots can send more traffic than a radio that is allocated a single slot.

The network can be configured to have from 2 to 16 radios, and each radio is permanently allocated a minimum of one slot (regardless of whether the radio is currently in the network).

Slots can be allocated permanently ("hard" slots) or dynamically ("soft" slots). The number of hard slots allocated to a radio is based on the radio configuration; the number can be changed by reconfiguring the radio.

Soft slots are allocated automatically based on the traffic needs of the radios in the network. The allocation process starts when a radio is dropping data packets due to congestion. The radio announces its need to other radios via network management packets. If the need persists and there are some unassigned soft slots, an unassigned soft slot is assigned to the radio. If all the soft slots have been assigned, another radio that is not dropping data packets will give up one of its soft slots. If several radios are in overload, the soft slot is assigned to the radio that needs it the most. Note that soft slots are allocated in reaction to an existing traffic overload, and there is no attempt to predict a future overload.

3.4.7 OTA Quality of Service

The AN/VRC-99A Radio provides two priority levels (low priority and high priority) for scheduling OTA data packet transmission. High priority packets are transmitted in preference to low priority packets.

The radio provides three quality-of-service levels related to reliability and delay:

- Acknowledged service. The receiving radio acknowledges received data packets, and a lost packet is retransmitted until it is received. When a packet is relayed, it is acknowledged on each radio-to-radio link. In the absence of network congestion or link loss, all packets entering the network are delivered to the destination radio.
- Transmit-once service, with normal delay. Packets are not acknowledged and there is no automatic retransmission.
- Transmit-once service, with low delay. Packets are not acknowledged and there is no automatic retransmission. These packets are put on a queue that is normally used for packets being retransmitted; these packets are transmitted before other packets of the same priority.

Acknowledged service is appropriate when loss of a single packet is undesirable. Transmit-once service is appropriate for (1) traffic that cannot be used if delayed (such as voice), (2) periodic traffic that is updated after a short interval, and (3) traffic where end-to-end control is sufficient.

The priority and reliability/delay quality-of-service levels are selected on a packet-by-packet basis, based on the Type of Service field of the IP header. The radio can be configured to provide a specific quality of service for each possible value of the (8-bit) Type of Service field.

When the LAN side of the radio is configured as an IP router using the OSPF routing protocol, OSPF control packets generated by the radio are sent using high priority, transmit-once (normal delay) service.

3.4.8 Time Management

The radios in an AN/VRC-99A Radio OTA network must have accurate time relative to one another. The network structure is TDMA, and all radios must know when they are to transmit.

Initially, radios are configured with time (in the form of time-of-day). In order for the radio network to form, the time at the various radios must be within 90 seconds of each other (and preferably within 60 seconds). During the network formation process, the radios synchronize their time.

One radio (the one with the lowest ID) is designated the network time master, and all other radios determine their time based on the time reported by the time master. Time information is exchanged among radios using network management packets to synchronize the radios more accurately and to maintain synchronization.

If the time master leaves the network, another radio (the radio with the next lowest ID) picks up this function.

It is possible for a network to become splintered into subnets, with no radio in one subnet able to hear any radio in another subnet. Each subnet then has its own time master. Later, if the subnets rejoin, the radios will transition to again use a single time master, as follows. If radio A (in a network) hears a message from radio B (also in a network) that reports that radio B's time master has a lower ID than radio A's time master, radio A drops out of the network and then attempts to re-enter.

3.5 TRANSMITTER

The transmission function involves generation of RF signals in the RF/IF module, modulation with both data and spectrum-spreading signals in the IF CCA, and amplification to a 10-watt output level by the Power Amplifier module. The transmitted signal is applied, with bandpass filtering, to the ANT jack on the front panel, for application through an external RF cable to the antenna.

3.6 RECEIVER

RF signals received via the antenna and RF cable are applied via the ANT jack through an internal bandpass filter to the RF/IF module. The received information is stripped of the PN coding, converted to baseband signals, and demodulated in the Matched Filter Non-Coherent Recursive Integrator (MF/NRI) module.

The demodulator output is validated in the NP CCA and, if valid, the packet header is decoded to determine the appropriate action. Messages to be relayed are re-modulated and re-transmitted. Messages addressed to the local platform are decrypted in the COMSEC CCA and routed by the IOP CCA to the radio's Ethernet port.

3.7 POWER SUPPLIES

The Power System for the AN/VRC-99A Radio is divided into three groups, the Power Conditioner, the Red Power Supply, and the Black Power Supply.

The Power Conditioner is mounted to the rear panel of the radio adjacent to the DC POWER receptacle. Its function is to provide the surge and EMI filtering required to avoid power-line conducted interference problems, and to supply voltages to the Red and Black Power Supplies and the Power Amplifier.

The Red Power Supply is a plug-in replaceable module supplying power to the IOP and COMSEC CCAs. Since these modules handle un-encrypted information, special isolation of all interfaces to the balance of the equipment is required. The Red Power Supply incorporates the filtering and isolation required for this purpose. The Red Power Supply is located in the isolated part of the mother board system within the "RED" section of the radio. As discussed in section 3.8, the chassis is divided into separate areas depending on whether or not the information being processed is encrypted.

The Black Power Supply provides supply voltages used by all circuits handling signals that have been encrypted. These include the NP CCA and the MF/NRI and RF/IF modules.

3.8 CHASSIS

The equipment chassis provides support and interconnection of all components of the radio, as well as mounting for controls, indicators and connectors. The interior connections are provided by a motherboard system and flexible wire cables. The space inside the chassis is partitioned to provide electrical isolation of all circuits carrying information that has not been encrypted. A chassis partition and an isolated portion of the motherboard system provide this isolation.

The front panel, shown in figure 1-1, carries the controls and indicators associated with operation of the radio, as well as receptacles for RF and Ethernet. A maintenance connector for radio setup is also provided as described in section 4.

The rear panel, also shown in figure 1-1, carries the DC Power receptacle, the equipment fuse and spare fuse, a platform interface connector (which carries signals for use in applications where an external power amplifier and receiver front end may be used), and a maintenance connector used during factory servicing.

4. OPERATING INSTRUCTIONS

4.1 GENERAL

This section contains:

- a description of the controls, indicators and connectors
- instructions for startup
- instructions for configuring database entries for normal operation
- instructions for AN/VRC-99A(C) key fill

4.2 CONTROLS, INDICATORS AND CONNECTORS

The AN/VRC-99A Radio controls, indicators and connectors are shown in figure 3-2 and are described in Table 4-1.

4.3 STARTUP PROCEDURE

- a. Be sure the ANT receptacle on the front panel of the radio is properly connected to the antenna by means of an antenna cable
- b. Set the T/R STBY control to T/R.
- c. Set the ON/OFF control to the ON position.
- d. Make certain that the POWER indicator on the radio front panel is lighted.
- e. Allow approximately ½ minute for the AN/VRC-99A Radio to complete its built-in test (BIT). At the end of this interval, the IOP FAULT and FAULT indicators should be out. The ALARM indicator will be out if a valid cryptographic key is loaded in the selected key position; the ALARM indicator will flash if a key is not loaded. If this sequence does not occur, refer to the troubleshooting procedure described in section 5.

Table 4-1. Controls, Indicators, and Connectors

Control / Indicator / Connector	Function
ON/OFF control	Controls 28 VDC power input applied to the DC POWER connector
ZEROIZE control	Clears all cryptographic keys in the COMSEC module
KEY control	Selects the cryptographic key number used by the COMSEC module encryption and decryption
T/R STBY control	Disables transmission when in STBY position; normal operation when in the T/R position
PWR indicator	Lights when power is applied to the DC POWER connector and the ON/OFF control is set to ON
FAULT indicator	Lights when BIT fault is detected in "BLACK" circuits
IOP FAULT indicator	Lights when BIT fault is detected in "RED" circuits
ALARM indicator	Lights continuously when alarm condition is detected in the COMSEC module. Flashes when no key is loaded for the key position selected by the KEY switch. Flashes at a slow rate when the battery is low. Not illuminated otherwise.
XMT indicator	Lights when AN/VRC-99A Radio is transmitting packets
RCV indicator	Lights when AN/VRC-99A Radio is receiving valid packets
ANT connector	Connects AN/VRC-99A Radio to antenna cable
VOICE connector	Not used
HOST connector	Not used
802.3 connector	Connects AN/VRC-99A Radio to Ethernet interface
KEY FILL connector	Connects AN/VRC-99A Radio to key fill device
IOP MAINTENANCE connector	Connects AN/VRC-99A Radio to terminal for radio setup and for factory maintenance
DC POWER connector	Connects AN/VRC-99A Radio to 28 VDC power
NP MAINTENANCE connector	Connects AN/VRC-99A Radio to terminal for factory maintenance
PLATFORM INTERFACE connector	Connects AN/VRC-99A Radio to external power amplifier and receiver front end applications

4.4 RADIO CONFIGURATION PROCEDURE

This section describes how to connect to the AN/VRC-99A Radio to view or change the configuration. The connection to the radio can be:

- via an RS-232C serial connection to the IOP Maintenance Connector on the AN/VRC-99A Radio front panel
- via Telnet from a host on the IP network

4.4.1 Connection Via the IOP Maintenance Connector

The IOP Maintenance Port Cable (P/N 1050711G-1) can be used to connect the radio to an RS-232C serial port on a terminal or computer. The serial port should be set for the following parameters.

Baud rate:	9600
Data bits:	8
Stop bits:	1
Parity:	None
Flow Control:	None

When the serial port is on a computer, a terminal emulation program must be run that makes the computer act as a “dumb” terminal.

4.4.2 Connection Via Telnet

After a radio has been initially configured and is in communication with an IP network, a connection to it can be made from a host on the IP network.

The path from the host to the radio can be either via the wired LAN (Ethernet port), or via the radio network (OTA).

The Telnet server IP address of the radio is the Ethernet IP address of the radio.

Upon connecting via Telnet, the user will need to enter a password. No password is needed when connecting via the IOP Maintenance Connector. The password can be changed via the command ‘telnet password’.

The ‘logout’ command is used to disconnect from the Telnet session. Some configuration changes automatically terminate the Telnet session.

Warning: Take care when changing radio network operating parameters while connected via the radio network. The changes may cause the radio to drop out of the radio network, and until the

radio rejoins the network, OTA Telnet sessions cannot be used. This can be a problem if the changes were wrong.

4.5 RADIO CONFIGURATION COMMAND SUMMARY

This section describes the configuration information required by the AN/VRC-99A Radio, and the configuration commands to enter this information.

The configuration information is divided into two parts:

- Configuration information for the LAN side of the radio gateway (e.g., IP addresses, OSPF parameters, etc.)
- Configuration information for the OTA side of the radio gateway (e.g., radio network channels, network size, number of transmit slots, transmit rates, etc.)

Refer to sections 3.1.1, 3.2 and 3.4 for an overview of the functionality provided by the LAN and OTA sides of the radio gateway.

Radio configuration information is stored in non-volatile memory, and there is no need to re-enter the information after the radio is powered down.

Appendix C provides description of all configuration commands provided by the radio, including those intended for use at the factory.

4.5.1 LAN Side Configuration

This section addresses the configuration of the LAN side of the radio gateway provided by the AN/VRC-99A Radio. These configuration parameters affect the IP router or bridge functionality of the radio, the IP interface to the Ethernet LAN, and the IP interface to the OTA network.

4.5.1.1 IP Bridge/Router Configuration

The LAN side of the radio gateway must be configured either as an IP bridge or as an IP router.

4.5.1.2 Ethernet IP Addressing

The Ethernet interface must be assigned a unique IP address. The radio must also be assigned an Ethernet IP address mask that (together with the IP address) specifies the subnet associated with the Ethernet interface.

When the radio is configured as an IP bridge, the radio network forms a single subnet; that is, the Ethernet interfaces on all the radios are in the same subnet. The Ethernet IP addresses assigned to the radios must be in this subnet. The only messages that use a radio's IP address are ping, Telnet and ARP messages addressed to the radio.

When the radio is configured as an IP router, the Ethernet interfaces on the radios are in separate subnets. All traffic to be routed by the radio uses the radio's IP address. A host computer on the Ethernet can specify this address as its default gateway.

4.5.1.3 Over-the-Air IP Addressing

The OTA radio network tunnels IP packets from the LAN side of one radio to the LAN side of another radio. On the LAN side of the radio, the interface to the OTA side must be assigned an OTA IP address. It must also be assigned an OTA IP address mask that (together with the IP address) specifies the IP subnet associated with the OTA network.

When the radio is configured as an IP bridge, the OTA subnet is used internally within the radio network and is not visible to outside routers.

When the radio is configured as an IP router, the OTA subnet is the subnet that connects the IP routers in the various radios. The subnet addressing should not be used elsewhere in the network.

4.5.1.4 Router Control

When the radio is configured as a router, it must either be configured to use the OSPF routing protocol or be configured with static routes. When OSPF is enabled, it automatically generates the routing tables used by the router to send unicast traffic across the network. When OSPF is not enabled, the user must specify routes for all unicast traffic; that is, for each destination subnet, the user must identify the next-hop router (the router on the Ethernet or OTA interface that will receive the traffic).

IP multicast messages are treated by the radios as broadcast messages and are automatically sent over the air to each radio in the network. As a result, no routing table entries are required for multicast data.

4.5.1.5 OSPF Considerations

The AN/VRC-99A Radio is a limited implementation of the OSPF routing protocol. Configuration parameters are provided to allow the radio to be in two areas (as an area boundary router), but the implementation is designed for use in a single area.

Normally, the router is in the OSPF backbone area, the area with ID 0.0.0.0. The OSPF configuration parameters for the first area, area0, should specify information about this backbone area. The configuration parameters for the second area, area1, should have an area ID other than 0.0.0.0, and should have an IP address of 0.0.0.0 (to disable it).

Only a single address range can be specified for an area.

The OSPF standard supports several network topologies; each network must be implemented as one of these standard topologies. The OTA network is implemented on the AN/VRC-99A Radio as a broadcast network (i.e., like an Ethernet).

Some OSPF parameters are related to the Ethernet and OTA interfaces. The radio supports separate values for these parameters.

In a mobile environment, over-the-air links may have frequent connectivity changes, while links on the wired Ethernet interface usually do not. This has an impact on the router dead interval value used for the OTA interface. The dead interval should be set so that the OSPF neighbor relationship is not lost if the link is lost and then quickly regained.

The OTA network has limited bandwidth, so the OTA hello interval should be set so that OSPF packets only take up a small portion of the overall bandwidth. Note that OSPF requires that the hello and router dead intervals be the same at all routers on a subnet.

4.5.1.6 Quality of Service

The radio supports two priority levels (high and low priority), and both acknowledged and non-acknowledged transmission. Refer to section 3.4.7 for an overview.

This function is primarily performed on the OTA side of the radio gateway (as over-the-air transmission and retransmission takes place on the OTA side). But the quality of service level to be used is determined on the LAN side of the radio gateway, and it is directly related to information in the IP header of the message. Therefore, quality of service is considered a LAN side configuration parameter.

The Type of Service field of the IP header has 8 bits, which can provide 256 bit combinations. Each bit combination is called a codepoint, and is mapped to a specific quality of service level. There are thus 256 codepoints that can be specified by the user.

Codepoint mappings are set and can be displayed using the 'set qos' command. This command always takes a parameter that indicates the codepoints that are affected by the command. This parameter is based on expressing the codepoint value as a binary number (00000000 to 11111111). The parameter can be one of these 8-bit binary values, or it can be a binary value with some or all positions replaced by asterisks, where the asterisk is a wild card. For example, a parameter value of 00110*0* specifies the four codepoints 00110000, 00110001, 00110100, and 00110101.

When setting the codepoint mapping, the command format is:

```
set qos <codepoints> <priority> <tx_service>
```

where <priority> is either 'low' or 'high' and <tx_service> is either 'ack', 'tx_once', or 'tx_once_low_delay'.

To map all the codepoints, it is usually not necessary to issue 256 commands. Wild cards allow many codepoints to be mapped with just a few commands. For example, one might map all the codepoints to one value (with 'set qos *****'), and then, with a second command, re-map some of the codepoints to a different value.

Note 1. Mapping the IP header Type of Service field to the actual quality of service is similar to Differentiated Services for the Internet described in RFC 2474; however this implementation uses all 8 bits of the Type of Service field, whereas RFC 2474 uses only 6 of the 8 bits.

Note 2. The Type of Service field in the IP header is not altered by the radio.

4.5.2 Typical Configuration Commands for LAN Side

The following sample typical commands are used to view the current configuration of the LAN side of the radio gateway.

set bridge	Displays whether radio operates as an IP bridge or IP router (when bridge operation is disabled, the radio operates as an IP router)
ethernet params	Displays configuration related to Ethernet interface (IP address and mask, OSPF parameters)
ota params	Displays configuration related to over-the-air interface (IP address and mask, OSPF parameters)
ospf params	Displays whether OSPF routing protocol is enabled, and OSPF configuration parameters
set qos 00110000	Displays the quality of service level for a packet whose IP header Type of Service field contains the binary value 00110000
set qos 00110*0*	Displays the quality of service levels associated with the four codepoints: 00110000, 00110001, 00110100, and 00110101
set qos *****	Displays all the quality of service level mappings Note: This command displays 256 lines of output, and is appropriate only for a terminal with internal storage (such as a terminal emulator on a computer).

To configure the LAN side of the radio gateway, start by entering configuration state with the command:

enter config	Allows changes to the configuration. The response is: NP Configuration State Acknowledge Entered Configuration State
--------------	--

The following sample typical commands are used to configure the LAN side of the radio gateway. Appendix C provides a complete list of commands.

set bridge enable	Specifies that the radio operates as an IP bridge
set bridge disable	Specifies that the radio operates as an IP router
ospf state enable	Specifies that the OSPF routing protocol is used
ospf state disable	Specifies that the OSPF routing protocol is not used (and static routes must be entered)
ethernet ip 165.71.99.1	Specifies that the Ethernet interface is assigned IP address 165.71.99.1
ethernet ip_mask 255.255.255.0	Specifies that the Ethernet interface has a subnet mask of 255.255.255.0 (i.e., a 24-bit network mask)
ota ip 128.1.0.99	Specifies that the OTA interface is assigned IP address 128.1.0.99
ota ip_mask 255.255.255.0	Specifies that the OTA interface has a subnet mask of 255.255.255.0 (i.e., a 24-bit network mask)
ospf area0_id 0.0.0.0	Specifies that the radio's area 0 corresponds to OSPF area 0.0.0.0
ospf area0_ip 128.0.0.0	Specifies (with the IP mask) that the address range of the OSPF area is 128.0.0.0 to 191.255.255.255
ospf area0_ip_mask 63.255.255.255	See above; note that the OSPF area mask is a host mask (most masks are network masks)
ethernet ospf_areaid 0.0.0.0	Specifies that the Ethernet interface is in area 0.0.0.0
ethernet ospf_cost 10	Specifies that the "cost" of a transmission on the Ethernet interface is 10
ethernet ospf_hellointv 10	Specifies that Hello packets are sent on the Ethernet interface every 10 seconds

ethernet ospf_deadintv 40	Specifies that a neighbor on the Ethernet interface is considered dead if no Hello has been received for 40 seconds
ota ospf_cost 100	Specifies that the “cost” of a transmission on the OTA interface is 100
ota ospf_hellointv 20	Specifies that Hello packets are sent on the OTA interface every 20 seconds
ota ospf_deadintv 200	Specifies that a neighbor on the OTA interface is considered dead if no Hello has been received for 200 seconds
ota ospf_waitintv 80	Specifies that, when looking for another router on the OTA interface, it waits 80 seconds after receiving a Hello packet before it joins the network
ota ospf_retxintv 10	Specifies that, on the OTA interface, if an OSPF control message is not acknowledged, it is retransmitted after 10 seconds
route add 165.71.98.1 128.1.0.98 255.255.255.0 1	Adds a static route to destination subnet 165.71.98.0/24; it identifies the next hop router as 128.1.0.98, with a hop cost of 1
route flush	Removes all static routes
route drop 165.71.98.1 128.1.0.98 255.255.255.0 1	Removes the existing static route to destination subnet 165.71.98.0/24, with next hop router of 128.1.0.98 and hop cost of 1
set qos ***** high ack	Specifies that all packets are to be transmitted as high priority with acknowledged service
set qos 000***** low tx_once	Specifies that packets having the 32 codepoints 00000000 to 00011111 are transmitted as low priority with transmit once service When this command and the one above it are given in this order, all codepoints are mapped; those whose first bits are 000 are mapped as low priority and the others mapped as high priority

The following typical commands are used to exit configuration state.

store config	Stores the configuration in non-volatile memory. The response is: NP Configuration State Acknowledge Storing Configuration (this may be followed by an IOP reboot, which takes around 20 seconds) Warning: Do not shut off power to the radio until the prompt returns.
exit config	Uses the modified configuration, but does not store it in non-volatile memory
quit config	Discards the modifications; uses the configuration that was active earlier

4.5.3 OTA Side Configuration Information

This section addresses the configuration of the OTA side of the radio gateway provided by the AN/VRC-99A Radio. These parameters affect the interface to the OTA radio network.

4.5.3.1 Operating Frequency

The OTA radio network operates on one or more channels. The radio must be configured with the channels to use. All radios in the OTA network must be configured with the same set of channels.

The channels are specified with the 'radio channel' command. The format of this command is:

```
radio channel <number>,<channel-band>,<channels>
```

where <number> specifies the number of channels used, <channel-band> specifies channel band A or B, and <channels> is a list of the channels to be used. When multiple channels are specified, they must all lie in the same channel band.

The AN/VRC-99A and AN/VRC-99B Radios use different frequency bands, with different numbers of channels. Appendix A identifies the channels supported by each radio type, and specifies the associated carrier frequencies and the grouping of channels into channel bands.

When the 'radio channel' command configures the radio to use more than one channel, the 'radio hop_mode' command controls whether frequency hopping is used. When frequency hopping is disabled, only the first channel specified is used. When it is

enabled, all the channels are used in a quasi-random order. All radios in the OTA network must have the same frequency hop setting. When the 'radio channel' command specifies a single channel, frequency hopping is always disabled.

4.5.3.2 Network Size and Radio ID

The OTA network should be sized for the maximum number of radios that is expected to enter it. One slot is reserved for each radio not present in the network, so the network should not be larger than it needs to be. All radios in the OTA network must be configured for the same size network.

Each radio must be configured with an ID that is unique in the network. If the network size is n , the IDs values range from 0 to $(n-1)$.

The ID and network size are specified with the 'radio id_net_size' command.

Note: The radio attempts recovery actions if the network size or ID is not specified correctly.

If the radios are not all configured with the same network size, a radio entering the network automatically adjusts its network size. The action taken by the radio that initially forms the network is somewhat different from that taken by a radio that joins an existing network. A radio joins and forms the network when it hears a message from another radio not in a network; it chooses a network size that is the higher of its configured network size and the network size at the other radio. A radio joins an existing network when it hears a message from a radio in an existing network; the joining radio always adopts the existing network size (regardless of the radio's configured network size).

If a radio forms or joins a network and does not have an ID different from the others, it changes its ID to the lowest one that differs from the others. If all the IDs are already taken, it does not join the network.

However, different actions occur when two splintered subnets join together. If radio A (in a network) hears a message from radio B (also in a network) that reports that radio B's network is larger than radio A's network, radio A drops out of the network and then attempts to re-enter. If radio B reports that radio A's ID is taken by a radio C with a different serial number, the action taken depends on which radio has a lower serial number. If radio A has a higher serial number than radio C, radio A drops out of the network and then attempts to re-enter.

4.5.3.3 Time of Day

Each radio must be configured with time of day. The time of day is specified with the 'radio tod' command. Nominally, the time is "time since midnight", but any time can be used as long as all the radios in the OTA network are configured the same way.

Before two radios can communicate, the time at both radios must be within the same 3-minute period (where the first 3-minute period starts at midnight). Generally this means that they can communicate if time is set to wrist-watch accuracy (within a minute or so). After the radios communicate, they automatically synchronize to the same time.

4.5.3.4 Transmit Rate

Each radio must be configured with the minimum and maximum over-the-air transmit rates and the modulation scheme. Refer to section 3.4.2 for overview information.

These are specified with the 'radio burst_rate' command. The format of this command is:

```
radio burst_rate <min-rate>,<max-rate>,<modulation>
```

where <min-rate> and <max-rate> specify the minimum and maximum burst (symbol) transmit rates, and <modulation> specifies whether offset or non-offset QPSK modulation is used.

The allowable values for modulation are 'offset' and 'no_offset'. All radios in the OTA network must be configured for the same modulation scheme.

Radios in the OTA network may be configured with different transmit rates. When offset QPSK modulation is used, the allowable transmit rates (in Mbps) are: .625, 1.25, 2.5, and 5. When non-offset QPSK modulation is used, the allowable transmit rates (in Mbps) are .625, 1.25, 2.5, 5 and 10.

Note: Offset QPSK modulation provides a better RF spectrum than non-offset, and is recommended when none of the radios in the network are configured to use 10 Mbps.

4.5.3.5 Slot Assignment

Each radio must be configured with the number of hard slots it is to use, an initial number of soft slots, and the maximum number of soft slots for the OTA network. Refer to section 3.4.6 for overview information. The number of hard slots, initial soft slots, and the maximum number of soft slots are specified with the 'radio hard_slots' command, the 'radio soft_slots' command, and the 'radio max_soft_slots' command.

The radios in the network may be assigned different numbers of hard slots. Each radio in the network has a minimum of one hard slot. If a radio is not currently present in the network, one hard slot is reserved for it.

The total number of hard slots assigned to radios in the network should not exceed 32. (If the total exceeds 32, radios with higher ID numbers will lose slots but they will not lose their one reserved slot.)

The radios in the network may be assigned different initial numbers of soft slots. The radios should all be configured with the same maximum number of soft slots.

If the total number of soft slots initially assigned to the radios is less than the maximum, the unassigned soft slots will be assigned to radios that are experiencing congestion. After all the unassigned soft slots have been assigned, soft slots will migrate from radios that are not experiencing congestion to radios that are.

The total number of hard slots assigned to radios plus the maximum number of soft slots may be less than 32. The remaining slots are reserved for use as hard slots by radios that have not yet entered the network.

If the maximum number of soft slots is set to zero, only hard slots are used and network management packets associated with soft slot migration are not generated.

4.5.4 Typical Configuration Commands for OTA Side

The following typical commands are used to view the current configuration of the OTA side of the radio gateway.

radio params	Displays the primary configuration parameters related to the OTA interface and the OTA network (channel, network size, radio ID, transmit rate limits, slot assignments, time of day)
radio params_ext	Displays less-frequently used parameters (such as radio serial number)

To configure the OTA side of the radio gateway, start by entering configuration state with the command:

enter config	Allows changes to the configuration. The response is: NP Configuration State Acknowledge Entered Configuration State
--------------	--

The following sample typical commands are used to configure the OTA side of the radio gateway. Appendix C provides a complete list of commands.

radio channel 1,a,8	Specifies that the OTA network is to operate using channel 8
radio channel 3,a,2,5,7	Specifies that the OTA network is to operate using channels 2, 5 and 7 (provided frequency hopping is enabled)

radio hop_mode enable	Specifies that frequency hopping is enabled
radio id_net_size 3,8	Specifies that the radio ID is 3, and that the OTA network size is 8
radio tod 14:17:00	Specifies that the time is 14:17
radio burst_rate .625,10,no_offset	Specifies that the radio is to adaptively use transmit rates in the range 0.625 to 10 Mbps, using non-offset modulation
radio hard_slots 3	Specifies that the radio is to be permanently assigned 3 transmit slots in the network
radio soft_slots 0	Specifies that the radio is to initially have no dynamically-assigned transmit slots in the network
radio max_soft_slots 8	Specifies that the OTA network is to have a maximum of 8 dynamically-assigned slots

The following typical commands are used to exit configuration state.

store config	Stores the configuration in non-volatile memory. The response is: NP Configuration State Acknowledge Storing Configuration (this may be followed by an IOP reboot, which takes around 20 seconds) Warning: Do not shut off power to the radio until the prompt returns.
exit config	Uses the modified configuration, but does not store it in non-volatile memory
quit config	Discards the modifications; uses the configuration that was active earlier

4.6 NORMAL OPERATION

4.6.1 Network Initialization

After the proper configuration parameters have been set-up and stored in the AN/VRC-99A Radio, make sure the T/R STBY switch on the radio front panel is enabled for normal operation; if necessary, move the switch from STBY to T/R.

The radio automatically initiates a process to detect and join an existing radio network or to form a network if none exists. The first action of the radio is to listen for packets

from other radios within transmission range. Packet reception is indicated by the flashing of the RCV indicator on the front panel. In response to network management packets received from other radios, the newly-activated radio joins the network and begins to transmit network management packets. The network management packets inform other radios of the radio's presence in the network and start to establish a link connection with the neighboring radios.

If no network management packets are received from other radios within approximately 90 seconds, the newly-activated radio starts to transmit network management packets to attempt to establish communications with another radio in the area. This transmission is indicated by the flashing of the XMT indicator on the front panel. Another radio that detects these transmissions will respond, and the two radios will automatically link up to form a two-radio network. This network may then be joined by other radios. If no responses are obtained from the radio's transmissions, it tries again periodically until a network is established. If necessary, refer to the troubleshooting information in section 5.3.

This process is fully automatic and no operator action is required after turning the radio on. The connection of the radio to a network is evidenced by the blinking of the XMT and RCV indicators and the ability to send and receive data transmissions.

4.6.2 Data Transmission

No operator action is required for transmission of data once the radio is activated and connected to a LAN. IP datagrams from the LAN are processed by the radio either as an IP bridge or as an IP router (refer to section 3.2), and are sent over the air to the appropriate destination, via relay if needed. IP datagrams received over the air are similarly processed by the radio and are sent over the LAN.

4.6.3 Maximum Packet Size

The AN/VRC-99A Radio supports transmission of datagrams of all legal sizes that can be carried on Ethernet (i.e., IP datagrams containing up to 1500 bytes including the IP header). If the datagram is too large to fit in an over-the-air transmission, it is fragmented.

Appendix B shows the maximum datagram size that can be transmitted without fragmentation.

4.7 CO-SITE CONSIDERATIONS

Two radio networks can be connected by locating two AN/VRC-99A Radios together at a site (one radio from each network), and connecting the radios via Ethernet.

When this is done, one radio network must be configured to use channel band A, and the other must use channel band B. External RF co-site filters must be used, and there are restrictions on antenna location. For an AN/VRC-99B Radio (frequency band 2), there are additional restrictions on the frequencies used.

4.7.1 Co-Site Filters

Co-site filters are mounted external to the AN/VRC-99A Radio and are located in the RF cabling between the radio antenna output connector and the transmit/receive antenna. They are designed to pass channel band A and reject channel band B, or vice versa. The radio on the network using channel band A would use the filter that passes band A, and the other radio would use the filter that passes band B.

Part numbers for the filters are provided in Table 4-2.

Table 4-2. Co-Site Filter Part Numbers

Frequency Band	Channel Band Passed	Part Number
1 (VRC-99A)	Pass Channel Band A	1050406P-1
	Pass Channel Band B	1050406P-2
2 (VRC-99B)	Pass Channel Band A	1050724P-1
	Pass Channel Band B	1050724P-2

4.7.2 Antenna Separation Requirements

The antennas must be separated by a horizontal distance of a minimum of 10 meters. This provides approximately 50 dB of isolation between the transmitting and receiving antennas and will prevent damage to the radio receiver due to RF signal overload.

4.7.3 Frequency Channel Selection Requirements

The radio networks must use frequencies that are at least 40 MHz apart.

On an AN/VRC-99A Radio (frequency band 1), this does not impose an additional restriction because channel bands A and B are 40 MHz apart. But on an AN/VRC-99B Radio, channel bands A and B are only 16 MHz apart, and care must be taken in selecting the channels used.

4.8 KEY FILL PROCEDURE FOR AN/VRC-99A(C)

The following is a sample procedure that shows how to load a key into the AN/VRC-99A(C) radio using the DTD key fill device. DTD key fill devices vary in how they are configured, so the following is intended only as a guide. The exact procedure for your particular DTD may be different.

4.8.1 Equipment Required

- AN/CYZ-10 V(3) (DTD) with AN/VRC-99A Radio keymat installed
- Fill Cable

4.8.2 Sample Procedure

- a. Connect the DTD to the AN/VRC-99A(C) radio with the fill cable.
- b. Turn on the DTD.
- c. Select "APPL" from the DTD display by pressing ENTER or use the right or left arrow for selection.
- d. Select "JFILL" and press ENTER.
- e. Select "JTIDS" and press ENTER.
- f. Select "UTIL" and press ENTER.
- g. Select "SETUP" and press ENTER.
- h. Select "Protocol" and press ENTER.
- i. Select "DS101" and press ENTER.
- j. Select "YES" to use the DS101 Wakeup, and press ENTER.
- k. Select "XMIT" and press ENTER.
- l. Select the keymat by pressing P UP (Page Up) or P DN (Page Down), and press ENTER.
- m. Verify a "*" mark on the right side of the display. This indicates that the keymat has been selected.
- n. Select "QUIT" to exit the keymat selection menu, and press ENTER.
- o. Select "SEND" for initializing the transfer, and press ENTER. The message "Activating Wake" message will show on the display.
- p. The message "UUUUUUUUUUUUUUUUUU05" will show then the message "SUCCESS: 1" if the keymat transfers successfully. Then press ENTER.

Notes:

1. A successful key load is indicated by the extinguishing of the ALARM indicator.
2. If the key load is unsuccessful, as indicated by a flashing ALARM indicator, check the key fill cable connections and repeat steps b and c.
3. If the ALARM light is on continuously after a key load attempt, reset the radio by turning power off, then on, and repeat the key load sequence.

5. MAINTENANCE AND SERVICING

5.1 GENERAL

This section contains the troubleshooting and maintenance instructions for the organizational level of support. These instructions are limited to detection of equipment malfunctions and battery replacement. All other maintenance actions are to be conducted at the factory.

5.2 CLEANING

No special cleaning procedures are required.

5.3 TROUBLESHOOTING

Troubleshooting of the AN/VRC-99A Radio is conducted with the aid of the front panel indicators that show the results of built-in test operations and monitor operation of the equipment. At power-up, all the indicators should light momentarily, built-in test is then executed, and the overall results are displayed by the fault indicators. If any of the following takes place, proceed as indicated:

- a. If the POWER indicator fails to light when the ON/OFF control is set to ON, check that the 28 VDC supply to the rear-panel DC POWER connector is present. If 28 VDC power is present, check the rear-panel fuse, and replace if necessary. If the POWER indicator still fails to light when the ON/OFF control is set to ON, send the AN/VRC-99A Radio to the factory for repair.
- b. If any indicator fails to light initially within 10 seconds after the ON/OFF control is set to ON, send the AN/VRC-99A Radio to the factory for repair.
- c. If, one minute after the ON/OFF control is set to ON, any of the IOP FAULT, FAULT, or ALARM indicators are lit steadily: If the Alarm indicator is illuminated, check the battery. If the battery is good, repeat the power up sequence 3 times. If any of the fault indicators still remain illuminated, send the AN/VRC-99A Radio to the factory for repair.
- d. If, five minutes after the ON/OFF control is set to ON, the XMT indicator fails to light or to begin flashing, verify that the T/R STBY switch is in the T/R position and that the radio is not in Configuration State. If the Radio is set to T/R and the XMT indicator fails to begin flashing after five minutes, send the AN/VRC-99A Radio to the factory for repair.
- e. If, five minutes after the ON/OFF control is set to ON, the RCV indicator fails to light or to begin flashing, and the AN/VRC-99A Radio is believed to be within range of other AN/VRC-99A Radios, check the connections of the antenna cable to the ANT receptacle on the front panel and to the antenna, and the integrity of the antenna cable and antenna. Verify that the T/R STBY front panel switch is

set to normal operation, that the radio is not in configuration mode, and that the following operational parameters have been set properly:

- radio channel
- radio hop_mode
- radio burst_rate
- radio id_net_size
- radio tod (must be within 90 seconds of other radios in the network)

To verify operation of the AN/VRC-99A Radio under conditions of unknown RF links to other AN/VRC-99A Radios, connect the ANT receptacle of the radio through a RF attenuator of at least 80 dB, to the ANT receptacle of a known-good radio. If, five minutes after the ON/OFF controls to both radios are set to ON, and the indicators on the front panel of the known-good radio are normal, and the operational parameters are set correctly, the RCV indicator of the radio is not flashing, send the AN/VRC-99A Radio to the factory for repair.

- f. In the event that cryptographic keys are lost (as indicated by flashing of the ALARM indicator) after primary power to the unit is interrupted (either due to interruption of the platform 28 VDC supply or by setting the ON/OFF control to OFF and then back to ON), replace the battery pack using the procedure described in 5.4.

5.4 BATTERY REPLACEMENT PROCEDURE

The battery pack should be replaced every three months or when battery failure is indicated by inability to retain cryptographic keys when the unit is powered down and then re-energized. (Normally, the battery pack should retain cryptographic codes for more than three months after the ON/OFF control is set to OFF.) The procedure for removal and replacement of the battery pack is as follows:

- a. Set the ON/OFF control on the front panel to OFF.
- b. Remove the front panel battery access cover by loosening the four captive screws that secure it to the front panel.
- c. Remove and unplug the battery pack. Note battery disposal instructions below.
- d. Plug in the replacement battery pack (note polarized connector).
- e. Place the battery pack into the battery compartment.
- f. Route the battery wires so that they will not be pinched when the battery cover is re-installed.
- g. Re-install the battery access cover.
- h. Set the ON/OFF control to ON.
- i. Note the date of battery replacement on the platform maintenance log.

Battery Disposal Instructions:

The battery pack uses two “C-size” lithium thionyl-chloride batteries. **The used battery packs must not be charged, short-circuited, incinerated or mutilated. Otherwise the battery may vent or rupture releasing toxic materials.**

The used battery pack should not be discarded as conventional waste. It should be placed in the “zip-lock” plastic bag, in which the replacement is supplied. The used battery pack should then be returned for proper disposal to the factory or to the U.S. Army Battery Collection And Recycling System.

5.5 DISASSEMBLY AND REASSEMBLY

No disassembly or reassembly of the AN/VRC-99A Radio, other than battery pack replacement described in 5.4, is authorized.

5.6 SCHEDULED MAINTENANCE

The battery pack should be replaced every 3 months. To replace the battery pack, execute the procedure described in paragraph 5.4. The part number of the battery pack is 1050417G-1.

6. PREPARATION FOR SHIPMENT

6.1 GENERAL

This section contains the disassembly and preparation for shipment instructions for the AN/VRC-99A Radio.

6.2 DISASSEMBLY

- a. Make certain that the ON/OFF switch on the front panel is set to OFF.
- b. Disconnect the Ethernet cable from the 802.3 connector on the front panel.
- c. Disconnect the VDC power source from the rear-panel DC POWER connector.
- d. Disconnect the antenna cable from the XMT on the front panel.
- e. Release the hold-down handles on the mounting tray and remove the AN/VRC-99A Radio from the tray.

6.3 PREPARATION FOR SHIPMENT

- a. Open the battery compartment and disconnect the battery connector. Re-close the battery compartment with the battery disconnected.
- b. Wrap the AN/VRC-99A Radio in plastic, MIL-B-81705, Type II.
- c. Gently insert the wrapped AN/VRC-99A Radio into carton ASTM D-5118 or equivalent (19 x 10.5 x 10.5 inches).
- d. Seal all corners of the carton using 3-inch reinforced tape.
- e. For an AN/VRC-99A(C) Radio, stamp CCI on all sides of the carton and mark the container with the following: TO BE OPENED BY COMSEC CUSTODIAN.
- f. Gently insert the carton into an outer carton, MIL-P-26514 or equivalent (23 x 14.5 x 15 inches with 2-inch polyurethane foam).
- g. Seal the outer carton using 3-inch reinforced tape.

7. STORAGE

7.1 GENERAL

There are no special instructions for storing the AN/AN/VRC-99A Radio except that the storage temperature must be between -51°C and $+71^{\circ}\text{C}$.

8. PARTS LIST

8.1 GENERAL

Table 8-1 provides the maintenance parts list for the AN/VRC-99A Radio. This parts list has been prepared to assist supply and maintenance personnel in the identification, requisitioning, and stocking of replaceable parts.

8.2 MAINTENANCE PARTS LIST

The maintenance parts list contains (1) all replacement parts, (2) all parts that must be removed, disconnected, or handled to gain access to the replacement parts, and (3) all assembly part numbers required to show relationship (indenture) of replacement parts to their next higher assemblies, based on the program maintenance concept.

The only Unit Level maintenance for the AN/VRC-99A Radio is battery replacement. All other maintenance is performed at the factory. The only parts involved in Unit Level maintenance are the battery pack and the battery access cover on the front panel of the radio. The battery access cover is secured by four captive screws. Removal of the cover permits the battery pack to be unplugged and withdrawn for replacement.

8.2.1 Part Number Column

This column lists the contractor's drawing number, including dash numbers, assigned to each part. Parts altered or selected for special fit, tolerance, etc., from vendor, commercial, or Government standard items have contractor part numbers.

8.2.2 CAGE Column

This column lists a five-digit code number denoting the vendor from whom the part may be procured and is shown following the part number. The source of vendor code numbers is the Commercial and Government Entity (CAGE) Cataloging Handbook H4/H8. A list of applicable vendor code numbers and corresponding vendors follows:

80249
BAE SYSTEMS
1 Hazeltine Way
Greenlawn, NY 11740

8.2.3 Description Column

This column contains the description of all items appearing on the maintenance parts list. The indentation headed "1" through "7" in this column shows the relationship of

parts and subassemblies to assemblies. These are in accordance with the contractor's drawing title plus modifiers that are necessary to identify the particular item.

8.2.4 Units Per Assembly

This column contains the number of units required per assembly and/or subassembly.

Table 8-1 Maintenance Parts List

Part Number	Cage Code	Description	Units Per Assembly
1050700G	80249	AN/VRC-99A RADIO ASSEMBLY	REF
1050417G-1	80249	BATTERY ASSEMBLY	1
1050369G-1	80249	COVER ASSEMBLY, BATTERY	2

Appendix A

Channel and Frequency Designation

The 'radio frequency_band' configuration parameter must be set to match the frequency band supported by the radio. It must be set to 1 for the AN/VRC-99A Radio and to 2 for the AN/VRC-99B Radio.

The 'radio channel' configuration parameter specifies the channels (and therefore the RF frequencies) used by the radio.

Table A-1 specifies the channel numbers supported by the AN/VRC-99A Radio, the RF carrier frequency for each channel and the division of channels into channel bands.

Table A-2 specifies the same information for the AN/VRC-99B Radio.

Table A-1 Channel/Frequency Designations for AN/VRC-99A Radio

Channel Band A		Channel Band B	
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	1308	10	1412
2	1316	11	1420
3	1324	12	1428
4	1332	13	1436
5	1340	14	1444
6	1348	15	1452
7	1356	16	1460
8	1364	17	1468
9	1372	18	1476
		19	1484

Table A-2 Channel/Frequency Designations for AN/VRC-99B Radio

Channel Band A		Channel Band B	
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	1708	18	1852
2	1716	19	1860
3	1724	20	1868
4	1732	21	1876
5	1740	22	1884
6	1748	23	1892
7	1756	24	1900
8	1764	25	1908
9	1772	26	1916
10	1780	27	1924
11	1788	28	1932
12	1796	29	1940
13	1804	30	1948
14	1812	31	1956
15	1820	32	1964
16	1828	33	1972
17	1836	34	1980

Appendix B

Maximum Packet Size

Table B-1 specifies the largest size packet that can be sent over the air in a transmit slot without fragmentation. The size specified is the UDP payload (i.e., the data bytes that follow a UDP header); allowance has already been made for the UDP header, IP header, MAC header, and all OTA radio headers and overheads.

The table shows 1472 bytes at the higher transmit rates because the maximum size UDP payload that can be carried on Ethernet is 1472 bytes. The table ignores bundling multiple packets in a slot.

If TCP is being used, the TCP payload would be 12 bytes smaller than the UDP payload shown in the table (as a TCP header takes 12 bytes more space than a UDP header).

The maximum packet size varies based on the transmit rate on the link, the radio configuration for maximum transmit range, and whether the LAN side of the radio is configured as an IP bridge or an IP router.

The 'radio tx_range' configuration parameter specifies the maximum distance allowed between a transmitting and a receiving radio. Two values are supported. Normal range supports a maximum distance of 40 miles (35 nautical miles). Extended range supports a maximum distance of 115 miles (100 nautical miles). More data can be transmitted in a slot when the radio is configured for normal range.

Table B-1. Maximum UDP Payload In Slot Without Fragmentation

Link Transmit Rate (Mbps)	Maximum UDP Payload Bytes			
	Extended Range		Normal Range	
	IP Bridge	IP Router	IP Bridge	IP Router
10	1472	1472	1472	1472
5	1472	1472	1472	1472
2.5	650	666	746	762
1.25	218	234	266	282
0.625	90	106	114	130

Tables B-2 and B-3 provide detailed information about data that can fit into a slot, and provides source information regarding the fragmentation and bundling of packets. Table B-2 applies to extended range and Table B-3 applies to normal range. The following explanation applies to both tables.

Line 1 shows the raw size of the slot (in bytes). Technically, this is the number of bytes that are FEC encoded. Line 3 shows the space available for packets after removing the slot overheads consumed by hardware and software.

Each data packet contains encrypted data plus a 32-byte header. When the slot is scheduled for transmission, packets are taken from the transmit queue in priority order and included in the transmission until no more will fit or a maximum of 14 packets have been included. [This discussion concentrates on data packets. Network management packets are also transmitted; they are usually put into the transmission before any data packets. Data packets can be bundled with network management packets when the transmit rates are appropriate and the data fits into the remaining space.]

At a transmit rate of 10 Mbps, two maximum-size packets can fit in a slot with some space left over. At 10 Mbps, line 4 shows the space taken by two packet headers; at the other transmit rates, it shows the space taken by one packet header.

The encrypted data is fragmented before it is put on the transmit queue. When the expected transmit rate is 0.625 Mbps, the fragmentation size is the available packet space in the slot. At the other transmit rates, the fragments are sized to allow an Ack packet to be bundled with the data.

Line 5 shows the reserved space for the Ack packet. Note that this space is reserved only during fragmentation; it is ignored when the slot is actually scheduled for transmission. If, during scheduling, an Ack packet needs to be transmitted, it is put into the transmission before any data; otherwise, the entire transmit space is available.

Line 6 shows the maximum number of encrypted bytes that will fit into a slot after the packet header has been removed. At 10 Mbps, two packet headers are removed.

The largest possible encrypted data is 1522 bytes when the radio is configured as an IP bridge, and 1506 bytes when it is an IP router (based on the maximum size of an Ethernet packet and the overheads in line 7). At 10 and 5 Mbps, line 6 shows that the space available is larger than this. That means that at 10 and 5 Mbps, packets are not fragmented. For the remaining transmit rates, line 6 shows the fragmentation size.

Line 10 subtracts the encrypted overheads (IOP header, MAC header, IP header, and UDP header), and shows the UDP payload size associated with the largest unfragmented packet. At 10 Mbps, two sets of overheads have been subtracted. At 10 and 5 Mbps, the values in line 10 are larger than the maximum size of an Ethernet UDP payload. At the other transmit rates, the line 10 values match those in Table B-1.

Table B-2. Packet Size Information for Extended Range

Line	Transmit Rate (Mbps)	10	5	2.5	1.25	0.625
1	Raw bytes available in OTA slot	3384	1680	840	408	192
2	Slot overheads (CRC, slot header, etc)	20	20	20	20	20
3	Space available for packets	3364	1660	820	388	172
4	OTA packet header	64 (2 packets)	32	32	32	32
5	Provision for Ack packet	88	88	88	88	0
6	Maximum encrypted bytes without fragmentation	3212 (1606 each)	1540	700	268	140
7	Encrypted IOP and MAC headers ... when radio is IP Bridge ... when radio is IP Router	44 (2 headers) 12 (2 headers)	22 6	22 6	22 6	22 6
8	IP header	40 (2 headers)	20	20	20	20
9	UDP header	16 (2 headers)	8	8	8	8
10	Nominal UDP payload without fragmentation ... when radio is IP Bridge ... when radio is IP Router	3112 (1556 each) 3144 (1572 each)	1490 1506	650 666	218 234	90 106

Table B-3. Packet Size Information for Normal Range

Line	Transmit Rate (Mbps)	10	5	2.5	1.25	0.625
1	Raw bytes available in OTA slot	3768	1872	936	456	216
2	Slot overheads (CRC, slot header, etc)	20	20	20	20	20
3	Space available for packets	3748	1852	916	436	196
4	OTA packet header	64 (2 packets)	32	32	32	32
5	Provision for Ack packet	88	88	88	88	0
6	Maximum encrypted bytes without fragmentation	3596 (798 each)	1732	796	316	164
7	Encrypted IOP and MAC headers ... when radio is IP Bridge ... when radio is IP Router	44 (2 headers) 12 (2 headers)	22 6	22 6	22 6	22 6
8	IP header	40 (2 headers)	20	20	20	20
9	UDP header	16 (2 headers)	8	8	8	8
10	Nominal UDP payload without fragmentation ... when radio is IP Bridge ... when radio is IP Router	3496 (1773 each) 3528 (1764 each)	1682 1698	746 762	266 282	114 130

Appendix C

Configuration Messages

This appendix provides the syntax and usage of all commands available from the IOP Maintenance Port, NP Maintenance Port and the Telnet Interface.

Table C-1 provides the format of commands and output messages. The columns of the table contain the following information:

- The Format column represents the text input by the user. This text input is not case sensitive.
- The Description column provides both a description of the message and the resulting output by the AN/VRC-99A Radio.
- The Interface column indicates on which of the three interfaces this command is valid.

The Format and Description columns use the following syntax:

- Text not in braces must be entered as shown.
- Italic text in angle braces (e.g. < param >) indicates a required input parameter, or an output field. Table C-2 provides more information about the parameter.
- Square braces (e.g. [optional-input]) indicate one or more optional input parameter(s) that must be entered as shown.
- Italic text in square and angle braces (e.g. [< input >]) indicates an optional input parameter. Table C-2 provides more information about the parameter.

All text entries are case insensitive. The Table always uses lower case letters, but any entry can instead use upper case (or mixed case) letters.

Help is provided on the IOP Maintenance Port and Telnet Interface. Typing a “?” after any portion of a command will provide the remaining options for that command. Note that not all commands support help; typing a “?” after these commands will result in an error message.

Invalid input (such as misspelling or parameter out of range) will result in an error message.

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
arp	<p>Displays the ARP table.</p> <p>Result:</p> <ul style="list-style-type: none"> Type: < route_type > Target IP: < target_ip > Mac Address: < mac_address > Port: < port > Age: < arp_entry_age > 	1, 3
bit sru	<p>Displays the radio's Built-In-Test results on a per-module basis.</p> <p>Result:</p> <ul style="list-style-type: none"> IOP: < test_result > VIM: < test_result > COMSEC: < test_result > Red Power Supply: < test_result > Network Processor: < test_result > MF/NRI: < test_result > RF: < test_result > Power Amplifier: < test_result > PA Power Supply: < test_result > Black Power Supply: < test_result > COMSEC TOD: < test_result > COMSEC ID: < test_result > 	1, 3
bit status	<p>Displays the IOP's Built-In-Test results on a per-test basis.</p> <p>Result:</p> <ul style="list-style-type: none"> Key Status: < test_result > RBR Status: < test_result > VIM XLINX Read Back: < test_result > VIM CW Loop Back: < test_result > VIM Voice Loop Back: < test_result > VIM Other: < test_result > Red Power Supply: < test_result > Ethernet Loop Back: < test_result > LAPB Loop Back: < test_result > RS232 Loop Back: < test_result > Maintenance Loop Back: < test_result > ROM CRC: < test_result > RAM Addressability: < test_result > RAM Data: < test_result > 	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
comsec_ctl status [clear] [hex]	<p>Displays status and statistics for the COMSEC controller. If the clear parameter is present, the statistics are zeroed. If the hex parameter is present, the status and statistics will be output in ASCII hex.</p> <p>Result:</p> <ul style="list-style-type: none"> Link up: <stat> Xoff state: <stat> Alarm state: <stat> RBR requests: <stat> Wrong rx length: <stat> Link ack timeout: <stat> Re-readied TX: <stat> Tx pkt link fail: <stat> Tx unknown pkt: <stat> Tx complete: <stat> Tx fail: <stat> Tx force fail: <stat> Tx probe request: <stat> Tx probe response: <stat> Tx ack: <stat> Tx np ctrl: <stat> Tx hpri demand: <stat> Tx mpri demand: <stat> Tx lpri demand: <stat> 	1, 3
comsec status [clear] [hex]	<p>Displays status and statistics for the COMSEC device. If the clear parameter is present, the statistics are zeroed. If the hex parameter is present, the status and statistics will be output in ASCII hex.</p> <p>Result:</p> <ul style="list-style-type: none"> Not present: <true_false> Is ok: <true_false> Rx enabled: <true_false> Transmitting: <true_false> In tx isr: <true_false> Low Battery: <true_false> Comsec Reg Hi: <stat> Comsec Reg Lo: <stat> Is alarmed: <true_false> Has no key: <true_false> X1 Alarmed: <true_false> X2 Alarmed: <true_false> Zeroize alarm: <stat> 	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
	X_cdh alarm: <stat> Output alarm: <stat> Cdh low voltage alarm: <stat> Crc alarm: <stat> Tsn alarm: <stat> Dma err from np: <stat> Dma err to np: <stat> Dma err from iop: <stat> Dma err to iop: <stat> Tx CRC errors: <stat> Comsec interrupts: <stat> Rx interrupts: <stat> Tx interrupts: <stat> Tx kicks: <stat>	1, 3
debug < debug-param > enter config	Displays and sets debugging conditions, intended for use by developers. See Table A-4. Enters the configuration state, which allows configuration parameter changes. Result: Entered Configuration State.	1, 2, 3
ethernet arp_age [< arp_age >]	Displays time that an ARP table entry will persist since the time it was first learned on the 802.3 port. If parameter is present, sets the age. Result: ethernet ARP_age: < ARP_age >	1, 3
ethernet arp_retries [< arp_retries >]	Displays maximum number of attempts to be made at resolving an address via ARP on the 802.3 port. If parameter is present, sets the number of attempts. Result: ethernet ARP_retries: < ARP_retries >	1, 3
ethernet arp_timeout [< arp_timeout >]	Displays maximum time to wait for an ARP reply to a request previously transmitted out the 802.3 port. If parameter is present, sets the time. Result: ethernet ARP_timeout: < ARP_timeout >	1, 3
ethernet ip [< port_ip >]	Displays IP address for 802.3 port. If parameter is present, sets the address. Result: ethernet IP: < port_ip >	1, 3
ethernet ip_assem_len	Displays the assembly length for 802.3 port. Result: ethernet IP_assem_len: < IP_assem_len >	1, 3
ethernet ip_mask [< port_ip_mask >]	Displays IP address mask for 802.3 port. If the parameter is present, sets the mask. Result: ethernet IP_mask: < port_ip_mask >	1, 3
ethernet ip_mtu	Displays the MTU for 802.3 port. Result: ethernet IP_MTU: < MTU >	1, 3
ethernet mac_address [< mac_address >]	Displays the MAC address for 802.3 port. If the parameter is present and the current MAC address is all zeroes, sets the MAC address. Result: ethernet MAC_address: < mac_address >	1, 3
ethernet ospf_areaid [< port_ospf_areaid >]	Displays OSPF Area ID for 802.3 port. If the parameter is present, sets the OSPF Area ID. Result: ethernet OSPF_AreaID: < port_OSPF_AreaID >	1, 3
ethernet ospf_cost [< port_ospf_cost >]	Displays OSPF cost for 802.3 port. If the parameter is present, sets the OSPF cost. Result: ethernet OSPF_Cost: < port_OSPF_Cost >	1, 3
ethernet dead_interval [< port_ospf_deadintv >]	Displays OSPF dead interval for 802.3 port. If the parameter is present, sets the OSPF dead interval. Result: ethernet OSPF_DeadIntv: < port_OSPF_DeadIntv >	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
ethernet hello_interval [< port_ospf_hellointv >]	Displays OSPF hello interval for 802.3 port. If the parameter is present, sets the OSPF hello interval. Result: ethernet OSPF_HelloIntv: < port_OSPF_HelloIntv >	1, 3
ethernet ospf_priority [< port_ospf_priority >]	Displays OSPF priority for 802.3 port. If the parameter is present, sets the OSPF priority. Result: ethernet OSPF_Priority: < port_OSPF_Priority >	1, 3
ethernet ospf_retxintv [< port_ospf_retxintv >]	Displays OSPF LSA retransmit interval for 802.3 port. If the parameter is present, sets the OSPF LSA retransmit interval. Result: ethernet OSPF_ReTxIntv: < port_OSPF_ReTxIntv >	1, 3
ethernet ospf_waitintv [< port_ospf_waitintv >]	Displays OSPF wait interval for 802.3 port. If the parameter is present, sets the OSPF wait interval. The wait interval is the number of seconds that the radio waits after hearing the first hello packet on this interface before running a designated router election. Result: ethernet OSPF_WaitIntv: < port_OSPF_WaitIntv >	1, 3
ethernet ospf_xmitdel [< port_ospf_xmitdel >]	Displays estimated time to transmit an OSPF LSA over this interface. If the parameter is present, sets the estimated OSPF transmit time. Result: Ethernet OSPF_XmitDel: < port_OSPF_XmitDel >	1, 3
ethernet params	Displays ethernet parameters Result: ethernet params ARP_age: < ARP_age > ARP_retries: < ARP_retries > ARP_timeout: < ARP_timeout > IP: < port_IP > IP_mask: < port_IP_mask > IP_MTU: < MTU > OSPF_AreaID: < port_OSPF_AreaID > OSPF_Cost: < port_OSPF_Cost > OSPF_HelloIntv: < port_OSPF_HelloIntv > OSPF_Priority: < port_OSPF_Priority > OSPF_DeadIntv: < port_OSPF_DeadIntv > OSPF_WaitIntv: < port_OSPF_WaitIntv > OSPF_XmitDel: < port_OSPF_XmitDel > OSPF_ReTxIntv: < port_OSPF_ReTxIntv > IP_assem_len: < IP_assem_len > MAC_address: < mac_address >	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface *
ethernet status [clear] [hex]	<p>Displays the status and statistics of the 802.3 port. If the clear parameter is present, the status and statistics will be output in ASCII hex.</p> <p>Result:</p> <p>Channel enabled: <true_false> Output enabled: <true_false> Transmitting: <true_false> In isr: <true_false> Mcast enabled: <true_false> Next Rx BD: <stat> Oldest Tx BD: <stat> Next Tx BD: <stat> Rx packet error: <stat> Crc error: <stat> Overrun: <stat></p> <p>Rx too long: <stat> Rx missing bits: <stat> Dropped frames: <stat> Rx good: <stat> Rx send failed: <stat> Rx no buffers: <stat> Tx total: <stat> Tx good: <stat> Invalid tx buf: <stat> Tx packet error: <stat> Late collision: <stat></p> <p>ReXmit limit: <stat> Underrun: <stat> Carrier lost: <stat> Retries: <stat> Heart beat: <stat> Event count: <stat> Spurious count: <stat> Interrupts: <stat> Kicks: <stat></p>	1, 3
exit config	<p>Saves the configuration changes and exits configuration state. Configuration changes will be lost on power down.</p> <p>Result: Exited Configuration State.</p>	1, 2, 3
help	<p>Provides listing of all possible commands.</p> <p>Result: <command ></p>	1, 3
iprintf [<iop_mod_num> [<0/1>]]	<p>Displays IOP debug print settings. If <iop_mod_num> parameter is present, displays debug print setting for the specified IOP module. If <0/1> parameter is present, sets the debug print settings for the specified IOP module.</p> <p>Result:</p> <p>(00) ALL MODULES (01) VIM MODULE: <0/1> (02) ROUTER MODULE: <0/1> (03) RNVDRAM MODULE: <0/1> (04) ROUTERDEBUG MODULE: <0/1> (05) CFG MODULE: <0/1> (06) MAINTENANCE MODULE: <0/1> (07) COMSEC MODULE: <0/1> (08) MAILBOX MODULE: <0/1> (09) LAPBDEV MODULE: <0/1> (10) COMSECDEV MODULE: <0/1> (11) ETHERDEV MODULE: <0/1> (12) OTADEV MODULE: <0/1> (13) EEFLASH MODULE: <0/1> (14) TELNET MODULE: <0/1> (15) WATCHDOG MODULE: <0/1> (16) BIT MODULE: <0/1></p>	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Telnet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
ip cache_bucket [<route_num_buckets >]	Displays number of IP route cache hash table buckets. Result: IP cache_bucket: <route_num_buckets >	1, 3
ip cache_bucket_len [<route_bucket_len >]	Displays maximum number of entries per IP route cache hash table bucket. Result: IP cache_bucket_len: <route_bucket_len >	1, 3
ip params	Displays IP related parameters. Result: IP params reassem_timeout: < IP_reassem_timeout > TTL: < num_ttl_hops > cache_bucket_len: <route_bucket_len> cache_bucket: <route_num_buckets>	1, 3
ip reassem_timeout [< ip_reassem_timeout >]	Displays time that IP will wait for all fragments of an IP datagram to be reassembled before dumping the partial result. If parameter is present, sets the time to wait. Result: IP reassem_timeout: < IP_reassem_timeout >	1, 3
ip ttl [< num_ttl_hops >]	Displays time-to-live value used in the IP header of IP packets generated by the radio. If parameter is present, sets the time-to-live value. Result: IP TTL: < num_ttl_hops >	1, 3
lapb baud [< lapb_baudrate >]	Not used.	1, 3
lapb host_address [< host_address >]	Not used.	1, 3
lapb ip [< port_ip >]	Not used.	1, 3
lapb ip_assem_len	Not used.	1, 3
lapb ip_mask [< port_ip_mask >]	Not used.	1, 3
lapb ip_mtu	Not used.	1, 3
lapb params	Not used.	1, 3
lapb port_address [< port_address >]	Not used.	1, 3
lapb status [clear] [hex]	Not used.	1, 3
lock config	Locks the radio serial number from any further changes. Result: Configuration Store LOCKED	2
logout	Terminates a telnet session.	3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Telnet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
mailbox	<p>Displays the mailbox numbers of all the IOP mailboxes. Result: (00) ALL (01) CONTROL (02) VIM CTRL (03) VIM CTRL BITRESULT (04) VIM BIT (05) VIM PORT MONITOR (06) VIM CW DISPATCH (07) VIM CALL MGR0 (08) VIM CALL MGR1 (09) VIM CALL MGR2 (10) VIM CALL MGR3 (11) VIM VOICE DISPATCH (12) VIM DEMAND DISPATCH (13) VIM BEARER DISPATCH (14) VIM CTRL DISPATCH (15) VIM PHONEBOOK (16) ETHERNET OUTPUT (17) LAPB OUTPUT (18) RS232 OUTPUT (19) OTA LPRI OUTPUT (20) OTA HPRI OUTPUT (21) OTA LPRI INPUT (22) OTA HPRI INPUT (23) OTA BUNDLE (24) OTA BUNDLE TIMEOUT (25) OTA CONTROL (26) ROUTER FREE (27) RTR HPRI ETHR (28) RTR HPRI RADIO (29) RTR HPRI LAPB (30) RTR HPRI SERIAL (31) RTR LPRI ETHR (32) RTR LPRI RADIO (33) RTR LPRI LAPB (34) RTR LPRI SERIAL (35) ROUTER CONTROL (36) ROUTER COMMAND (37) CFG (38) CFG NP (39) MAINTENANCE (40) COMSEC TX BEARER (41) COMSEC TX LPRI (42) COMSEC TX MPRI (43) COMSEC TX HPRI (44) COMSEC TX NP (45) COMSEC SEND PROBE (46) COMSEC PROBE RESP (47) COMSEC GOT ACK (48) COMSEC SEND ACK (49) COMSEC NEXT TX (50) COMSEC OUTPUT (51) COMSEC LED (52) TELNET SEND (53) TELNET RECEIVE (54) TELNET SESSION</p>	1, 3
mailbox find <mailto_name> [<stat>]	<p>Searches all IOP mailboxes that have a non zero value for the specified status/statistic. If parameter is present, the searches all IOP mailboxes that match the specified value for the status/statistic. Result: (List of Mailbox numbers that match the specified criterion)</p>	1, 3
mailbox status [<mailbox_num>]	<p>Displays the IOP general mailbox status and statistics. If parameter is present, displays the IOP mailbox status and statistics for the specified mailbox. Result for general mailbox status and statistics: Msgs Allocated: <stat> Msgs Dropped: <stat> Free Errors: <stat> Max Msgs Allocated: <stat> Ticks Dropped: <stat> Msgs Overflowed: <stat> Get Buffer Failed: <stat></p> <p>Result for a specified mailbox: Mode: <stat> Times Closed: <stat> Msgs Queued: <stat> Msgs Received: <stat> Size: <stat> Times Disabled: <stat> Msgs Overflowed: <stat> Ticks Received: <stat> Flow Number: <stat> Times Enabled: <stat> Msgs Dropped: <stat> Ticks Dropped: <stat> Times Opened: <stat> Times Flowed: <stat> Msgs Pended: <stat></p>	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Telnet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
ospf area0_addr_range_adv [<i>< mode ></i>]	Indicates if advertising of summary routes to external areas is enabled. If parameter is present, sets mode of external area advertising. Result: OSPF Area0_Addr_Range_Adv: <i><mode></i>	1, 3
ospf area0_ext_routing [<i>< mode ></i>]	Indicates if flooding of Autonomous System external advertisements into/throughout the area is enabled. If parameter is present, sets mode of external advertisement flooding. Result: OSPF Area0_Ext_Routing: <i><mode ></i>	1, 3
ospf area0_id [<i>< area0_id ></i>]	Displays the ID assigned to Area 0. If parameter is present, assigns an ID to Area 0. Result: OSPF Area0_ID: <i><area0_id ></i>	1, 3
ospf area0_ip [<i>< area0_ip ></i>]	Displays the IP address assigned to Area 0. If parameter is present, assigns an IP address to Area 0. Result: OSPF Area0_IP: <i><area0_ip ></i>	1, 3
ospf area0_ip_mask [<i>< area0_ip_mask ></i>]	Displays the IP mask assigned to Area 0. If parameter is present, assigns an IP mask to Area 0. Result: OSPF Area0_IP_Mask: <i><area0_ip_mask ></i>	1, 3
ospf area1_addr_range_adv [<i>< mode ></i>]	Indicates if advertising of summary routes to external areas is enabled. If parameter is present, sets mode of external area advertising. Result: OSPF Area1_Addr_Range_Adv: <i><mode></i>	1, 3
ospf area1_ext_routing [<i>< mode ></i>]	Indicates if flooding of Autonomous System external advertisements into/throughout the area is enabled. If parameter is present, sets mode of external advertisement flooding. Result: OSPF Area1_Ext_Routing: <i><mode ></i>	1, 3
ospf area1_id [<i>< area1_id ></i>]	Displays the ID assigned to Area 1. If parameter is present, assigns an ID to Area 1. Result: OSPF Area1_ID: <i><area1_id ></i>	1, 3
ospf area1_ip [<i>< area1_ip ></i>]	Displays the IP address assigned to Area 1. If parameter is present, assigns an IP address to Area 1. Result: OSPF Area1_IP: <i><area1_ip ></i>	1, 3
ospf area1_ip_mask [<i>< area1_ip_mask ></i>]	Displays the IP mask assigned to Area 1. If parameter is present, assigns an IP mask to Area 1. Result: OSPF Area1_IP_Mask: <i><area1_ip_mask ></i>	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
ospf params	Displays the OSPF parameters. Result: OSPF params OSPF state: <mode> OSPF Area0_ID: <area0_id > OSPF Area0_IP: <area0_ip > OSPF Area0_IP_Mask: <area0_ip_mask > OSPF Area0_Addr_Range: <area0_addr_range > OSPF Area0_Addr_Range_Advertise: <mode> OSPF Area0_Ext_Routing: <mode> OSPF Area1_ID: <area1_id > OSPF Area1_IP: <area1_ip > OSPF Area1_IP_Mask: <area1_ip_mask > OSPF Area1_addr_range: <area1_addr_range > OSPF Area1_Addr_Range_Advertise: <mode> OSPF Area1_Ext_Routing: <mode>	1, 3
ospf_routes	Causes the current OSPF routing table to be printed on the IOP debug port.	1, 3
ospf state [< mode >]	Indicates if the OSPF routing protocol is enabled or disabled. (When OSPF is disabled, the routing table is defined via static routes.) If parameter is present, enables or disables OSPF. OSPF can be enabled only when the LAN gateway is operating as an IP router. (When OSPF is enabled, all static routes are flushed.) Result: OSPF State: <mode>	1, 3
ota arp_age [< arp_age >]	Displays time that an ARP table entry will persist since the time it was first learned on the OTA port. If parameter is present, sets the time. Result: OTA ARP_age: < ARP_age >	1, 3
ota arp_retries [< arp_retries >]	Displays maximum number of attempts to be made at resolving an address via ARP on radio's OTA port. If parameter is present sets the number of attempts. Result: OTA ARP_retries: < ARP_retries >	1, 3
ota arp_timeout [< arp_timeout >]	Displays maximum time to wait for an ARP reply to a request previously transmitted out radio's OTA port. If parameter is present, sets the time. Result: OTA ARP_timeout: < ARP_timeout >	1, 3
ota demand_len	Displays maximum demand data length that will be sent to the NP from the OTA port. Value is zero until received from the NP. Result: OTA Demand_Length: <demand_len>	1, 3
ota ip [< port_ip >]	Displays the IP address for radio's OTA port. If parameter is present, sets the IP address. Result: OTA IP: < port_ip >	1, 3
ota ip_assem_len	Displays the assembly length for radio's OTA port. Result: OTA IP_assem_len: <IP_assembly_len>	1, 3

* 1 – IOP Maintenance Port
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Table C-1. Configuration Message Dictionary

Format	Description	Interface*
ota params	<p>Displays the parameters for the radio port</p> <p>Result: OTA params ARP_age: < ARP_age > ARP_retries: < ARP_retries > ARP_timeout: < ARP_timeout > Demand_Length: < demand_len > IP: < port_IP > IP_mask: < port_IP_mask > IP_MTU: < MTU > OSPF_AreaID: < port_OSPF_AreaID > OSPF_Cost: < port_OSPF_Cost > OSPF_HelloIntv: < port_OSPF_HelloIntv > OSPF_Priority: < port_OSPF_Priority > OSPF_DeadIntv: < port_OSPF_DeadIntv > OSPF_WaitIntv: < port_OSPF_WaitIntv > OSPF_XmitDel: < port_OSPF_XmitDel > OSPF_RetxIntv: < port_OSPF_RetxIntv > IP_assem_len: < IP_assembly_len > MAC_address: < mac_address ></p>	1, 3
ota status [clear] [hex]	<p>Displays the status and statistics of the OTA port. If the clear parameter is present, statistics are zeroed. If the hex parameter is present, the status and statistics are output in ASCII hex.</p> <p>Result: Channel enabled: <true_false> Got Startup params: <true_false> Bundling enabled: <true_false> Multicast Enabled: <true_false> Multicast By Broadcast: <true_false> Num bundled pkts: <stat> Bundled length: <stat> My radio id: <stat> Demand data len: <stat> Bundle latency: <stat></p> <p>Max bundled pkts: <stat> Rx good: <stat> Rx send failed: <stat> Non ota msg: <stat> Rx pkt not for me: <stat> Rx Multicast: <stat> Tx good: <stat> Tx send failed: <stat> Tx Multicast: <stat> Bundle tx good: <stat></p> <p>Bundle tx fail: <stat> Bundle tx timeout: <stat> Bundle tx max pkts: <stat> Bundle tx max size: <stat> Bundle not equal: <stat> Node unreachable: <stat> Non router msg: <stat> Out of return mem: <stat> Drop long pkt: <stat></p>	1, 3
quit config	<p>Discards all changes and quits out of configuration state.</p> <p>Result: Quit configuration state.</p>	1, 2, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
radio burst_rate [< min_burst_rate >, < max_burst_rate >, < offset_mode >]	Displays minimum and maximum burst transmit rates and transmit modulation type. If parameter is present, sets the minimum and maximum burst transmit rates and whether QPSK or offset QPSK modulation is used. The radio automatically transmits on the highest configured transmit rate that has good link quality. Result: radio burst_rate: < min_burst_rate >, < max_burst_rate >, < offset_mode >	1, 2, 3
radio channel [< num_channels >, < channel_band >, < physical_channels >]	Displays the number of channels, band and physical channel number for each of the demand channels. If parameters are present, sets the channel map. All radios in a network should be set to the same channels. Result: radio channel: < num_channels >, < channel_band >, < physical_channels >	1, 2, 3
radio diag <diag_code>, <stat_set> [<stat_subset>]	Displays diagnostic information from the NP. Returns data in ASCII hex format. See Tables C-3, C-4 and C-5 for details.	1, 2, 3
radio frequency_band [< freq_band >]	Displays the frequency band installed in the radio. If parameter is present, sets the frequency band. See Appendix B. Result: radio frequency_band: < freq_band >	1, 2, 3
radio hard_slots [< num_hard_slots >]	Displays number of transmit slots per frame that are permanently assigned to the radio. If parameter is present, sets the number of slots permanently assigned. Result: radio hard_slots: < num_hard_slots >	1, 2, 3
radio hop_mode [< mode >]	Indicates whether frequency hopping is enabled or disabled. If parameter is present, sets the mode of frequency hopping. All radios in a network should be set to the same hop mode. Result: radio hop_mode: < mode >	1, 2, 3
radio id_net_size [< platform_ID >, < num_nodes_in_ntwk >]	Displays the platform ID and maximum number of nodes that the network is configured for. If parameters are present, sets the platform ID and maximum nodes in network. All radios in a network should be set to the same network size. Result: radio id_net_size: < platform_ID >, < num_nodes_in_ntwk >	1, 2, 3
radio link_packet_rate [< link_packet_rate_in_frames >]	Displays the rate, in frames, at which link connectivity packets are transmitted. If parameter is present, sets the link connectivity packet transmission rate. Result: radio link_packet_rate: < link_packet_rate_in_frames >	1, 2, 3
radio lo_pri_packet_min [< lo_pri_packet_min >]	Displays the low priority packet transmit factor. If parameter is present, sets the low priority packet transmit factor. The low priority transmit factor allows transmission of a small amount of low priority traffic when high priority traffic is present. Result: radio lo_pri_packet_min: < lo_pri_packet_min >	1, 2, 3
radio lq_consec_bad [< lq_bad_in_a_row >]	Displays the number of missed link connectivity packets in a row at a given transmit rate to stop using that rate and use a lower rate. If parameter is present, sets the number of missed link connectivity packets in a row at a given transmit rate to stop using that rate and use a lower rate. Result: radio lq_consec_bad: < lq_bad_in_a_row >	1, 2, 3
radio lq_consec_bad_min_br [< lq_bad_in_a_row >]	Displays the number of missed link connectivity packets in a row at the lowest transmit rate to declare the link down. If parameter is present, sets the number of missed link connectivity packets in a row at the lowest transmit rate to declare the link down. Result: radio lq_consec_bad_min_br: < lq_bad_in_a_row >	1, 2, 3

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Table C-1. Configuration Message Dictionary

Format	Description	Interface *
radio lq_consec_good [<i>< lq_good_in_a_row ></i>]	Displays the number of good link connectivity packets received in a row at a given transmit rate to declare the link good at that rate. If parameter is present, sets the number of good link connectivity packets received in a row at a given transmit rate to declare the link good at that rate. Result: radio lq_consec_good: <i>< lq_good_in_a_row ></i>	1, 2, 3
radio lq_good_count [<i>< lq_good_count ></i>]	Displays the minimum value that the link quality filter counter must reach to declare the link good at a given transmit rate. If parameter is present, sets the minimum value that the link quality filter counter must reach to declare the link good at a given transmit rate. Result: radio lq_good_count: <i>< lq_good_count ></i>	1, 2, 3
radio lq_threshold [<i>< lq_threshold ></i>]	Displays the target percent of good received packets vs packets transmitted to maintain a good link; if the average percent of packets received is more than the target, the link should become or stay good; if less, the link should become or stay bad. (This is implemented by incrementing the filter by (100-threshold) when a link connectivity packet received and decrementing the filter by the threshold when a link connectivity packet is missed.) If parameter is present, sets the target percent of good received packets vs packets transmitted. Result: radio lq_threshold: <i>< lq_threshold ></i>	1, 2, 3
radio max_soft_slots [<i>< max_soft_slots ></i>]	Displays the maximum number of soft slots in the network. If parameter is present, sets the maximum number of soft slots in the network. All radios in a network should be set to the same soft slot maximum. Result: radio max_soft_slots: <i>< max_soft_slots ></i>	1, 2, 3
radio params	Displays the basic radio configuration parameters. Result: radio params radio burst_rate: <i>< min_burst_rate ></i> , <i>< max_burst_rate ></i> , <i>< offset_mode ></i> radio channel: <i>< num_channels ></i> , <i>< channel_band ></i> , <i>< physical_channels ></i> radio hard_slots: <i>< num_hard_slots ></i> radio soft_slots: <i>< num_soft_slots ></i> radio max_soft_slots: <i>< max_soft_slots ></i> radio hop_mode: <i>< hop_mode ></i> radio id_net_size: <i>< platform_ID ></i> , <i>< num_nodes_in_ntwk ></i> radio TOD: <i>< TOD ></i>	1, 2, 3

* 1 – IOP Maintenance Port
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Table C-1. Configuration Message Dictionary

Format	Description	Interface *
radio params_ext	<p>Displays the supplementary radio configuration parameters.</p> <p>Result:</p> <pre> radio tx_range: < range > radio frequency_band: < frequency_band > radio sap_rate: < slot_allocation_packet_rate_in_frames > radio slot_in_a_row_count: < give_slot_in_a_row_count > radio slot_to_mult: < give_slot_timeout_in_frames > radio rx_timeout: < rx_timeout > radio link_packet_rate: < link_packet_rate_in_frames > radio lo_pri_packet_min: < lo_pri_packet_min > radio lq_threshold: < lq_threshold > radio lq_good_count: < lq_good_count > radio lq_consec_good: < lq_good_in_a_row > radio lq_consec_bad: < lq_bad_in_a_row > radio lq_consec_bad_min_br: < lq_bad_in_a_row > radio serial_num : < serial_num > </pre>	1, 2, 3
radio rx_timeout [< rx_timeout >]	<p>Displays the time (in number of 2-frame units) that a receiving radio must wait before deciding that a packet with a given sequence number is lost and should be timed out. If parameter is present, sets the time value that a receiving radio must wait before timing out a packet.</p> <p>Result: radio rx_timeout: < rx_timeout ></p>	1, 2, 3
radio sap_rate [< sap_rate_in_frames >]	<p>Displays the rate, in frames, at which slot allocation packets are transmitted. If parameter is present, sets the rate at which slot allocation packets are transmitted.</p> <p>Result: radio sap_rate: < sap_rate_in_frames ></p>	1, 2, 3
radio serial_num [< serial_num >]	<p>Displays the serial number of the radio. If parameter is present, and the configuration has not been locked, sets the serial number.</p> <p>Result: serial number: < serial_num ></p>	1, 2, 3
radio slot_in_a_row_count [< give_slot_in_a_row_count >]	<p>Displays the number of slot allocation packets that must be received from a "needy" radio before this radio will give the needy radio a soft slot. If parameter is present, sets the number of slot allocation packets that must be received from a "needy" radio before this radio will give the needy radio a soft slot.</p>	1, 2, 3

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Table C-1. Configuration Message Dictionary

Format	Description	Interface*
radio slot_to_mult [< give_slot_timeout_multiplier >]	Displays the number of slot allocation packet transmit intervals that a radio must wait after receiving a soft slot before it can declare itself to be "needy" again (i.e., the delay is < give_slot_timeout_multiplier > * < sap_rate_in_frames > frames). If parameter is present, sets the number of slot allocation packet transmit intervals that a radio must wait after receiving a soft slot before it can declare itself to be "needy" again. Result: radio slot_to_mult: < give_slot_timeout_multiplier >	1, 2, 3
radio soft_slots [< num_soft_slots >]	Note: This parameter also affects the delay in a radio that has received a soft slot before that radio can give a slot to another radio. That delay is slot-in-a-row-count times the delay to become "needy" again (i.e., the delay is < give_slot_in_a_row_count > * < give_slot_timeout_multiplier > * < sap_rate_in_frames > frames). Result: radio slot_in_a_row_count: < give_slot_in_a_row_count >	1, 2, 3
radio tod [< tod >]	Displays the number of non-permanent (soft) transmit slots per frame initially assigned to the radio. If parameter is present, sets the number of soft slots initially assigned to the radio. Result: radio soft_slots: < num_soft_slots >	1, 2, 3
radio tx_range [< tx_range >]	Displays radio's time of day. If parameter is present sets the time. All radios in a network should be set to the same time. Result: TOD: < tod >	1, 2, 3
radio version	Displays the radio transmit range. If parameter is present, sets the radio transmit range. All radios in a network should be set to the same transmit range. Result: radio tx_range: < tx_range >	1, 2, 3
restore config	Displays the version and checksum of the Network Processor software. Result: Restored configuration.	1, 2, 3
route	Displays the static routes to hosts and networks Result: route: < route_ip, gateway_ip, route_ip_mask, gateway_hop_metric > ...	1, 3
route add < route_ip >, < gateway_ip >, < route_ip_mask >, < gateway_hop_metric >	Adds a static route to a host or network. A static route can be added only when the OSPF state is disabled. The radio can hold up to 100 static routes. Result: Route Added: IP: < route_ip > gateway_ip: < gateway_ip > IP_mask: < route_ip_mask > gateway_hop_metric: < gateway_hop_metric >	1, 3

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Table C-1. Configuration Message Dictionary

Format	Description	Interface*
route drop < route_ip, gateway_ip, route_ip_mask, < gateway_hop_metric >	Drops a static route to a host or network. Result: Route Dropped: IP: < route_IP > gateway_IP: < gateway_IP > IP_mask: < route_IP_mask > gateway_hop_metric: < gateway_hop_metric >	1, 3
route flush	Drops all static routes to a host or network. Result: Static Route table flushed.	1, 3
router status [clear] [hex]	Displays status and statistics for the router. If the clear parameter is present, the statistics are zeroed. If the hex parameter is present, the status and statistics will be output in ASCII hex.	
	Result: Running: <true_false> Mcast Enabled: <true_false> Mcast Via Broadcast: <true_false> Bad lpcmd msg: <stat> Telnet connect: <stat> Telnet disconnect: <stat> Telnet read: <stat> Telnet write: <stat> Rx from devices: <stat> Bad port num: <stat> Bad tx buffers: <stat> Ether Tx offlow: <stat> Lapp Tx offlow: <stat> Radio Tx offlow: <stat> Rs232 Tx offlow: <stat> Ether Rx Hi offlow: <stat> Ether Rx Lo offlow: <stat> Radio Rx Hi offlow: <stat> Radio Rx Lo offlow: <stat> Rs232 Rx Hi offlow: <stat> Rs232 Rx Lo offlow: <stat> Lapp Rx Hi offlow: <stat> Lapp Rx Lo offlow: <stat>	1, 3
rs232 baud [< rs232_baudrate >] rs232 bits [< num_bits >]	Not used. Not used.	1, 3 1, 3

* 1 – IOP Maintenance Port
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3 – Telnet Interface

Table C-1. Configuration Message Dictionary

Format	Description	Interface*
rs232 ip [< port_ip >]	Not used.	1, 3
rs232 ip_assem_len	Not used.	1, 3
rs232 ip_mask [< port_ip_mask >]	Not used.	1, 3
rs232 ip_mtu	Not used.	1, 3
rs232 params	Not used.	1, 3
rs232 parity [< parity >]	Not used.	1, 3
rs232 stopbits [< stopbits >]	Not used.	1, 3
rte config	Unlocks the radio serial number to allow it to be changed. Result: Blank Response	2
set bridge [< mode >]	Displays whether the LAN gateway operates as an IP bridge. (When IP bridge mode is set to disabled, the LAN gateway operates as an IP router.) If parameter is present, sets whether the LAN gateway operates as an IP bridge. (When operation as an IP bridge is enabled, the OSPF state is set to disabled.) Result: set bridge: < mode >	1, 3
set bridge_to [< bridge_timeout >]	Displays the timeout value for traffic information stored by the IP bridge. If parameter is present, sets the timeout value for traffic information stored by the IP bridge. Result: set bridge_to: < bridge_timeout >	1, 3
set prompt [< prompt >]	Displays the prompt used on the interface. If parameter is present, sets the prompt. Result: Prompt : < prompt >	1, 3
set qos < qos_codepoints > [< priority > < qos_service >]	Displays the priority and service associated with the specified set of codepoints. If parameters are present, sets the priority and service associated with the specified set of codepoints. Result (one for each codepoint in the set): QOS_Service < qos_codepoint > : < priority > < qos_service >	1, 3
store config	Permanently stores configuration changes and exits out of configuration state. Configuration changes will not be lost upon power down. Do not shut off power to the radio until the store operation is complete. Result: Stored Configuration.	1, 2, 3
top dup_ack [< dup_ack_num >]	Displays number of Duplicate ACKs that may be received before Van Jacobson's Fast Recovery algorithm becomes active. If parameter is present, sets value. Result: TCP Dup_Ack : < dup_ack_num >	1, 3
top params	Displays TCP parameters. Result: Segment_Life : < ms_time > RTT : < ms_time > Retrans_Timeout : < ms_time > Segment_Size : < miss > RCV_Window_Size : < win_size > Dup_ACK : < dup_ack_num > Start_Threshold : < thres_num >	1, 3

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Table C-1. Configuration Message Dictionary

Format	Description	Interface*
top rcv_window_size [<i>< win_size ></i>]	Displays default TCP receive window size. If parameter is present, sets value. Result: TCP RCV_Window_Size : <i>< win_size ></i>	1, 3
top retrans_timeout [<i>< ms_time ></i>]	Displays minimum time in milliseconds that TCP will wait before retransmitting an unacknowledged packet. If parameter is present, sets value. Result: TCP Retrans_Timeout : <i>< ms_time ></i>	1, 3
top rtt [<i>< ms_time ></i>]	Displays default Round Trip Time in milliseconds that is used to calculate the Retransmission Timeout before the RTT is measured for that TCP connection. If parameter is present, sets value. Result: TCP RTT : <i>< ms_time ></i>	1, 3
top segment_life [<i>< ms_time ></i>]	Displays the time (in milliseconds) that TCP uses when gracefully closing a connection. TCP waits for 2 times this value before finally closing the connection. If parameter is present, sets value. Result: TCP Segment_Life : <i>< ms_time ></i>	1, 3
top segment_size [<i>< mss ></i>]	Displays the default maximum size for a TCP segment. If parameter is present, sets value. Result: TCP Segment_Size : <i>< mss ></i>	1, 3
top start_threshold [<i>< thres_num ></i>]	Displays the initial threshold (in bytes) for the Slow Start algorithm. If parameter is present, sets value. Result: TCP Start_Threshold : <i>< thres_num ></i>	1, 3
telnet password [<i>< telnet_password ></i>]	Sets the password that must be entered when logging into subsequent Telnet sessions. If parameter is not present, there is no password, and the response to the 'password' prompt is the <enter> key (a Telnet line terminator).	1, 3
version	Displays the version and checksum of the Input/Output Processor software.	1, 3
vim bearer_length	Not used.	1, 3
vim led_mode [<i>< mode ></i>]	Not used.	1, 3
vim module_state [<i>< module_state ></i>]	Displays the current status of the VIM. Result: vim module_state: <i>< module_state ></i>	1, 3
vim params	Displays VIM parameters: Result: vim params Bearer_Length: <i>< bearer_len ></i> LED_mode: <i>< mode ></i> Module_State: <i>< module_state ></i>	1, 3
vim phonebook	Not used.	1, 3
vim port <i>< vim_port_no ></i>	Not used.	1, 3
vim status [clear] [hex]	Not used.	1, 3

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Telnet Interface

Table C-2 provides additional information for message parameters used in Tables C-1 and C-6. The 'Values' column specifies the legal values; when specified in the form 'x.y', indicates the range of values x through y.

Table C-2. Configuration Message Parameters

Message Parameter	Description	Interface*	Values	Units
area0_id	ID of the primary OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
area0_ip	IP address of the primary OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
area0_ip_mask	IP address mask of the primary OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
area1_id	ID of the secondary OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
area1_ip	IP address of the OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
area1_ip_mask	IP address mask of the OSPF area	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
ARP_age	Time that a router ARP table entry will persist since the time it was first learned	1, 3	1..65535	seconds
ARP_entry_age	Time that an entry has existed in the router ARP table	1, 3	1..65535	seconds
ARP_retries	Maximum number of attempts router makes at resolving an address via ARP; each attempt will occur after the preceding request times out	1, 3	1..255	retries
ARP_timeout	Maximum time router waits for an ARP reply to a previously transmitted request	1, 3	1..65535	seconds
bearer_len	Not used.	N / A	N / A	bytes
bridge_timeout	Time that traffic information is retained by the IP bridge; used for smart forwarding of IP datagrams and for proxy ARP	1, 3	1..9999	seconds
channel_band	The band associated with the selected channels	1, 2, 3	A, B	N / A
command	Commands that can be issued by the user	1, 2, 3	radio, enter config, exit config, debug, ethernet ip, ospf, ota, route, quit config, restore config, store config, voice, status, set	N / A

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
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Table C-2. Configuration Message Parameters

Message Parameter	Description	Interface*	Values	Units
debug_IP	IP address of the debug port (only in debug output)	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
debug_param	Parameters used to enable/disable debug output.	1, 3	See Table C-6	N / A
demand_length	The length in bytes available to the IOP for data (demand) packets	1, 3	1..65535	N / A
diag_code	Diagnostic code for processor statistics; see Tables C-3, C-4 and C-5	1, 2, 3	PDM = Protocol Diagnostic Message EDM = Exec Diagnostic Message ODM = OPCON Diagnostic Message	N / A
dup_ack_num	The number of duplicate ACKs that may be received in TCP	1, 3	1..TBD	N / A
freq_band	Frequency band installed in the radio	1, 2, 3	1 = ANVRC-99A 2 = ANVRC-99B	N / A
gateway_hop_metric	Gateway metric used to determine routes	1, 3	1..255	N / A
gateway_IP	IP address of the gateway	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
give_slot_in_a_row_count	Number of slot allocation packets that must be received from a "needy" radio before this radio will give the needy radio a soft slot	1, 2, 3	1..100	slot allocation packets
give_slot_timeout_multiplier	Number of slot allocation packet (SAP) transmit intervals that a radio must wait after receiving a soft slot until it can declare itself needy again	1, 2, 3	0..100	SAP transmit intervals
host_address	SDLC address of the host on the RS-422 port	1, 3	0..FF	(hexadecimal)
IOP_mod_num	IOP module number	1, 3	0..16	N / A
IP_assembly_len	Length of IP reassembly packets	1, 3	1..65535	N / A
IP_reassem_timeout	Time that IP will wait for all the fragments of an IP datagram to be reassembled before dumping the partial result	1, 3	1..65535	seconds
LAPB_baudrate	Baud rate for the RS-422 port (not used)	1, 3	0-10000, where 0 indicates that the clock is generated externally	Kbps
link_packet_rate_in_frames	Rate at which link connectivity packets are transmitted	1, 2, 3	1..100	frames
lo_pri_packet_min	Low priority transmit factor. When zero, no low priority packets are transmitted when high priority packets are present. When non-zero, a low-priority packet is transmitted after transmitting <i>n</i> consecutive high-priority packets, where <i>n</i> is the parameter value.	1, 2, 3	0..100	packets
lq_bad_in_a_row	Number of missing link connectivity packets in a row to declare a link unusable at a given transmit rate	1, 2, 3	1..15	packets

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-2. Configuration Message Parameters

Message Parameter	Description	Interface*	Values	Units
lq_good_count	Minimum value that link quality filter counter must reach before a link is declared usable at a given transmit rate	1, 2, 3	300..600	N / A
lq_good_in_a_row	Number of good link connectivity packets in a row to declare a link usable at a given transmit rate	1, 2, 3	1..15	packets
lq_threshold	Target percent of good received packets vs packets transmitted for a link to be usable at a given transmit rate	1, 2, 3	1..99	percent
mac_address	MAC address of the radio Ethernet port or of an ARP entry	1, 3	xx:xx:xx:xx:xx:xx where xx is 00-FF hex	N / A
mailbox_num	The number of the IOP mailbox.	1, 3	0..54	N / A
max_burst_rate	Maximum burst transmit rate to be used for transmissions	1, 2, 3	.625, 1.25, 2.5, 5, 10	Mbps
max_soft_slots	Maximum number of soft slots in the entire network	1, 2, 3	1..31	slots
min_burst_rate	Minimum burst transmit rate to be used for transmissions	1, 2, 3	.625, 1.25, 2.5, 5, 10	Mbps
mode	Mode	1, 2, 3	enable, disable	N / A
module_state	The state of the VIM module	1, 3	not_initialized, present, not_present	N / A
mss	Maximum Segment Size for TCP packets.	1, 3	1..65535	bytes
mstat_name	Mail box statistic name.	1, 3	Mode, Times Closed, Msgs Queued, Msgs Received, Size, Times Disabled, Msgs Overflowed, Ticks Received, Flow Number, Times Enabled, Msgs Dropped, Ticks Dropped, Times Opened, Times Flowed, Msgs Pended	N / A
ms_time	Time in milliseconds	1, 3	1..65535	ms
MTU	Maximum transfer unit	1, 3	1..65535	N / A
num_bits	Word length for the RS-232 port	1, 2, 3	7, 8	bits
num_channels	Number of frequencies to use	1, 2, 3	1..10	channels
num_hard_slots	Number of transmit slots per frame permanently assigned to the radio	1, 2, 3	1..31	slots
num_nodes_in_ntwk	Maximum number of radios allowed in the current network	1, 2, 3	2..16	nodes
num_soft_slots	Number of slots temporarily assigned to the radio	1, 2, 3	1..31	slots
num_TTL_hops	Time-to-live value set in IP packets generated by radio	1, 3	1..255	hops

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Teinet Interface

Table C-2. Configuration Message Parameters

Message Parameter	Description	Interface*	Values	Units
offset_mode	Determines whether the radio uses offset or non-offset QPSK modulation	1, 2, 3	offset, no_offset	N / A
parity	Parity mode for the RS-232 port	1, 3	odd, even, none	parity
physical_channels	Contains a physical channel number for each of the num_channels channels.	1, 2, 3	channel, ..channel_num_channels	N / A
port	Router port	1, 3	Ethernet, OTA	N / A
platform_ID	Platform ID of AN/VRC-99A Radio	1, 2, 3	0..15	N / A
port_address	SDLC address of the RS-422 port (not used).	1, 3	0..FF	(hexadecimal)
port_IP	IP address of the port	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
port_IP_mask	IP address mask of the port	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
port_ospf_areaid	OSPF area ID of the port	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
port_ospf_cost	OSPF cost for the port	1, 3	1..65535	N / A
port_ospf_deadintv	OSPF router dead interval for the port	1, 3	1..65535	seconds
port_ospf_hellointv	OSPF hello interval for the port	1, 3	1..65535	seconds
port_ospf_priority	OSPF priority for the port	1, 3	0..255	N / A
port_ospf_retxintv	OSPF LSA retransmit interval for the port	1, 3	1..255	seconds
port_ospf_waitintv	Amount of time that the router will wait after hearing a hello packet on that port before becoming eligible to be designated router or backup designated router	1, 3	1..65535	seconds
port_ospf_xmitdel	Estimated OSPF LSA transmit time for the port	1, 3	1..255	seconds
prompt	Prompt used on the IOP Maintenance Port and Telnet Interface	1, 3	1..11 characters	N / A
qos_codepoint	Single QOS codepoint	1, 3	0000000..11111111	(binary)
qos_codepoints	Set of QOS codepoints: format is like qos_codepoint, but any of the 8 characters may be a wild card (**)	1, 3	Eight characters, all of which are '0', '1' or '**'	N / A
qos_priority	Priority associated with one or more QOS codepoints	1, 3	high, low	N / A
qos_service	QOS service associated with one or more QOS codepoints	1, 3	ack, tx_once, tx_once_low_delay	N / A
route_bucket_len	Maximum number of entries per IP Route cache hash table buckets.	1, 3	1..65535	
route_IP	IP address of the router	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
route_IP_mask	IP address mask of the router	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N / A
route_num_buckets	Number of IP Route cache hash table buckets	1, 3	1..65535	N / A

* 1 – IOP Maintenance Port
2 – NP Maintenance Port
3 – Telnet Interface

Table C-2. Configuration Message Parameters

Message Parameter	Description	Interface*	Values	Units
route_type	Type of IP route	1, 3	Static, Dynamic	N/A
rs232_baudrate	Baud rate for the RS-232 port	1, 3	2400, 4800, 9600, 19200, 38400	bits per second
rx_timeout	Length of time that a receiving radio must wait before declaring that a packet is lost and timing out that sequence number	1, 2, 3	0..20	2-frame units (i.e., frames/2)
sap_rate_in_frames	Rate at which slot allocation packets are transmitted	1, 2, 3	1..1000	frames
serial_num	The serial number of the radio.	1, 2, 3	1..9999	N/A
socket	Number of socket for diagnostic output	1, 3	1..65535	N/A
stat	Current value of statistic (numeric); usually indicates the number of times a specific event occurred	1, 3	1..65535	N/A
stat_set	Identifies the group of diagnostic information requested	1, 2, 3	0..FF; see Tables C-3, C-4 and C-5	(hexadecimal)
stat_subset	Identifies the statistics subgroup requested	1, 2, 3	0..7; see Table C-3	N/A
stopbits	Stop bits for the RS-232 port	1, 3	1, 2	bits
target_ip	IP address of the ARP table entry	1, 3	xxx.xxx.xxx.xxx xxx is 0..255	N/A
telnet_password	Password for logging into a subsequent Telnet session.	1, 3	1..8 characters	N/A
test_result	Result of test	1, 3	Pass, Fail	N/A
thres_num	The initial threshold for the TCP start algorithm.	1, 3	1..TBD	bytes
tod	Radio's time of day	1, 2, 3	HH:MM:SS HH is 0..23, MM is 0..59, SS is 0..59	HH - hours MM - min. SS - sec
true_false	True/False indication	1, 3	0=False, 1=True	N/A
tx_range	Operating range of the radios	1, 2, 3	Normal (maximum range of 40 miles, or 35 nautical miles) Extended (maximum range of 115 miles, or 100 nautical miles)	N/A
vim_port_no	The number of the VIM port (not used).	1, 3	0..3	N/A
win_size	The size of the TCP receive window.	1, 3	1..65535	bytes

* 1 - IOP Maintenance Port
2 - NP Maintenance Port
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Tables C-3, C-4 and C-5

Tables C-3, C-4 and C-5 provide detailed information related to the 'radio diag' command (see Table C-1) and the format of responses to this command.

The responses are output in text lines of up to 50 characters. The output to an ODM diagnostic starts with 'S' and a space, followed by up to 16 bytes (four 32-bit words) of data separated by spaces. Subsequent lines start with 's' and a space.

The output to an EDM or PDM diagnostic always has a first line that contains the statistics set and subset of the response. If there is a command response data, it is output in subsequent lines. The line containing the statistics set and subset starts with 'R' and a space, followed by the statistics set and subset (one byte each).

Note: The statistics set output for an EDM message is always '10'. The statistics subset output contains valid information only for a 'radio diag pdm,f,x' command; in this case, the output is 'x' (the statistics subset from the command); in all other cases, the output is not meaningful.

The first line of command response data for an EDM or PDM diagnostic starts with 'D' and a space, followed by up to 16 bytes (four 32-bit words) of data separated by spaces. Subsequent lines start with 'd' and a space.

The four bytes of a 32-bit word are output with the first byte containing the most significant part of the word. When a response has multiple fields within a 32-bit word, the response description in the table lists the fields in order, with the field in the least-significant bits listed first. When the field contains an array, the lowest-numbered array entry is in the least significant bits. When an array is split across multiple words, the lowest-numbered array entries are in the first word.

For example, the command 'radio diag pdm,2' causes the output of an initial line (an 'R' line) that contains the statistics set and subset of the response, plus eight data output lines ('D' and 'd' lines). The first data output line (in this example) is:

```
D 3F FF FF 3F-A0 03 FF FF-3F FF FF FF-0F 03 FF FF
```

The first two words (3FFFFFF3F and A003FFFF) provide information about the RF link status of Radio 0. The first word (3FFFFFF3F) provides information about RF links between Radio 0 and Radios 0 to 9. In binary, it is:

```
0011 1111 1111 1111 1111 1111 0011 1111
```

Divided into the fields defined for this message, it is:

```
00 111 111 111 111 111 111 111 100 111 111
   7   7   7   7   7   7   7   7   4   7   7
```

which says: Radio 0 has a good RF link with Radio 2 at data rate 2.5 Mbps, and no other good links.

The second word (A003FFFF) provides information about Rx links from radios 10 to 15, and the Age and Sequence Number for Radio 0. In binary, it is:

```
1010 0000 0000 0011 1111 1111 1111 1111
```

Divided into fields, it is:

```
1010 0000 0000 00 111 111 111 111 111 111
  A   0           7   7   7   7   7   7
```

which says: Radio 0 has no good RF links to Radios 10 through 15, the Age is 0, and the Sequence Number is A.

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
<i>Notes:</i> 1. The statistics set is specified using hexadecimal values. 2. The statistics set number used with a PDM radio diag command is the request number associated with the desired response. Statistics sets 0, 2, 4, 6, 8, A, C, F, 14, 16 and 18 are requests for a message response from the radio, and the radio generates the corresponding response (sets 1, 3, 5, 7, 9, B, D, 10, 15, 17 and 19). The statistics set numbers generated by the radio are not valid for use in a command.	
0 - Link Quality Request	See note 2.
1 - Link Quality Response	1 - Link quality filter counts for Rx at this radio (from all other radios) (48 words). 16 sets of link quality data (3 words each). Each set contains 5 Rx Link Quality counts (16 bits each) for Rx at this radio from one other radio; it contains: Word 1. Rx Link Quality counts for .625 and 1.25 Mbps Word 2. Rx Link Quality counts for 2.5 and 5 Mbps Word 3. Rx Link Quality count for 10 Mbps, plus 16 spare bits
2 - Neighbor Link Request	See note 2.

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
3 - Neighbor Link Response	<p>3 - Link connectivity info for Rx at each radio (from all other radios) (32 words). 16 sets of link info (2 words each). Each set contains the link info for Rx at one radio from each other radio; it contains 16 Rx Link entries, an Age and a Sequence Number.</p> <p>Word 1. 10 Rx Link entries (Rx from radios 0 to 9) and 2 spare bits</p> <p>Word 2. 6 Rx Link entries (Rx from radios 10 to 15), 6 spare bits, a 4-bit Age, and a Sequence Number</p> <p>Each Rx Link entry (3 bits) has values:</p> <ul style="list-style-type: none"> 2 = good Rx link; highest data rate is .625 Mbps 3 = good Rx link; highest data rate is 1.25 Mbps 4 = good Rx link; highest data rate is 2.5 Mbps 5 = good Rx link; highest data rate is 5 Mbps 6 = good Rx link; highest data rate is 10 Mbps 7 = bad Rx link <p>The Sequence Number (4-bits) has values:</p> <ul style="list-style-type: none"> 0 = not in the net 1 = in registration state 2 to 15 = in net (value cycles on each change)
4 - Hop Count Request	See note 2.
5 - Hop Count Response	<p>5 - Minimum number of hops from each radio to each other radio (64 words). 16 sets of hop count data (4 words each). Each set contains the number of hops from one radio to each other radio (using bi-directional links); it contains 16 Hop Count entries. Each Hop Count entry (4 bits) has values:</p> <ul style="list-style-type: none"> 0 = no path to destination radio, or source = destination 1 to 15 = number of hops to destination radio
6 - System State Request	See note 2.
7 - System State Response	<p>7 - NP system state (one byte). Value:</p> <ul style="list-style-type: none"> 0 = initialization 1 = configuration 2 = standby 3 = net entry 4 = registration 5 = operational
8 - Configuration Request	See note 2.

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
9 - Configuration Response	9 - Configuration info (36 words), 1 word per configuration item: Serial Number Locked (1=locked; 0=unlocked) Minimum Transmit Rate (2=.625; 3=1.25; 4=2.5; 5=5; 6=10 Mbps) Maximum Transmit Rate (2=.625; 3=1.25; 4=2.5; 5=5; 6=10 Mbps) Transmit Modulation (1=QPSK; 0=offset QPSK) FEC Rate (2=¾ rate; 1=½ rate; 0=no FEC) Hop Mode (0=freq hopping enabled; 1=freq hopping disabled) Number of Nodes in Network (2 to 16) Number of Hard Tx Slots (1 to 31) Tx Range (1=extended range; 0=normal range) Platform ID (0 to 15) Serial Number of the Radio (1 to 99) Time of Day (hour (8 bits), minutes (8 bits), second (8 bits)) Number of Channels in Map (1 to 10) Channel Map (10 words, one channel number per word) Number of Soft Tx Slots in Radio (1 to 31) Maximum Number of Soft Tx Slots in Network (1 to 31) Maximum Number of Packets Bundled by NP into a Tx (1 to 15) Slot Allocation Packet Rate In Frames (1 to 1000 frames) Give Slot In A Row Count (1 to 100) Give Slot Timeout Multiplier (0 to 100) Rx Timeout (0 to 20) Link Packet Rate In Frames (1 to 100) Qual Filter Up Count (1 to 600) Qual Filter Down Count (1 to 600) Qual Filter Good Count (300 to 600) Qual Filter Good In A Row (1 to 15) Qual Filter Bad In A Row (1 to 15)
A - Node State Request	See note 2.
B - Node State Response	B - Node state info for each radio (16 words). 16 sets of node state data (1 word each); it contains a 4-bit Sequence Number, a 4-bit Age, a 16-bit Serial Number, a 2-bit FEC rate, and 6 spare bits. The Sequence Number (4-bits) has values: 0 = not in the net 1 = in registration state 2 to 15 = in net (value cycles on each change)
C - Rcvd Pkt Characteristics Request	See note 2.
D - Rcvd Pkt Characteristics Response	D - Minimum and maximum AGC level from all received packets (from all radios) since startup (2 words). Word 1. Minimum AGC level Word 2. Maximum AGC level
E - Zero Statistics	E - The command must specify a statistics subset to be zeroed: 0 - Zero the IOP and OPCON message counts 1 - Zero the flow control counts 2 - Zero the over-the-air counts 3 - Zero the over-the-air Tx bundle counts 4 - Zero the over-the-air Rx bundle counts 5 - Zero the over-the-air control packet counts 6 - Zero the over-the-air data packet counts 7 - Zero the over-the-air bearer data packet counts (not used) 8 - Zero all statistics subsets

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
F - Statistics Request	F - See note 2. The command must specify the statistics subset to be sent in the response message: 0 - IOP and OPCON message counts 1 - Flow control counts 2 - Over-the-air counts 3 - Over-the-air Tx bundle counts 4 - Over-the-air Rx bundle counts 5 - Over-the-air control packet counts 6 - Over-the-air data packet counts 7 - Over-the-air bearer data packet counts (not used)
10 - Statistics Response	10 - The response contains a single requested statistics subset. Each subset contains a number of 32-bit word values. The words are numbered (followed by =>): Subset 0. (21 words) IOP and OPCON message counts: 1 => Demand Packets To IOP 2 => Demand Packets From IOP 3 => Bearer Packets From IOP 4 => Bearer Packets To IOP 5 => Invalid Bearer Circuit Number 6 => Control Message To IOP 7 => Control Message From IOP 8 => Control Message To OPCON 9 => Control Message From OPCON 10 => OPCON To IOP Message 11 => IOP To OPCON Message 12 => Invalid Length From IOP 13 => Invalid Length From OPCON 14 => Invalid State From IOP 15 => Invalid State From OPCON 16 => Invalid Record From IOP 17 => Invalid Record From OPCON 18 => Invalid Opcode From IOP 19 => Invalid Opcode From OPCON 20 => Received Message Error From IOP 21 => Host Input Queue Overflow for Demand Data Packet
10 (continued)	Subset 1. (15 words) Flow control counts: 1 => Low Priority Host Messages Put on Tx Queue 2 => Medium Priority Host Messages Put on Tx Queue 3 => High Priority Host Messages Put on Tx Queue 4 => Low Priority Relay Messages Put on Tx Queue 5 => Medium Priority Relay Messages Put on Tx Queue 6 => High Priority Relay Messages Put on Tx Queue 7 => Low Priority Messages No Room on Tx Queue 8 => Medium Priority Messages No Room on Tx Queue 9 => High Priority Messages No Room on Tx Queue 10 => Old Low Priority Messages Purged from Tx Queue 11 => Old Medium Priority Messages Purged from Tx Queue 12 => Old High Priority Messages Purged from Tx Queue 13 => NC Queue Full 14 => Current Free Tx Queue Buffers 15 => Current Number of Soft Slots

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
10 (continued)	<p>Subset 2. (23 words) Over-the-air counts:</p> <ul style="list-style-type: none"> 1 => Good Rx Transmission Herald 2 => Rx Bundled Packet Dropped - Invalid Transmission Herald 3 => Good Rx Demand Packet Header 4 => Rx Packet Dropped - Invalid Demand Packet Header 5 => Rx Packet Dropped - Not Addressed To This Node 6 => Rx Packet Dropped - Receiver Overloaded 7 => Rx Bundled Packet Dropped - Inconsistent DMA Length 8 => Rx Bundled Packet Dropped - Checksum Failed 9 => Rx Packet Dropped - Invalid State 10 => Slipped Schedule 11 => No Packet Ready (not used) 12 => Reroute Packet Discarded (not used) 13 => Periodic Node State Packet Not Available for Tx 14 => No Room In Acquisition Packet (not used) 15 => Reroute Packet on Tx Queue 16 => Tx Packet Dropped - Sliding Window Closed 17 => Tx Packet Changed to Tx Once - Sliding Window Closed 18 => Tx Packet Does Not Fit in Bundle 19 => Tx Slot Not Used - No Packets 20 => Host Tx Once Normal Delay Packet Put on Tx Queue 21 => Host Tx Once Low Delay Packet Put on Tx Queue 22 => Relay Tx Once Normal Delay Packet Put on Tx Queue 23 => Relay Tx Once Low Delay Packet Put on Tx Queue
10 (continued)	<p>Subset 3. (38 words) Over-the-air Tx bundle counts (16 bits each):</p> <ul style="list-style-type: none"> 1 => Tx bundles sent containing 1 packet, at .625 and 1.25 Mbps 2 => Tx bundles sent containing 1 packet, at 2.5 and 5 Mbps 3 => Tx bundles sent containing 1 packet, at 10 Mbps, and Tx bundles sent containing 2 packets, at .625 Mbps 4 => Tx bundles sent containing 2 packets, at 1.25 and 2.5 Mbps 5 => Tx bundles sent containing 2 packets, at 5 and 10 Mbps 6 to 10 => Tx bundles sent containing 3 and 4 packets (as for words 1 to 5) 11 to 15 => Tx bundles sent containing 5 and 6 packets (as for words 1 to 5) 16 to 20 => Tx bundles sent containing 7 and 8 packets (as for words 1 to 5) 21 to 25 => Tx bundles sent containing 9 and 10 packets (as for words 1 to 5) 26 to 30 => Tx bundles sent containing 11 and 12 packets (as for words 1 to 5) 30 to 35 => Tx bundles sent containing 13 and 14 packets (as for words 1 to 5) 36 to 38 => Tx bundles sent containing 15 packets (as for words 1 to 3) and 16 spare bits
10 (continued)	<p>Subset 4. (38 words) Over-the-air Rx bundle counts (16 bits each):</p> <ul style="list-style-type: none"> 1 => Rx bundles received containing 1 packet, at .625 and 1.25 Mbps 2 => Rx bundles received containing 1 packet, at 2.5 and 5 Mbps 3 => Rx bundles received containing 1 packet, at 10 Mbps, and Rx bundles received containing 2 packets, at .625 Mbps 4 => Rx bundles received containing 2 packets, at 1.25 and 2.5 Mbps 5 => Rx bundles received containing 2 packets, at 5 and 10 Mbps 6 to 10 => Rx bundles received containing 3 and 4 packets (as for words 1 to 5) 11 to 15 => Rx bundles received containing 5 and 6 packets (as for words 1 to 5) 16 to 20 => Rx bundles received containing 7 and 8 packets (as for words 1 to 5) 21 to 25 => Rx bundles received containing 9 and 10 packets (as for words 1 to 5) 26 to 30 => Rx bundles received containing 11 and 12 packets (as for words 1 to 5) 30 to 35 => Rx bundles received containing 13 and 14 packets (as for words 1 to 5) 36 to 38 => Rx bundles received containing 15 packets (as for words 1 to 3) and 16 spare bits

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
10 (continued)	Subset 5. (57 words) Over-the-air control packet counts: 1 => Net Entry Node State packets 2 => Net Entry packets received after processing Node State 3 => Net Entry packets received other than Node State 4 => Tx Net Entry 5 => Tx Registration 6 to 10 => Rx Link Connectivity Packets (at each transmit rate) 11 => Generated Link Connectivity Packets 12 to 16 => Tx Link Connectivity Packets (at each transmit rate) 17 => Quality Rx More Than Tx 18 => Decrement Received Count Error (not used) 19 to 23 => Rx Node State Packets (at each transmit rate) 24 => Tx Node State Packets 25 => Node State Out of Sync 26 to 30 => Rx Ack Packets (at each transmit rate) 31 => Tx Ack Packets 32 => Ack Omni Sequence Number Out Of Range 33 => Ack packets generated due to timeout 34 to 38 => Rx Bearer Usage Packets (at each transmit rate) 39 => Tx Bearer Usage Packets 40 => Generate Bearer Usage Packets 41 => Control Packet Rx from Radio Not in Net 42 => Rx Packet from Radio in Net Entry 43 => Tx Time Management Packets 44 to 48 => Rx Time Management Packets (at each transmit rate) 49 => Bad Neighbor Had Good Quality 50 => Tx Slot Allocation Packets 51 => Rx Slot Allocation Packets 52 => Accepted Soft Slot To Give 53 => Timed Out Soft Slots To Give 54 => Invalid Transition Soft Slots To Give 55 => Node Dropped Soft Slots To Give 56 => Accepted Soft Slots To Take 57 => Ignored Soft Slots To Take

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
10 (continued)	Subset 6. (46 words) Over-the-air data packet counts: 1 to 4 => Rx Demand Data Packets (at each priority) 5 to 8 => Tx Demand Data Packets (at each priority) 9 to 12 => Retransmit Demand Data Packets (at each priority) 13 => Relay Queued For Tx 14 => Re Tx Packets 15 => Rx Out Of Range 16 => Rx Out Of Sequence 17 => Duplicate Packet 18 => Packet Timeout Started 19 => Packet Timeout Stopped 20 => Invalid Destination 21 => Can't Reach Destination 22 => No Route To Destination 23 => Control Packet Not Routed 24 => Relay Packet Not Routed 25 => Reroute Packet Not Routed 26 => Relay Route Array Error 27 => Drop Packet For Hop Count 28 => Relay Packet Fragmented 29 => Queue Packet Fragmented 30 => Fragment Created 31 => Fragment Received at Destination 32 => Defragmented Packet Sent To Host 33 => Fragmented Packet Timeout 34 => Packet Has Too Many Fragments 35 => Too Many Fragmented Packets 36 => Duplicate ETE Packet 37 => ETE Sliding Window Error 38 => Duplicate Fragment Received 39 => Tx_Q Is Full 40 => Temp Queue Is Full 41 => Retransmit Queue Error 42 => Bad Transmitted Flags 43 => Number of Connectivity Losses 44 => Packet Received From Bad Neighbor 45 => Packet Ignored: Not Start Pointer
10 (continued)	Subset 7. Over-the-air bearer data packet counts (not used)
11 - Debug IO Response	11 - Unsolicited ASCII string output (response only; no command)
12 - Enable Unsolicited Output	This statistics set is a command and does not return a value
13 - Disable Unsolicited Output	This statistics set is a command and does not return a value
14 - Demand Slot Table Request	See note 2.
15 - Demand Slot Table Response	15 - Slot Assignment Info (6 words). For each slot of the frame, indicates the assignment status. Word 1. Slot Assignment Usage for slots 1 to 16 (2 bits each). Word 2. Slot Assignment Usage for slots 17 to 32 (2 bits each). Word 3. Platform ID of the radio assigned to slots 1 to 8 (4 bits each); value undefined for unassigned slots. Words 4 to 6. Same as word 3 for slots 9 to 16, 17 to 24 and 25 to 32. Slot Assignment Usage has values: 0 = unassigned 1 = assigned as soft slot being reassigned to another radio 2 = assigned as soft slot 3 = assigned as hard slot

Table C-3. Parameters for Radio Diag PDM Command

Statistics Set	Response (in 32-bit Words)
16 - Slot Allocation Request	See note 2.
17 - Slot Allocation Response	<p>17 - Soft Slot Allocation Info at each radio (16 words). 16 sets of soft slot allocation data (1 word each); it contains:</p> <ul style="list-style-type: none"> Age (4 bits) Need Sequence Number (4 bits) Need Metric based on Dropped Packets (8 bits) Give Sequence Number (4 bits) Can_Give (1 bit) (1=able to give a slot; 0=unable to give a slot) Give_Slot (1 bit) (1=give in process; 0=no give in process) Slot Number of Slot being Given (6 bits) Platform ID of Radio being Given Slot (4 bits) <p>The Sequence Numbers have values:</p> <ul style="list-style-type: none"> 0 = not in the net 1 = initial value 2 to 15 = in net (value cycles on each change)
18 - Give Counter Request	See note 2.
19 - Give Counter Response	<p>19 - Soft Slot Give Counter info at this radio (2 words).</p> <p>Word 1. Platform ID of "Needy" Radio awaiting N-in-a-Row for Give</p> <p>Word 2. N-in-a-Row Counter for Give</p>

Table C-4. Parameters for Radio Diag EDM Command

Statistics Set	Response (in 32-bit Words)
<p><i>Notes:</i></p> <ol style="list-style-type: none"> <i>The statistics set is specified using a hexadecimal value.</i> <i>The statistics set number used with an EDM radio diag command is the set associated with the desired response.</i> 	
<p><u>Checksums</u></p>	
0 - NC (C44b) Checksum	0 - (1 word) Checksum
1 - RC (C44a) Checksum	1 - (1 word) Checksum
<p><u>Statistics</u></p>	
2 - Queue Depths 3 - Max Queue Depths 4 - Queue Overflows	2, 3, 4 - (16 words each) Queue depth/overflow counts for: RF Event Queue (Pending T/R events) RF Receive Status Queue (OTA receives waiting to be processed) RF Transmit Complete Queue (OTA transmitted events waiting to be freed) Buffer Pool Backup Get Queue Buffer Pool Backup Put Queue Bundled Backup Get Queue Bundled Backup Put Queue IOP ISR Input Queue (Rcvd IOP pkts waiting for Exec processing) IOP Protocol Message Input Queue (Rcvd IOP pkts waiting for Protocol processing) IOP Output Queue (packets waiting to be sent to IOP) OPCON Input Queue (packets from OPCON waiting to be processed) OPCON Output Queue (packets to be sent to OPCON) OPCON Output Queue (packets waiting to be put on "locked" output queue) Exec RC-to-NC Queue Single-Packet Buffers in Use Bundled-Packet Buffers in Use
5 - RF Transmit Statistics	5 - (12 words) Counts for: DMA Not Available (DMA not ready at setup time) Completed Successfully Disabled (scheduled while not in T/R) RF Event Queue Overflow Error Invalid Control (bad control parameters specified) Time_Adjust (aborted transmit events due to time adjusts) Timing Violation (invalid schedule time) Preempted By Transmit (scheduled transmit not executed due to a second scheduled transmit) Preempted By Receive (scheduled transmit not executed due to a scheduled receive) Transmit In Progress (aborted because of ongoing transmit) Receive In Progress (aborted because of ongoing receive) Unknown Error

Table C-4. Parameters for Radio Diag EDM Command

Statistics Set	Response (in 32-bit Words)
6 - RF Receive Statistics	6 - (20 words) Counts for: Completed Successfully Disabled (scheduled when no in T/R) RF Event Queue Overflow Error Invalid Control (bad control parameter specified) Time Adjust (aborted receive events due to time adjust) Timing Violation (invalid schedule time) Preempted By Transmit (no reception and transmit event scheduled) Preempted By Receive (no reception and receive event scheduled) Transmit In Progress (aborted because of ongoing transmit) Receive In Progress (aborted because of ongoing receive) Unknown Error Missed Header CRC (completed but no header CRC interrupt) DMA Address Error (DMA start/stop pointer mismatch) DMA Sync Error (fails 55555555H pattern check) DMA Overrun (receive hit end of buffer and no complete) Incompatible Offset (Coded/Uncoded packet receive while expecting opposite) Configuration Data Fault (not a valid configuration code on preamble) Header Byte Count Fault (bad byte count in header) Header CRC Fault (header CRC check failed) Data CRC Fault (data CRC check failed)
7 - OTA Input/Output Statistics	7 - (3 words) Counts for: Total Scheduled Transmits Total Scheduled Receives Total CSMA Receives
8 - IOP Transmits Statistics	8 - (17 words) Counts for: Completed IOP Probe Requests Completed IO Probe Response Completed Link Acks 2 spare words Completed Control Packets (from Protocol) Completed Demand Packets Completed Bearer Packets Aborted IOP Probe Requests Aborted IO Probe Responses Aborted Link Acks 2 spare words Aborted Control Packets Aborted Demand Packets Aborted Bearer Packets No Message Buffer

Table C-4. Parameters for Radio Diag EDM Command

Statistics Set	Response (in 32-bit Words)
9 - IOP Receive Statistics	9 - (19 words) Counts for: HW CRC Errors (no 55555555H at end of buffer) SW CRC Errors (software check failed) IOP ISR Input Queue Overflows NP Probe Requests IO Probe Responses Link Acks 2 spare words Control Packets (for Protocol) Demand Packets Bearer Packets Link Acks with Bad Seq # 2 spare words Control Packets with Bad Seq # Demand Packets with Bad Seq # Bearer Packets with Bad Seq # Discarded, Non-Operational Invalid Format
A - IOP Input/Output Statistics	A - (11 words) Counts for: Inputs Outputs Outputs Discarded due to Link Down Link Resets (operational to non-operational transitions) Transmits Done (DMA channel emptied) Spurious Xmt Interrupts (NC interrupted from RC but mailbox empty) Spurious Rcv Interrupts (COMSEC interrupt) Xmt IO Errors (transmit processing exception) Rcv IO Errors (receive processing exception) Invalid Setup (invalid IOP control parameters) Link Ack Timeouts
B - OPCON Input/Output Statistics	B - (2 words) Counts for: Total Inputs Total Outputs
C - Built-in Test (BIT) Diagnostics	C - (3 words) Word 1. RC (C44A) BIT Status. Bit values: D0: RC Application Checksum Test (1=PASS) D1: RC Local RAM Address Ability Test (1=PASS) D2: RC Local RAM Data Ability Test (1=PASS) D3: MF/NRI Interrupt Test (1=PASS) D4: Power Supply Test (1=PASS) D5: IF Loop Test (1=PASS) D6: RF Noise Test (1=PASS) D7: PA Power Supply Test (1=PASS) D8: PA Forward Power Test (1=PASS) D9: MF/NRI Loop Test (1=PASS) D10: Not Used D11: Xilinx Loopback Test (1=PASS) D12: NC/OPCON Completed within Time Limit (1=PASS) D13: NC/OPCON Consolidated Test Status (1=PASS) D14..D30: Not Used D31: RC BIT Value Updated (1=UPDATED)

Table C-4. Parameters for Radio Diag EDM Command

Statistics Set	Response (in 32-bit Words)
	Word 2. NC (C44B) BIT Status. Bit values: D0: Global RAM Address Ability Test (1=PASS) D1: Global RAM Data Ability Test (1=PASS) D2: NC Application Checksum Test (1=PASS) D3: NC Local RAM Address Ability Test (1=PASS) D4: NC Local RAM Data Ability Test (1=PASS) D5: OPCON Started within Time Limit (1=PASS) D6: OPCON Completed within Time Limit (1=PASS) D7: OPCON Status Updated (1=UPDATED) D8..D12: Not Used D13: OPCON Internal Test (1=FAIL) D14: OPCON Memory Test (1=FAIL) D15: OPCON TOD Test (1=FAIL) D16: OPCON Consolidated Test Status (1=PASS) D17..D30: Not Used D31: NC BIT Value Updated (1=UPDATED)
	Word 3. Module BIT Status. Bit values: D0: COMSEC ID (1=PASS) D1: COMSEC TOD (1=PASS) D2: Black Power Supply (1=PASS) D3: Power Amplifier Power Supply (1=PASS) D4: Power Amplifier (1=PASS) D5: RF/IF (1=PASS) D6: MF/NRI (1=PASS) D7: Processor (1=UPDATED) D8..D31: Not Used
D - Buffer Etiquette Errors	D - (1 word) Count of Invalid Buffer Pool Operations
E - Time Adjusts	E - (1 word) Total Number of MF/NRI Clock Adjustments
F - Radio Monitor Faults	F - (1 word) Total Number of RF Monitor BIT Faults
<u>Status</u>	
10 - Current Net Time In Day	10 - (2 words) Time In Second (100 ns LSB) Seconds in Day
11 - IOP Link State	11 - (1 word) Value: 0: Uninitialized 1: Reset Pending 2: Probe Pending 3: Probing 4: Operational 5: Fault
12 - NC Idle Meter	12 - (4 words) Reserved for Idle Meters
13 - NC Timing Meter	13 - (32 words) Reserved for Timing Meters
14 - RC Idle Meter	14 - (4 words) Reserved for Idle Meters
15 - RC Timing Meter	15 - (32 words) Reserved for Timing Meters
<u>Clear Statistics</u>	The Clear Statistics sets are commands and do not return a value
80 - Clear All Statistics (sets 2 to F)	
82 - Clear Statistics Set 2	
83 - Clear Statistics Set 3	
... 8F - Clear Statistics Set F	

Table C-4. Parameters for Radio Diag EDM Command

Statistics Set	Response (in 32-bit Words)
Debug Control	The Debug Control sets are commands and do not return a value
75 - NC Controls LEDs	
76-79 - Reserved for Enabling Idle Meters	
7A - Force TR switch position	
7B - Enable IOP via OPCON	
7C - Enable Radio Monitor	
7D - Enable Forced Fixed PN seed	
7E - Enable Debug Board (LEDs)	
7F - Enable ASCII Monitor Port	
F5 - RC Controls LEDs	
F6-F9 - Reserved for Disabling Idle Meters	
FA - Disable Force TR position	
FB - Disable IOP via OPCON	
FC - Disable Radio Monitor	
FD - Disable Forced Fixed PN SEED	
FE - Disable Debug Board (LEDs)	
FF - Disable ASCII Monitor Port	

Table C-5. Parameters for Radio Diag ODM Command

Statistics Set	Response (in 32-bit Words)
<i>Notes:</i>	
1. The statistics set number used with an ODM radio diag command is the set associated with the desired response.	
0 - Idle Meter	0 - (1 word) Minimum Idle Time (as percent)
1 - Monitor IO Statistics	1 - (5 words) Counts for: Total Interrupts Tx Interrupts Rx Interrupts Tx Queue Overflow Rx Queue Overflow
80 - Clear Idle Meter	This statistics set is a command and does not return a value
81 - Clear Monitor IO Statistics	This statistics set is a command and does not return a value

Table C-6 provides details related to the ‘debug’ commands. These commands are used by developers to control the output of diagnostic information to the IOP debug port.

Diagnostic information is organized by module. The modules are: ip, lsl, ospf, port, socket, tcp, and telnet.

There are several debug elements associated with each module. Each debug element indicates a type of debug information that can be output; each debug element can be enabled or disabled.

There are four command formats:

```
debug < module > params
debug < module > < debug-element >
debug < module > < debug-element > enable
debug < module > < debug-element > disable
```

The first format displays the enable/disable status of all debug elements associated with the module.

The second format displays the enable/disable status of a single debug element.

The third and fourth formats enable or disable a debug element.

Most modules have a special debug-element ‘mode’ that provides overall control of all debug output for the module. When the ‘mode’ debug-element is disabled, all debug output for the module is disabled regardless of the enable/disable status of the module’s other debug elements. For example, the command ‘debug ip mode disable’ stops all debug output for the ip module.

Table C-6. Debug Commands	
Debug command	Meaning
debug ip arp [<i>mode</i> >]	Debug element: Output all ARP packets and related events.
debug ip cache [<i>mode</i> >]	Debug element: Output all IP route cache related events.
debug ip critical [<i>mode</i> >]	Debug element: Output critical events.
debug ip data [<i>mode</i> >]	Debug element: Output packet data for all sent and received datagram headers.
debug ip diags [<i>mode</i> >]	Debug element: Output special events.
debug ip fragment [<i>mode</i> >]	Debug element: Output all IP fragmentation related events.
debug ip icmp [<i>mode</i> >]	Debug element: Output all ICMP packets and related events.
debug ip headers [<i>mode</i> >]	Debug element: Output all transmitted and received IP protocol datagram headers.
debug ip memory [<i>mode</i> >]	Debug element: Output memory allocation/freeing events.

Table C-6. Debug Commands

Debug command	Meaning
debug ip mode [<i>< mode ></i>]	Debug element: Controls all debug output for the module.
debug ip port [<i><mode></i>]	Debug element: Output all IP port related events.
debug ip rarp [<i><mode></i>]	Debug element: Output all IP RARP related events.
debug ip reassembly [<i>< mode ></i>]	Debug element: Output IP datagram reassembly events.
debug ip receive [<i>< mode ></i>]	Debug element: Output all received IP headers.
debug ip rip [<i><mode></i>]	Debug element: Output all IP RIP related events.
debug ip route [<i>< mode ></i>]	Debug element: Output IP routing table and related events.
debug ip params	Displays the enable/disable status of all debug elements for the module.
debug ip transmit [<i>< mode ></i>]	Debug element: Output all headers for transmitted IP datagrams.
debug ip udp [<i>< mode ></i>]	Debug element: Output all UDP related datagrams and events.
debug lsl buffer [<i><mode></i>]	Debug element: Output LSL memory events.
debug lsl critical [<i><mode></i>]	Debug element: Output LSL critical events.
debug lsl mode [<i><mode></i>]	Debug element: Controls all debug output for the module.
debug lsl params	Displays the enable/disable status of all debug elements for the module.
debug lsl snap [<i><mode></i>]	Debug element: Output LSL snap events.
debug lsl snmp [<i><mode></i>]	Debug element: Output LSL SNMP events.
debug ospf critical [<i><mode></i>]	Debug element: Output OSPF critical events.
debug ospf debug_statements [<i><mode></i>]	Debug element: Output OSPF debug statements.
debug ospf interface [<i><mode></i>]	Debug element: Output OSPF interface events.
debug ospf memory [<i><mode></i>]	Debug element: Output OSPF memory events.
debug ospf mode [<i><mode></i>]	Debug element: Controls all debug output for the module.
debug ospf neighbor [<i><mode></i>]	Debug element: Output OSPF neighbor events.
debug ospf packets [<i><mode></i>]	Debug element: Output OSPF packet events.
debug ospf params	Displays the enable/disable status of all debug elements for the module.
debug ospf route_table [<i><mode></i>]	Debug element: Output OSPF route table events.
debug ospf snmp [<i><mode></i>]	Debug element: Output OSPF SNMP events.
debug port params	Displays the enable/disable status of all debug elements for the module.
debug socket block [<i><mode></i>]	Debug element: Output socket block events.
debug socket critical [<i><mode></i>]	Debug element: Output socket critical events.
debug socket data [<i><mode></i>]	Debug element: Output socket data events.
debug socket event [<i><mode></i>]	Debug element: Output socket miscellaneous events.
debug socket general [<i><mode></i>]	Debug element: Output socket general events.
debug socket init [<i><mode></i>]	Debug element: Output socket initialization events.
debug socket memory [<i><mode></i>]	Debug element: Output socket memory events.
debug socket mode [<i><mode></i>]	Debug element: Controls all debug output for the module.
debug socket receive [<i><mode></i>]	Debug element: Output socket receive events.
debug socket params	Displays the enable/disable status of all debug elements for the module.
debug socket transmit [<i><mode></i>]	Debug element: Output socket transmit events.
debug tcp ack [<i><mode></i>]	Debug element: Output TCP ACK events.
debug tcp api [<i><mode></i>]	Debug element: Output TCP application interface events.
debug tcp control [<i><mode></i>]	Debug element: Output TCP control events.
debug tcp critical [<i><mode></i>]	Debug element: Output TCP critical events.
debug tcp data [<i><mode></i>]	Debug element: Output TCP data events.
debug tcp diags [<i><mode></i>]	Debug element: Output TCP special events.
debug tcp general [<i><mode></i>]	Debug element: Output TCP general events.
debug tcp init [<i><mode></i>]	Debug element: Output TCP initialization events.
debug tcp memory [<i><mode></i>]	Debug element: Output TCP memory events.
debug tcp mode [<i><mode></i>]	Debug element: Controls all debug output for the module.
debug tcp mss [<i><mode></i>]	Debug element: Output TCP MSS events.
debug tcp options [<i><mode></i>]	Debug element: Output TCP options events.
debug tcp prec [<i><mode></i>]	Debug element: Output TCP precedent events.

Table C-6. Debug Commands

Debug command	Meaning
debug tcp rtt [<i><mode></i>]	Debug element: Output TCP round trip time events.
debug tcp receive [<i><mode></i>]	Debug element: Output TCP receive events.
debug tcp params	Displays the enable/disable status of all debug elements for the module.
debug tcp snmp [<i><mode></i>]	Debug element: Output TCP SNMP events.
debug tcp state [<i><mode></i>]	Debug element: Output TCP state events.
debug tcp string [<i><mode></i>]	Debug element: Output TCP string events.
debug tcp tcb [<i><mode></i>]	Debug element: Output TCP task control block events.
debug tcp timer [<i><mode></i>]	Debug element: Output TCP timer events.
debug tcp transmit [<i><mode></i>]	Debug element: Output TCP transmit events.
debug tcp window [<i><mode></i>]	Debug element: Output TCP window events.
debug telnet critical [<i><mode></i>]	Debug element: Output TELNET critical events.
debug telnet data [<i><mode></i>]	Debug element: Output TELNET data events.
debug telnet init [<i><mode></i>]	Debug element: Output TELNET initialization events.
debug telnet mode [<i><mode></i>]	Debug element: Controls all debug output for the module.
debug telnet params	Displays the enable/disable status of all debug elements for the module.