MULTIMEDIA INTEGRATED DIGITAL ACCESS SYSTEM

MIDAS Series 4
System and Design Manual

Part Number MN/MID-DESIGN.IOM Revision 2

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System and Design Manual

Comtech EF Data is an ISO 9001 Registered Company.

Part Number MN/MID_DESIGN.IOM
Revision 2
May 15, 2002

Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, 480.333.2200, FAX: 480.333.2161.

Network Customer Support

The Network Customer Support Plan identifies the steps to be followed in resolving the Customer's concern.

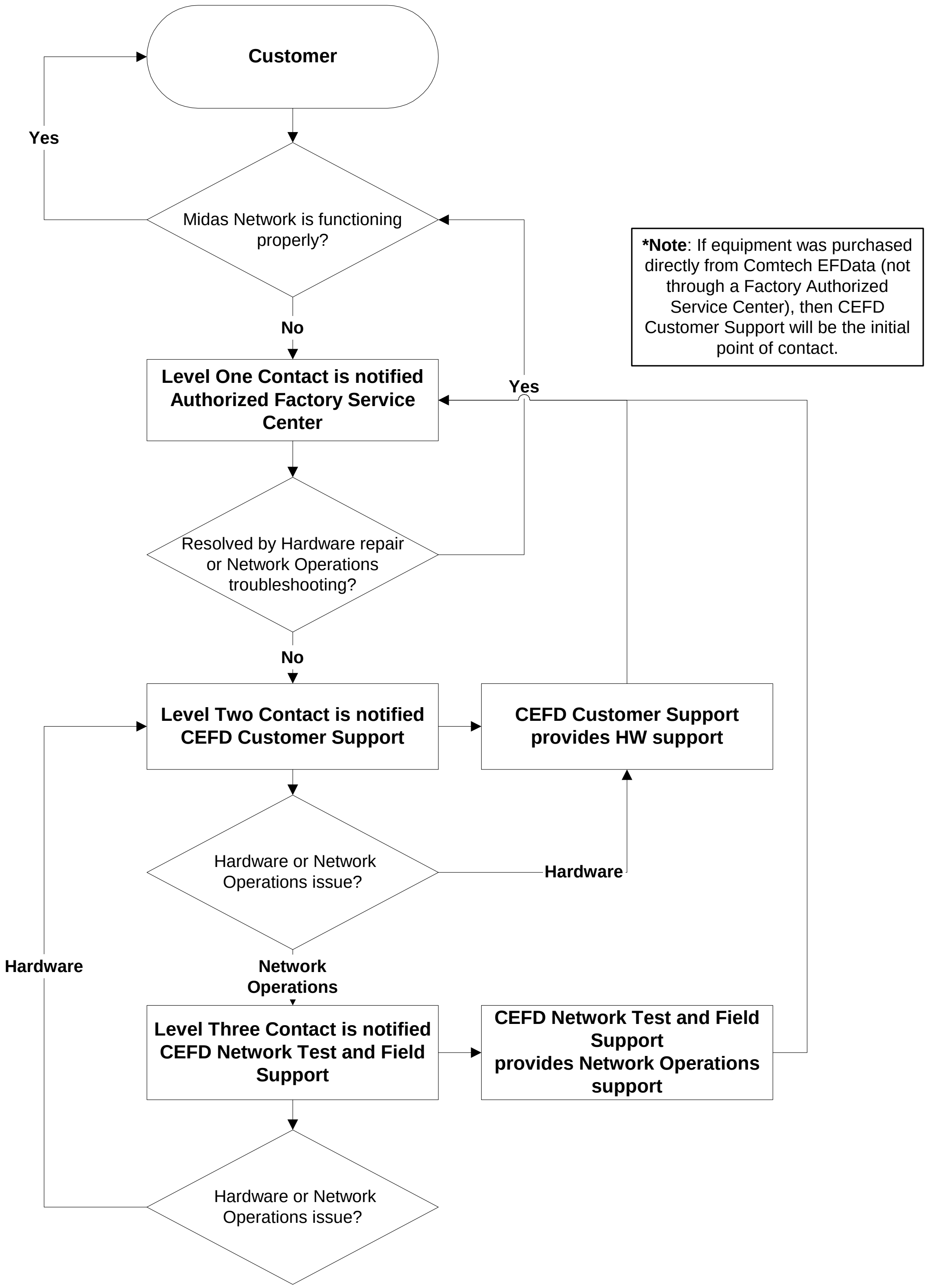
The resolution efforts will follow these levels of contact:

- **Level One Contact** – Factory Authorized Service Center.
- **Level Two Contact** – Comtech EF Data Customer Support.
- **Level Three Contact** – Network Test and Field Support

Procedural Steps

Step	Procedure
1	The **Customer** raises a concern with the **Level One Contact**.
2	The **Level One Contact** will perform ***Hardware*** repairs and ***Network Operations*** troubleshooting in accordance with the Comtech EF Data Service Center agreement.
3	If the **Level One Contact** is unable to resolve the concern, then the **Level One Contact** will inform the **Level Two Contact** of the concern in accordance with the instructions found within the attached Comtech EF Data Customer Support Department's document.
4	The **Level Two Contact** will enter the concern into the Comtech EF Data database and determine whether the concern is a ***Hardware*** concern or a ***Network Operations*** concern
5	The **Level Two Contact** will interface with the **Level One Contact** and provide the appropriate hardware support and enter all correspondence into the Comtech EF Data database.
6	If the **Level Two Contact** determines that the concern is a ***Network Operations*** concern, then the **Level Two Contact** will inform the **Level Three Contact**.
7	The **Level Three Contact** will interface with the **Level One Contact** and provide the appropriate support and enter all correspondence into the Comtech EF Data database.
8	If the **Level Three Contact** determines that there is a ***Hardware*** failure then the **Level Three Contact** will inform the **Level Two Contact**. Go to Step 5.

Network Customer Support Plan



See the Comtech EF Data website at http://www.comtechefdata.com for contact information for a Factory Authorized Service Center. Contact the Factory Authorized Service Center for:

- Product support
- Information on upgrading or returning a product

Contact the Comtech EF Data Customer Support Department for:

- Product support or training
- Information on upgrading or returning a product

A Customer Support representative may be reached at:

Comtech EF Data
Attention: Customer Support Department
2114 West 7th Street
Tempe, Arizona 85281 USA

480.333.2200 (Main Comtech EF Data Number)
480.333.4357 (Customer Support Desk)
480.333.2500 FAX

or, E-Mail can be sent to the Systems Support Engineering at:

midasfss@comtechefdata.com

To return a Comtech EF Data product (in-warranty and out-of-warranty) for repair or replacement:

1. Request a Return Material Authorization (RMA) number from the Comtech EF Data Customer Support Department.

2. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

3. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

4. Ship the product back to Comtech EF Data. (Shipping charges should be prepaid.)

Contact the Comtech EF Data Network Test and Field Support for:

- System level Network Operations support
- Information on upgrading Network Operation software
- Reporting comments or suggestions concerning manuals

A Network Test and Field Support representative may be reached at:

Comtech EF Data
Attention: Network Test and Field Support
2114 West 7th Street
Tempe, Arizona 85281 USA

480.333.2200 (Main Comtech EF Data Number)
480.333.3693 (Network Test and Field Support)
480.333.2161 (FAX)

or, E-Mail can be sent to the Network Test and Field Support Department at:

mailto:midasfss@comtechefdata.com

Contact us via the web at www.comtechefdata.com.

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About this Manual

This System and Design manual is written for the system operator using the MIDAS controller software and the Network Management System (NMS) or the local client to configure and administer satellite communications network.

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Trademarks

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual is appreciated. To submit comments, please email the Comtech EF Data Technical Publication Department: techpub@comtechefdata.com.

Disclaimer

1. Introduction

Introduction

This document contains the System and Design information of the Comtech EF Data's Bandwidth-on-Demand (BOD) Multimedia Integrated Digital Access System (MIDAS), Series 4 (Version 4.0, 4.2, and subsequent). The version number in the margin will identify differences.

Overview

A reliable and efficient communication network is of prime importance in today's highly competitive business world. The need for accurate (real-time) information is crucial to the success of any business requiring on-demand wide-area connectivity for:

- Enterprise Networking
- Circuit Restoral (Disaster Recovery)
- Overflow/Congestion Reduction
- Video Conferencing
- Tele-Medicine/Tele-Health
- Distance Learning
- Content Distribution

Until now, these applications depended on leased lines from the telephone company, which were mostly under-utilized and (typically) did not provide adequate bandwidth when needed. In some places, they simply did not exist.

- Dial-up lines were slower, because of limited bandwidth availability on Public Switched Telephone Network (PSTN) lines in most geographic regions.
- The reliability and maintenance of these circuits continues to be a problem, and lack of network control provisions continues to plague users.
- Natural or man-made disasters.

Dedicated satellite circuits can solve the bandwidth and connectivity problem, but such solutions are not cost effective for applications that do not require permanent connectivity.

- Users with mission-critical applications adopted dedicated circuits where local phone company service was unreliable or nonexistent.
- The dial-up equivalent of setting up a satellite circuit, though cost effective, was highly inefficient.
- Most users were certainly not enthused by setup times ranging anywhere from a few hours to a few days for such a circuit.

Very Small Aperture Terminal (VSAT) technology, coupled with the bandwidth-on-demand capabilities of Comtech EF Data's MIDAS system, provides a reliable, efficient, and cost-effective solution for users who require connectivity on demand.

MIDAS dynamically allocates satellite power and bandwidth based upon the communication needs of the network users.

- Under the control of MIDAS, circuits can be established and terminated ***on demand*** in a matter of seconds.
- The network can be monitored, controlled, and modified with the click of a mouse and a few keystrokes, providing network users with something new—complete control over their networks.

For users requiring on-demand services, the ability to allocate digital bandwidth on demand on a cost-per-minute basis is an excellent option:

- Graphics can be transmitted and updated in seconds, without the speed limitations of a dial-up PSTN line.
- Remote users are able to access data, video, and imaging services in a fraction of the time, as compared to that required by a dial-up PSTN line.
- Simultaneous, point-to-point, and point-to-multipoint video and audio communication makes it easy for business people, health care professionals, and educators to conduct face-to-face meetings without the time and expense of travel.

Multimedia Integrated Digital Access System

MIDAS provides a reliable, efficient, and cost-effective bandwidth-on-demand solution for satellite-based communication networks. It provides control of permanently assigned and dynamically assigned Single Channel Per Carrier (SCPC) channels, and supports full-mesh, single-hop data, and video circuits. MIDAS salient features include:

- Seamless application integration
- Bandwidth management, including “bandwidth on demand”
    - Bandwidth pools
- User-selectable grade of service
- LinkSync™
    - Automatic Frequency Control (AFC)
    - Uplink Power Control (UPC) at MIDAS Controller site
- Circuit prioritization and circuit preemption
- Redundancy options:
    - Redundant MIDAS Controller with automatic switchover
    - Redundant Network Control Modem with automatic switchover
    - Redundant LinkSync™ Modem with automatic switchover
- Multi-level user security system (via NMS user Interface Option)
- Graphical view of transponder bandwidth and circuit usage
- Call, event, and alarm monitoring logs
- Service messages
- Interoperability with: SNMP MIB
- AUPC Circuit
- Turbo Codec Circuit
- Event Management (Ver: 4.X or greater)
    - 2- Events
    - Color-Code Severity
    - View Historical Events
- Fault Management (Ver: 4.X or greater)
- Security Management (Ver: 4.X or greater) via NMS user Interface option
    - User Group
    - Functions and Devices Access Control Subnetting
- Multiple Operator Workstations (via NMS user Interface option)

System Architecture

MIDAS is divided into four distinct areas of operation:

- The MIDAS Controller
- Traffic Nodes
- Network Management System (NMS)
- Remote NMS

The network is interconnected with an outbound Time Division Multiplex (TDM) control channel and a bursted, ***Slotted Aloha*** inbound control channel. They are used for all network management and call control message transfers between the MIDAS Controller and the traffic nodes.

A direct link is supported between any two traffic nodes, so that additional delays are not encountered by having to route traffic through the MIDAS Controller site. Traffic nodes in the network communicate with the Controller for bandwidth allocation, call setup and termination, and status reporting.

A MIDAS network consists of:

- The MIDAS Controller site
- Traffic sites

The MIDAS Controller site may also host traffic nodes, sharing the RF equipment and the antenna with the MIDAS Controller.

A traffic site consists of one or more traffic nodes along with the RF equipment, the antenna and the customer equipment. Traffic sites are typically remote sites, however, as implied above, remote and traffic sites may be interchanged without loss of generality.

MIDAS Controller

The MIDAS Controller is responsible for managing the network. Via the operator workstation, the MIDAS Controller provides the operator interface (Local Client or NMS) for configuring and administering the network.

- It maintains a log of all network events, including call detail records, alarms, and other traffic node reported events.

- Users can access these records to monitor and analyze network performance.

- Call detail records can be exported in a comma-delimited format for off-line billing.

- Each traffic node can be monitored in real time to aid in remote troubleshooting.

The MIDAS Controller site consists of the MIDAS controller and an operator workstation running one of the MIDAS user interface programs.

A customer furnished printer(s) is connected to the operator workstation for printing logs and reports.

A typical MIDAS System is illustrated in Figure 1-1.

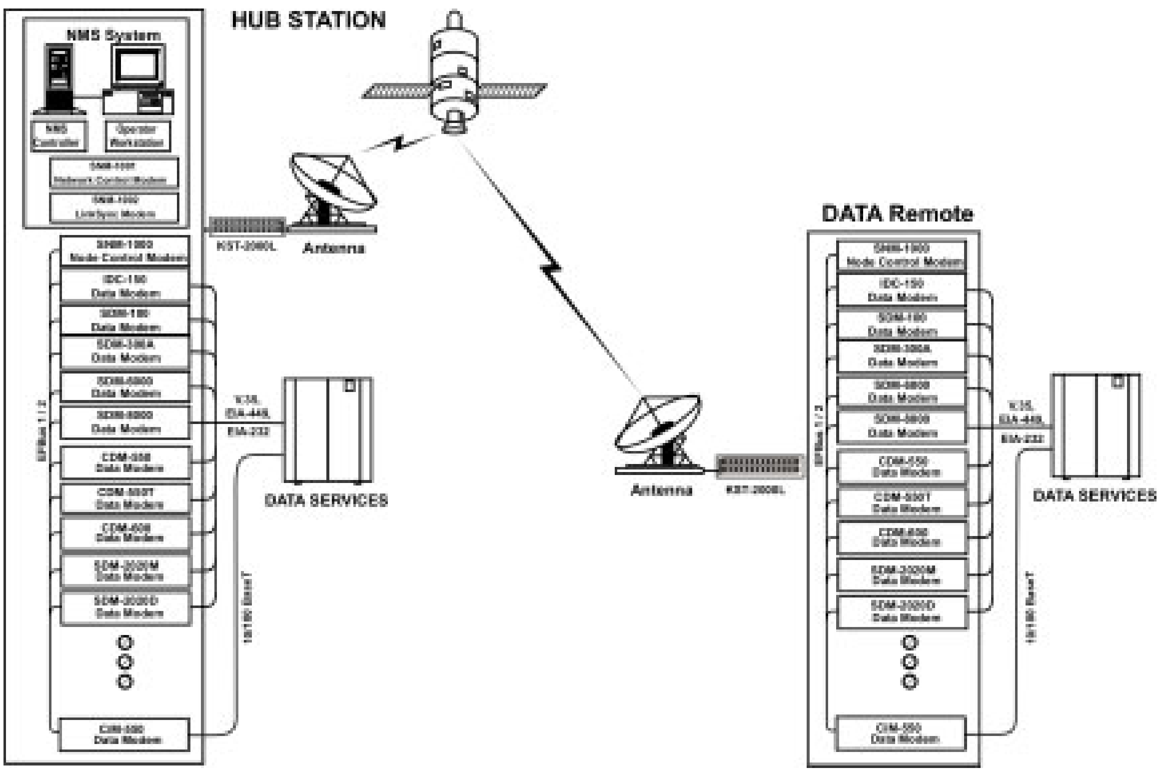

Figure 1-1. Typical MIDAS System

SNM-1001 Network Control Modem

The SNM-1001 Network Control Modem is an integral component of the MIDAS System, providing the control channel communication path between the MIDAS Controller and the remote nodes.

The MIDAS Controller transmits commands to the remote nodes through the SNM-1001, using a continuous, TDM, and outbound carrier. The remote nodes send requests and status messages to the NMS using the slotted ALOHA burst inbound channel. This inbound channel technology allows multiple remote nodes to share a single inbound carrier.

SNM-1002 LinkSync™ Modem

The SNM-1002 is an integral component of the MIDAS System, providing the LinkSync™ monitor and control communication between the NMS and the MIDAS network..

LinkSync™ provides three sets of capabilities for the MIDAS network.

Automatic Frequency Control (AFC)	For all modems within the network.
Power Management	For all active traffic circuits within the network.
Circuit Disruption Capability	Allows the NMS to terminate circuits between any two internal traffic nodes in the network.

The SNM-1002 performs a critical roll for each of these three LinkSync™ capabilities.

Traffic Node

The traffic node provides the terrestrial interface for customer equipment to access the network services and processes local requests for services under MIDAS control. Multiple traffic nodes can be located at a remote site and share the RF equipment.

MIDAS supports different traffic node configurations:

- Multi-channel traffic node
- Single-channel traffic node

Single-Channel Traffic Node

For sites requiring a single data circuit[1], an economical solution is to use the integrated control/traffic modems. They provide both control and traffic characteristics, switching between the two modes on demand. In the "idle" condition, they are tuned to the control channels, in active communication with the MIDAS Controller.

Once a traffic connection is requested, they switch to the traffic mode, severing the connection with the MIDAS Controller. On termination of the traffic connection, they return to the control mode. Figure 1-2 illustrates an SNM-1010/1010L Data/Control Modem based remote site capable of providing a single data circuit on demand

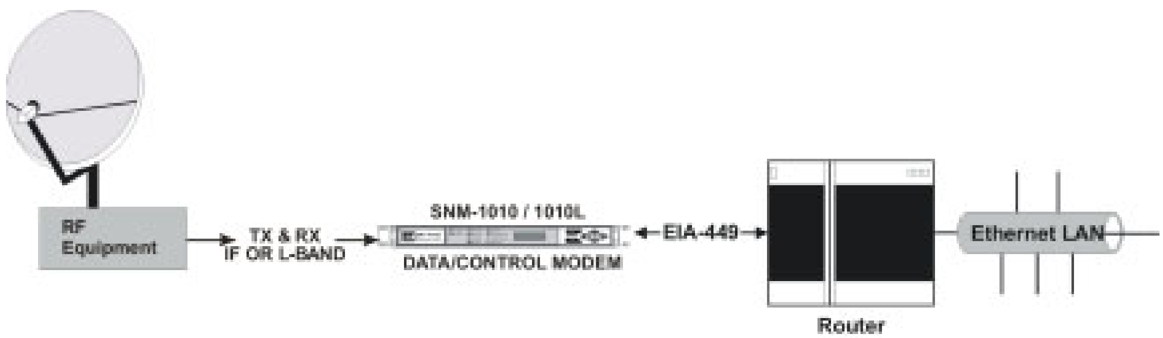

Figure 1-2. MIDAS SNM-1010-Series Based Traffic Site

[1] The SNM-1010-Series Data/Control Modem is available in 70/140 MHz IF and L-Band RF TX/RX frequencies.

Multi-Channel Traffic Node

The multi-channel traffic node consists of Comtech EF Data's SNM-1000 Node Control Modem controlling up to 30 data and video modems. The supported traffic modems include Comtech EF Data's extensive line of satellite modems, providing the user with a wide range of data rates, modulation, encoding schemes, and terrestrial interfaces to suit any application.

The SNM-1000 functions as a dedicated node controller. It manages the traffic modems, performs call setup and termination under MIDAS control, performs local monitoring and control (M&C) and reports events, alarms, and call detail records to the MIDAS Controller. The traffic modems are controlled via EIA-485 multi-drop buses. The SNM-1000 does not carry user traffic. Figure 1-3 illustrates a traffic site with multi-channel nodes.

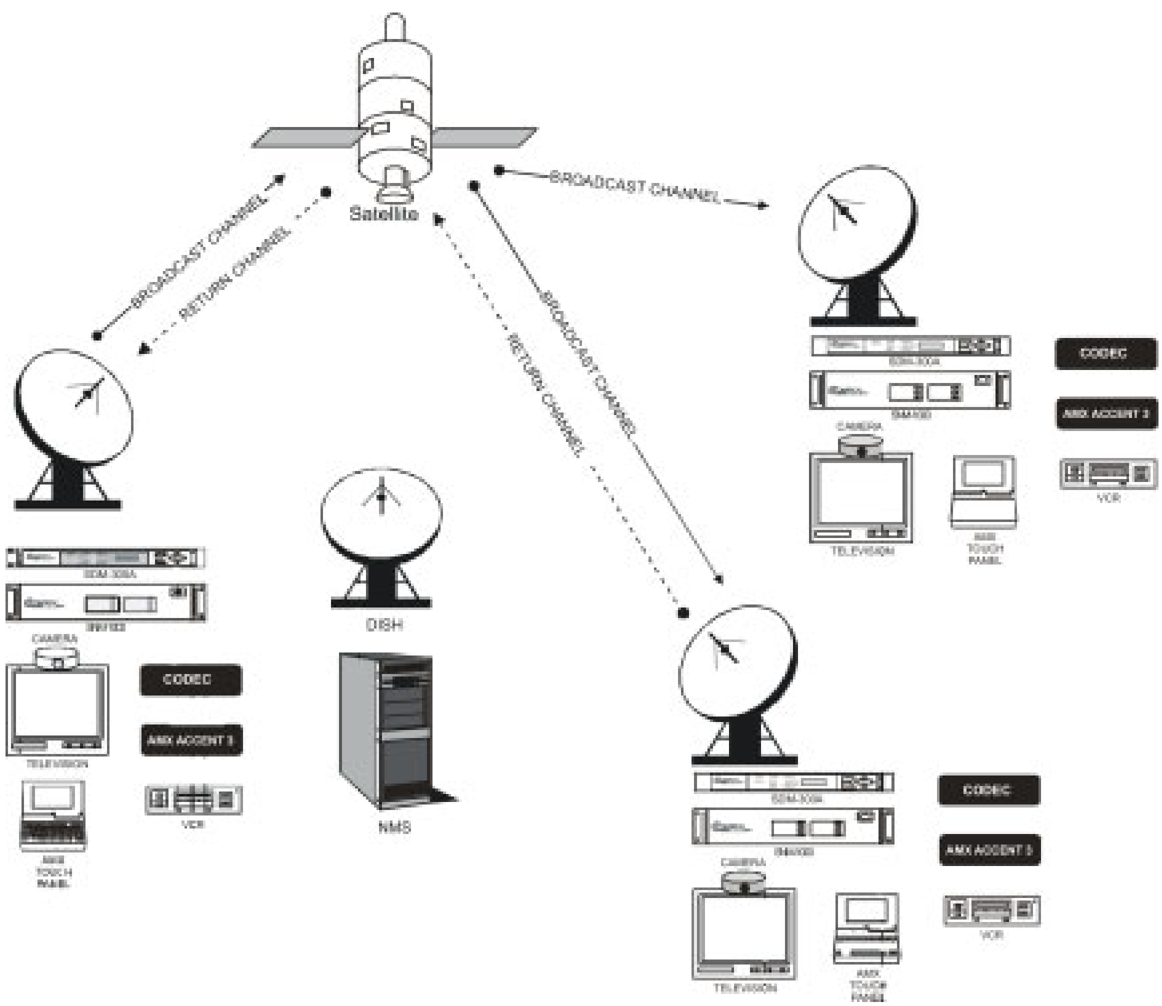

Figure 1-3. MIDAS Multi-Channel Traffic Site

Control Channels

Control channels provide the connectivity between the MIDAS Controller and the traffic nodes for call control and network management message transfers. Two types of control channels are used in the system:

- Outbound control channel
- Inbound control channel

The outbound control channel carries messages from the MIDAS Controller to the traffic nodes. The traffic nodes send messages to the MIDAS Controller using the inbound control channel.

Network Topology

A MIDAS network consists of:

- NMS site
- Remote sites

The NMS site hosts the Network Management System. It could also host traffic nodes, sharing the RF equipment and the antenna with the NMS.

A Traffic site consists of one or more traffic nodes, along with the RF equipment, the antenna and the customer equipment.

MIDAS Summary

The following tables reflect the chronographical history of the MIDAS Network.

MIDAS Released Features for Version 1.0	MIDAS Released Features for Version 2.0	MIDAS Released Features for Version 3.0	MIDAS Released Features for Version 4.X
AUPC for External for SDM-300A Modem	AUPC External for SDM-300A Modem	AUPC External for SDM-300A Modem	AUPC External for SDM-300A Modem.
Dongle Hardware Support (Licensed for software protection)	Dongle Hardware Support (Licensed for software protection)	Dongle Hardware Support (Licensed for software protection)	Dongle Hardware Support (Licensed for software protection)
MIDAS Baseline	AUPC Internal for SNM-1010 Modem	AUPC Internal for SNM-1010 Modem	AUPC Internal for SNM-1010 Modem
Y2K Compliant	Y2K Compliant	Y2K Compliant	Y2K Compliant
	Control Channel Performance	Control Channel Performance	Control Channel Performance
	Improvement (Exponential Backoff)	Improvement (Exponential Backoff)	Improvement (Exponential Backoff)
	Large Network Support 300 Nodes	Large Network Support 300 Nodes	Large Network Support 300 Nodes
	Node Channel Status Display	Node Channel Status Display	Node Channel Status Display
	Support Local Redundancy	NT Server (Operating System in NMS Controller)	NT Server (Operating System in NMS Controller)
		Support SDM-2020 Modulator	Support SDM-2020 Modulator
		Support SDM-2020L-Band Demodulator	Support SDM-2020L-Band Demodulator
		View only Client (Nonredundancy only)	Integrate with HPOV NMS (Optional)
			Local and Geo Redundancy
			Multiple Operation workstations
			Support SDM-300L, SNM-1010L, CDM-550 , CDM-600, CiM-550 Modems.
			Turbo Codec Support
			Support MIB Interface

2. Solutions

Enterprise Networking

The requirements for Enterprise Networking are diverse:

- Connectivity requirements
  - Indefinite connectivity
  - Connectivity on demand
    - Manual request
    - Automatic request by the customer equipment
- Grade of service

MIDAS provides an ideal solution for each of these requirements. One or more MIDAS traffic nodes are installed at each site that needs to be connected. The typical site equipment consists of:

- Antenna
- RF equipment
- Customer equipment, such as router(s)
- SNM-1000 Node Control Modem(s)
- SNM-1010(L) Data/Control Modem(s)
- Traffic modem(s), connected to the customer equipment

The Wide Area Network (WAN) link is established by connecting the customer equipment via satellite circuits when required. A typical setup to connect two routers is illustrated in Figure 2-1.

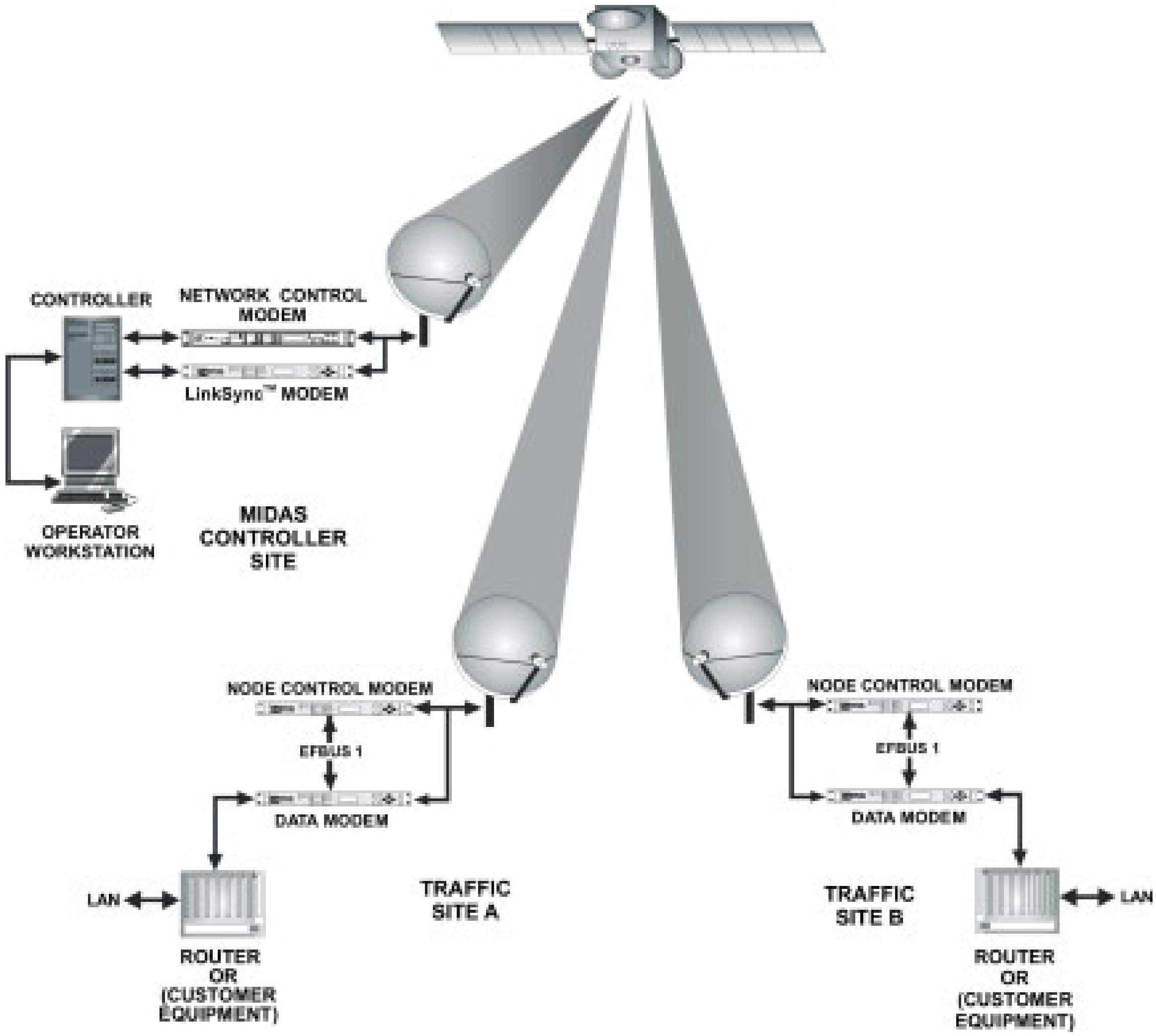

Figure 2-1. Enterprise Networking

Connectivity

Permanent Connectivity

Indefinite connectivity could be required between sites due to a need for continuous data transfer. A request for setting up a permanent circuit is entered at the MIDAS Controller, and requires the MIDAS operator to specify the participating traffic node and channel identification, and the desired grade of service (data rate, transmit power level, modulation, and encoding scheme).

The circuit is established immediately and remains active until specifically terminated by the MIDAS operator.

Connectivity on Demand

On-demand connectivity could be required for applications such as LAN extension, file sharing, file/media/software distribution, desktop videoconferencing, remote session, etc. MIDAS supports on-demand connectivity that can be initiated through the node control modem's user port, MIDAS operator's workstation, or automatic IP address routing.

Node Control Modem User Port

Manual Request

An end user can request a circuit to be set up immediately by entering the destination traffic node and channel identification, and the desired grade of service (data rate, modulation, and the encoding scheme) through the node control modem's user port.

The Node Control Modem sends a request to the MIDAS Controller. On receiving the request, MIDAS Controller validates the request, allocates bandwidth and transmits power, and informs the participating traffic nodes of the frequencies to be used for the circuit. On receiving the frequency assignment, the Node Control Modems tune the corresponding traffic modems and enable them to transmit and receive, respectively, leading to circuit establishment.

The user can request termination of the circuit any time by entering the termination command through the Node Control Modem's user port. The modem terminates the circuit locally and informs the MIDAS Controller. The MIDAS Controller terminates the satellite circuit and releases the associated hardware; Bandwidth frequency and Power allocation.

Customer Equipment Interface

User Port Commands

In addition to RTS/DTR triggered circuit setup and termination, customer equipment can also be programmed to send circuit setup and termination requests to the Node Control Modem via the user port. When a circuit is required, the customer equipment sends the setup request to the Node Control Modem via the user port.

The Node Control Modem sends the request to the MIDAS Controller, which assigns bandwidth and transmits power followed by circuit establishment. When the circuit is no longer required, the customer equipment sends the termination request to the Node Control Modem. The Node Control Modem terminates the circuit locally and informs the MIDAS Controller, which terminates the satellite circuit, and releases associate resources.

MIDAS Operator Workstation

The MIDAS operator can request the establishment and termination of a data circuit via the operator workstation. Through the GUI, a user can define a CKT with configurable parameters, such as Power Level, Modulation, FEC, and others.

Button	Results
ENABLE	The user can establish the CKT.
DISABLE	The user can teardown the CKT
DELETE	The user can reuse the CKT.

Automatic Request

RTS/DTR Triggered

Customer equipment such as routers can request circuit establishment and termination via a transition on the RTS/DTR line or by sending user port commands to the Node Control Modem. Comtech EF Data products such as the CiM-550 can be configured to request circuit establishment when an IP packet destination matches a satellite route in the CiM-550.

The router activates the RTS/DTR line when it requires a circuit to a pre-defined destination. The node control modem detects the traffic modem's activated RTS/DTR signal. A request for circuit establishment to the pre-determined destination is sent to the MIDAS Controller, which assigns bandwidth and transmit power followed by circuit establishment. When the circuit is no longer required, the router sets the RTS/DTR inactive. The Node Control Modem terminates the circuit locally and informs the MIDAS Controller, which terminates the satellite circuit, and releases associated resources.

User Port Triggered

In addition to RTS/DTR triggered circuit setup and termination, customer equipment also can be programmed to send circuit setup and termination requests to the Node Control Modem via the user port. When a circuit is required, the customer equipment sends the setup request to the Node Control Modem via the user port.

The Node Control Modem sends the request to the MIDAS Controller, which assigns bandwidth and transmits power followed by circuit establishment. When the circuit is no longer required, the customer equipment sends the termination request to the Node Control Modem. The Node Control Modem terminates the circuit locally and informs the MIDAS Controller, which terminates the circuit, and returns the bandwidth to the free pool.This allows for optimal bandwidth usage without user intervention.

IP Route

For IP enabled Comtech EF Data products, such as the CiM-550, there is a third method for automatic circuit establishment. The CiM-550 can be configured with one or more routes.

- When IP packets from the customer's LAN enter the 10/100 BaseT Ethernet port of the CiM-550, the destination IP address of the packet is checked for a match in its satellite route table.

- Upon finding a match, the CiM-550 Modem requests circuit establishment to a pre-determined destination through the MIDAS Node Controller, which assigns bandwidth and transmit power followed by circuit establishment.

- After a user configurable period of time expires where the presence of IP packets destined for a satellite route are absent, the CiM-550 will request circuit termination from the MIDAS Node Controller, releasing associated resources.

These automatic circuit request methods allow for optimal bandwidth usage without user intervention.

Grades of Service

MIDAS supports a wide range of grades of service to meet any requirements. The following circuit characteristics can be configured to provide different grades of service to different users:

- Data rates
- Modulation
- Encoding
- Transmit power
- Circuit priority
- Circuit preemption
- Multiple terrestrial interface
- Dedicated bandwidth pool with optional overflow pool

Congestion Reduction/Overflow

Usually, terrestrial circuits can only be leased for a fixed Committed Information Rate. For bursty traffic, it is very inefficient to lease capacity for peak traffic. MIDAS will perform the following:

- Provides an automatic congestion reduction solution to deal with occasional peaks in traffic.
- Handle the overflow traffic, when the customer leases terrestrial capacity for typical traffic needs supplementing the terrestrial network.
- Backup the primary terrestrial circuit in case of failure.
- A typical setup for congestion reduction is illustrated in Figure 2-2. In addition to terrestrial circuit, the routers also get connected over the overflow satellite circuit.

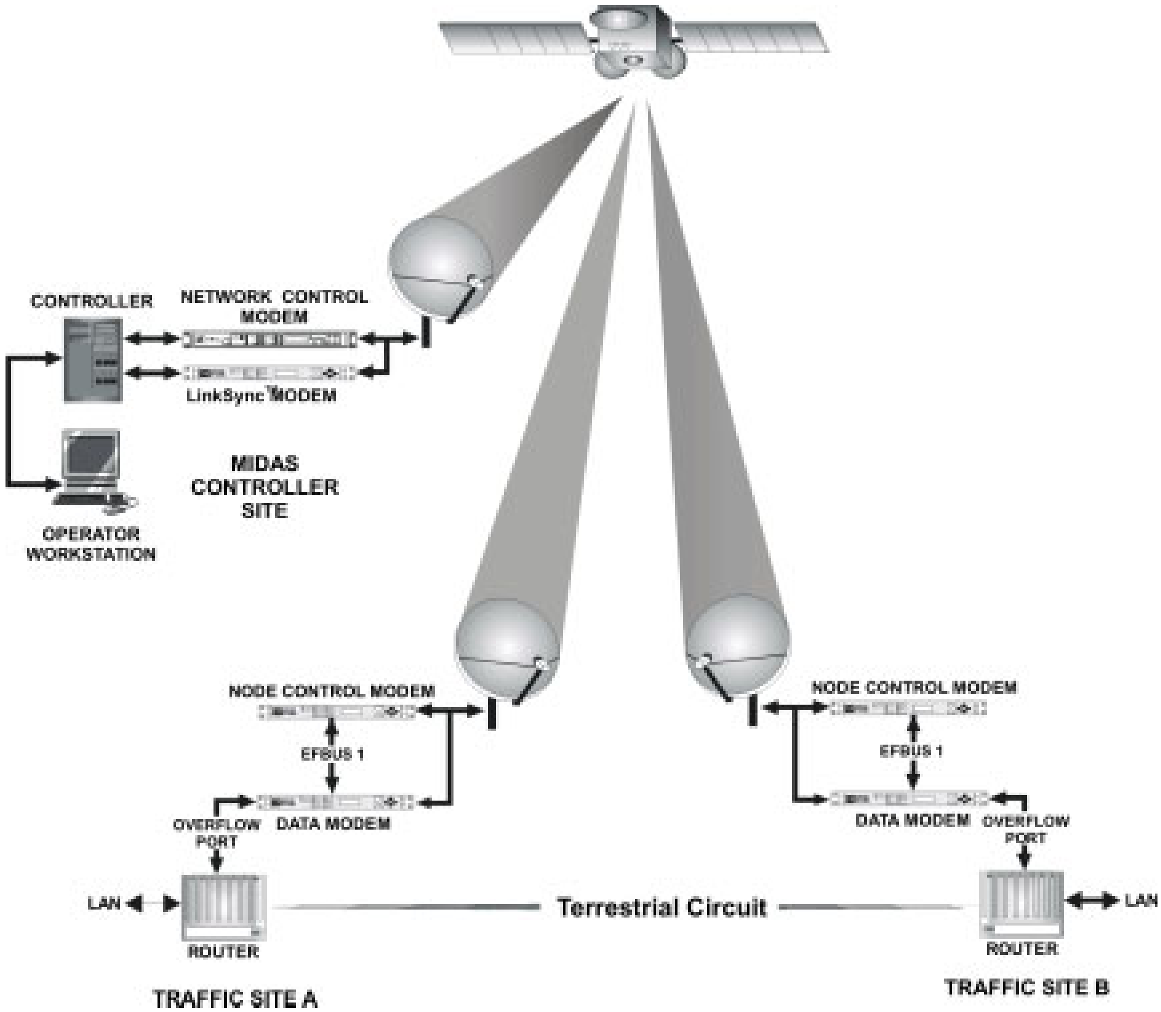

Figure 2-2. Congestion Reduction

The network operation for congestion reduction is to connect the routers via the primary terrestrial circuit. The router's overflow port is connected to the traffic modems via synchronous serial interface. The satellite circuit is not active. Router detects congestion, switches excess traffic to overflow port and raises RTS/DTR of the traffic modem. Node Control Modem detects RTS/DTR active state-of-the traffic modem; requests MIDAS Controller for overflow circuit.

MIDAS Controller allocates bandwidth, power, and establishes overflow circuit within seconds (preempting low priority circuits if required). The router detects end of congestion and deactivates RTS/DTR of the traffic modem. Node Control Modem detects RTS/DTR deactivation in the traffic modem, terminates the circuit locally and informs the MIDAS Controller. MIDAS Controller terminates the satellite circuit and releases the associated resources.

Automatic Circuit Restoral (Disaster Recovery)

With increasing reliance on enterprise networking, businesses have become much more vulnerable to operation-crippling circuit outages. Backup circuits have become a necessity to protect mission-critical communication links.

Emergency satellite backup circuits have historically taken anywhere from a few hours to a few days to set up. MIDAS offers ***automatic circuit restoral***, providing operational backup circuits within a matter of seconds.

One or more MIDAS traffic nodes are installed at each site that requires backup capability. The typical site equipment consists of:

- Antenna
- RF equipment
- Customer equipment, such as router(s)
- Node Control Modem(s)
- Traffic modem(s)

A typical setup for automatic circuit restoral is illustrated in Figure 2-3.

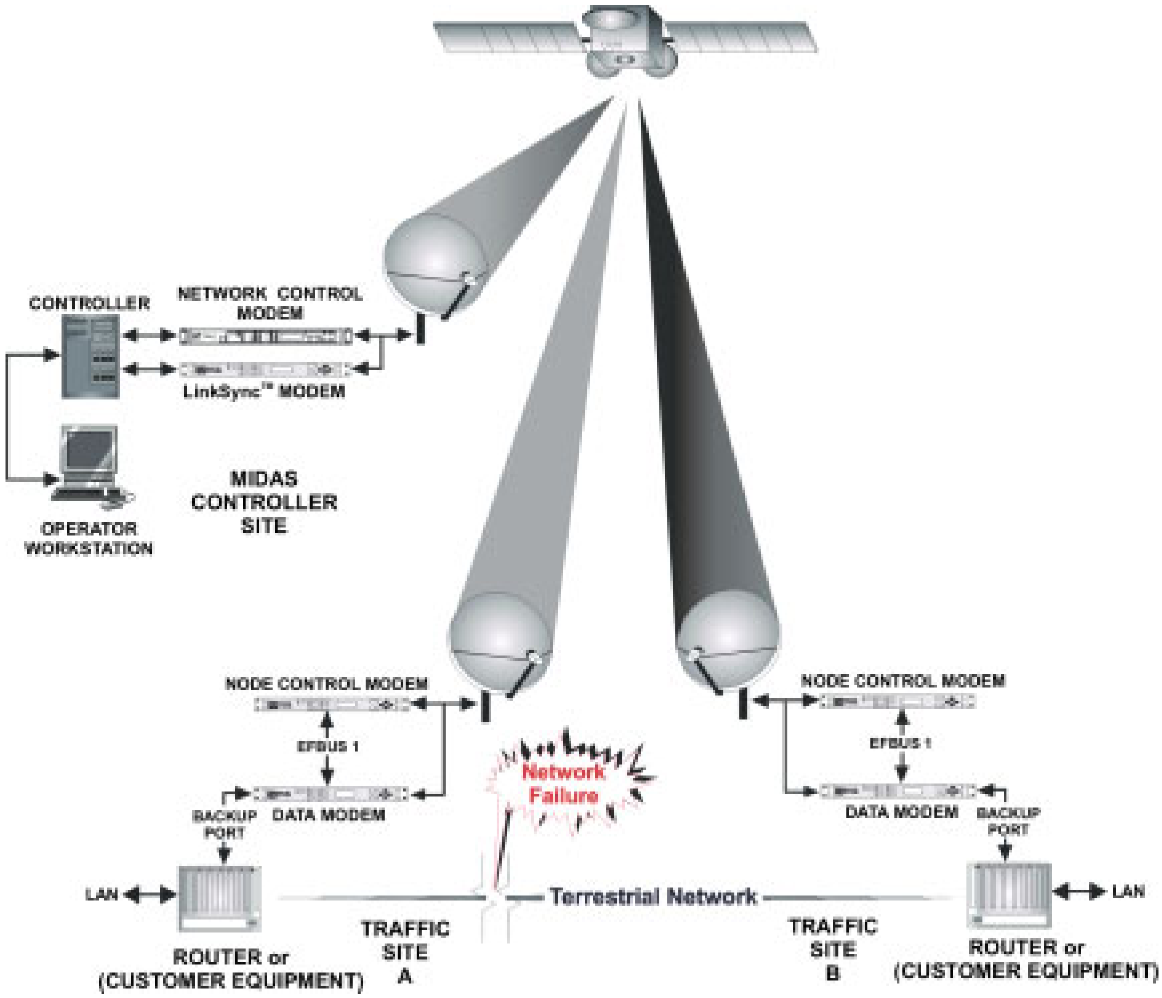

Figure 2-3. Automatic Circuit Restoral

The traffic modem is connected to the router's backup port via a synchronous serial interface. The Node Control Modem is configured with all the information required for requesting a circuit to the pre-determined destination.

- When the traffic modem detects an active RTS/DTR signal from the router indicating traffic is incoming.
- Node Control Modem is notified. The Node Control Modem sends a request to the MIDAS Controller for the establishment of a backup circuit.
- The router also can request the backup circuit establishment by sending user port commands to the Node Control Modem.

The MIDAS Controller validates the request, allocates traffic circuit frequencies, and informs the Node Control Modems. Upon receiving the frequency assignment, the Node Control Modems tune the respective traffic modems to the assigned frequencies and turn them on either to transmit or receive, leading to a backup circuit establishment. The circuit remains active until the router deactivates the RTS/DTR signal or sends a terminate command through the user port, at which time it is terminated and the bandwidth released. Since the circuit is only activated on demand, satellite resources are not used until needed.

Hunt Groups[1] can be used to provide many-to-many (*m* x *n*) mapping of the backup circuits, allowing for backing up more circuits using fewer modems. They can also be used to provide redundancy for the data modems. Additional modems are employed at the destination and configured as a hunt group. In case of failure in one of the modems, the system selects another available modem in that hunt group while establishing the backup circuit.

Semi-Automatic Circuit Restoral

Automatic circuit restoral depends upon the ability of the customer's equipment to generate a RTS/DTR (or similar control signal) transition when the backup path is needed.

- If the customer equipment is unable to provide RTS/DTR or a similar control signal to trigger the setup and termination of the backup circuit, the user port commands can be used to request backup circuit establishment and termination.

In case of primary link failure, the user requests the establishment of the backup circuit through the user port. Once the primary circuit is restored, the user can request termination of the backup circuit through the user port.

The circuit restoral time is comparable to the automatic operation, which means the backup circuit is established within a few seconds of the user entering the request through the user port. Comtech EF Data's extensive line of modems and interfaces are available for semi-automatic restoral, giving users the maximum flexibility within the data rate range of 2.4 kbps to 100 Mbps.

[1] A hunt group is a list of traffic channels that can span multiple nodes/sites.

Group Videoconferencing

Videoconferencing allows people in different locations to hold interactive meetings. The participants can hear each other, and share live, motion video images of each other. Images of documents and objects can also be exchanged. A videoconferencing system can provide all the same presentation choices and information exchange capabilities that are available in a face-to-face meeting. Videoconferencing avoids the time, cost, and difficulties of travel.

MIDAS provides an integrated point-to-multipoint videoconferencing capability. With an easy to use, Video Conference Control System (VCCS™), MIDAS allows interactive control of the videoconference session by the end user.

Site Configuration

A MIDAS traffic node is installed at each site. The typical site equipment consists of:

- Antenna
- RF equipment
- Node Control Modem
- Traffic modem
- Video Conference Control System (VCCS™)
- Video Codec, video camera, and display terminal

The VCCS™ provides a touch screen display, with an easy to use graphical user interface, for interactive management of the videoconference session. Users can interact with the VCCS™ by simply selecting the desired icon on the touch screen display. The VCCS™ interfaces with the user port of the Node Control Modem for communication with the MIDAS Controller for initiating, maintaining and terminating the videoconference.

A typical site setup for videoconferencing is illustrated in Figure 2-4.

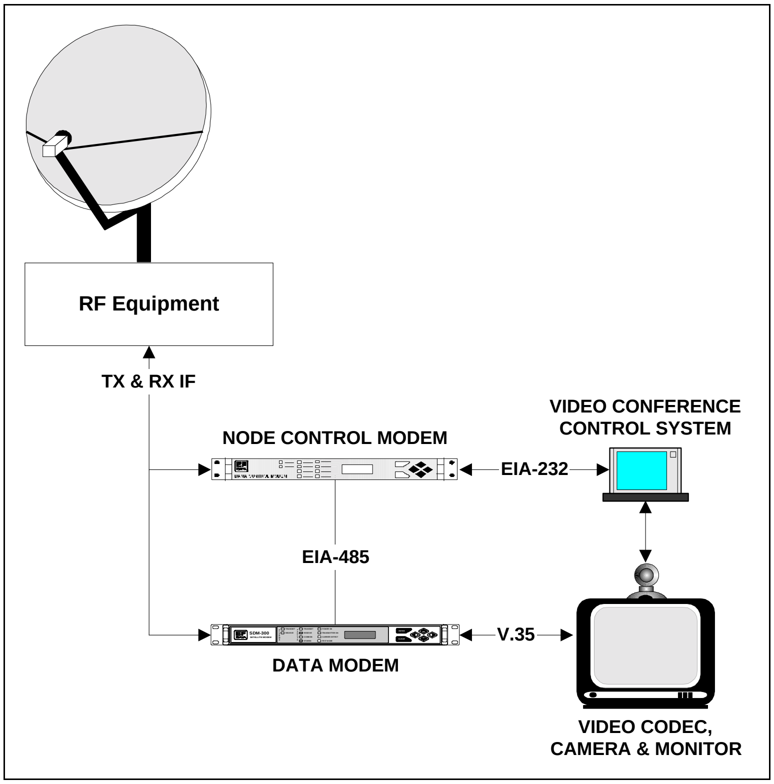

Figure 2-4. Video Conference Site Setup

Video Conference Session

A videoconference session involves a chairperson and one or more participants. The person initiating the conference is the chairperson for that conference. The chairperson also is the default broadcaster. Any site with VCCS™ can function as the chairperson site. The system does not favor or restrict a site's capability to provide chairperson control. A typical setup for videoconferencing is illustrated in Figure 2-5.

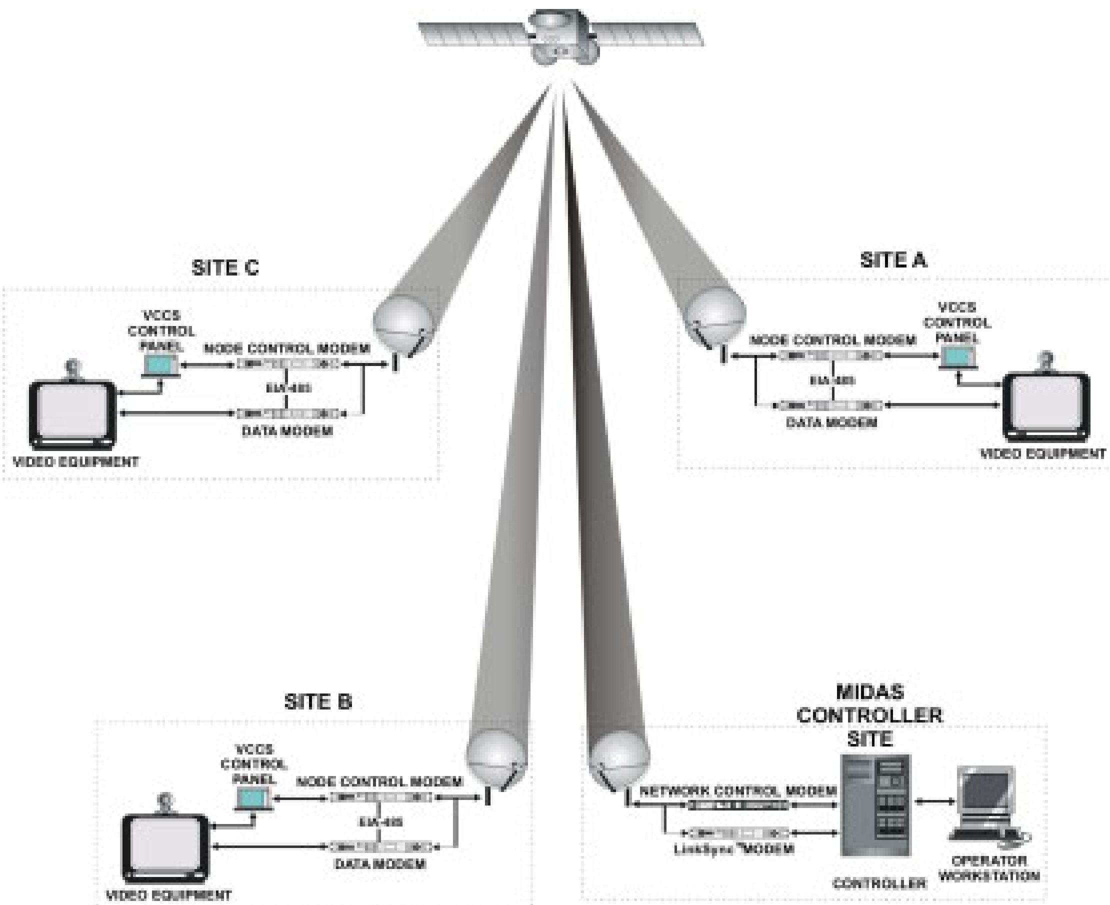

Figure 2-5. Videoconference Setup

Chairperson

The chairperson manages the videoconference session. Using VCCS™, the chairperson can:

- Select participants
- Initiate the conference
- Add participants
- Remove participants
- View the status of all the participants
- Accept or reject participant request for broadcast
- Change broadcaster
- Accept or reject participant request to talk back to the broadcaster through the return channel
- Change return channel transmitter
- Terminate the conference

Participant Capability

Using VCCS™, a participant can:

- Accept the invitation to join the conference
- Reject the invitation to join the conference
- Request to talk to the chairperson
- View the status of a request
- Cancel a pending request
- Leave the conference

Videoconference Session

The MIDAS operator creates a list of all the videoconference capable traffic channels with their phone numbers and group identity and stores it on a diskette, which is sent to all potential chairperson sites. This information is read by the VCCS™ and stored in the flash memory.

Initiation

1. Chairperson selects one of the pre-defined groups from the VCCS™ touch panel.
2. The panel displays all the group members.
3. Chairperson begins by selecting the participants. The chairperson is the default broadcaster.
4. When chairperson is done selecting, the MIDAS Controller is informed.
5. MIDAS allocates bandwidth and the Chairperson starts transmitting.
6. Upon selection, the MIDAS Controller informs each participant of the conference initiation.
7. As participants accept the invitation to join the conference, the chairperson is informed of their status on the control panel.
8. Chairperson can now add new participants or drop current participants.

Change Broadcaster/Return Channel

1. A participant can send a request to the chairperson indicating a wish to communicate.
2. The requesting participant's status changes on the chairperson's panel indicating the request.
3. The chairperson can accept the request and grant the requester either the return channel for talk back or the broadcast privilege, or reject the request.
4. If the requester is granted the return channel, the current participant (if any) transmitting on the return channel stops transmitting and the participant granted the return channel starts transmitting on the return channel. (MIDAS Controller allocates bandwidth for return channel, if required)
5. If the requester is granted the broadcast privilege, the current broadcaster stops broadcasting and the participant granted the broadcast privilege starts broadcasting.
6. If the request is rejected, the requesting participant is informed.
7. The chairperson can change the broadcaster designation at will.
8. The chairperson can change the return channel at will.

Termination

1. The participants can leave the conference by selecting the appropriate icon on the VCCS™ panel.
2. Upon leaving, a participant’s status changes on the chairperson’s control panel.
3. The chairperson can terminate the conference at will.
4. In the event of termination, all the participants are informed of the termination and they “hang up”.
5. The MIDAS Controller releases the bandwidth.

Advantages

The bandwidth-on-demand solution provided by MIDAS has many advantages:

Reliable network:	Based on field-proven technology.
Multi-Service Integrated Platform:	MIDAS provides seamless integration with a diverse range of applications including , group videoconferencing, data broadcast/multicast, automatic circuit restoral (disaster recovery), etc.
Flexible and scaleable architecture	Allows optimization of network price/performance on a site-by-site basis.
Investment protection:	Unlike most terrestrial solutions, a MIDAS network is easily expandable, facilitating network reconfiguration, and providing for the addition of new applications with minimal effort. Addition of capacity raises costs only incrementally.
Low total cost of ownership:	Inexpensive hub and remote equipment, and efficient space segment utilization.
Full mesh connectivity:	MIDAS supports single-hop connectivity between network sites. This avoids the additional delays encountered in STAR networks with two-hops for remote-to-remote circuits. It also alleviates the need for extra resources needed for double-hop circuits.
Multiple grades of service:	Dynamic allocation of satellite bandwidth and power from a pool allows multiple grades of services for applications with different requirements. MIDAS supports: ♦ Fully-configurable circuit characteristics ▪ Data rates (2.4 kbps to 100 Mbps) ▪ For Video Conferencing: 128, 256, 384, 512 and 768 kbps ▪ Encoding (Viterbi, Sequential, R=1/2, 2/3, 3/4, 5/6, 7/8, 8/9; Reed-Solomon, TCM) ▪ Turbo Codec (BPSK 5/16, 21/44; QPSK/OQPSK/8PSK/16QAM 3/4) • Modulation schemes (BPSK, QPSK, OQPSK, 8PSK, 16QAM) • Terrestrial interfaces (EIA-232, EIA-422/449, V.35, 10/100 BaseT Ethernet) • Circuit prioritization and preemption • Dedicated bandwidth pools with optional overflow pool
Broadcast/Multicast:	A MIDAS-based broadcast/multicast solution does not require additional bandwidth. Data can be broadcast to all the traffic nodes within the network using a single carrier.
Asymmetric services:	MIDAS supports asymmetric circuits, allowing for improved utilization of space segment for applications that do not require symmetric bandwidth in each direction, such as Internet access.
Simplified long term budgeting	A MIDAS network bypasses the complex web of terrestrial networks, operators and pricing schemes, and is not sensitive to the distance between the network sites, allowing a better prediction of recurring communication costs over longer periods of time.
Simplified network management and control:	The simplified architecture of the MIDAS network makes it easier to manage from a central MIDAS site than terrestrial networks. This architecture provides direct control over all individual network components.

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3. Theory Of Operation

Transmission Technologies

MIDAS, being a digital communication system, uses digital transmission techniques as adapted to satellite transmission.

Frequency Division Multiple Access

Frequency Division Multiple Access (FDMA) divides the available bandwidth into channels for allocation to users. FDMA makes channels available to different users/applications on a multiple access basis depending on availability. FDMA is normally the access scheme of choice for DAMA networks (bandwidth on demand), where the MIDAS Controller controls the allocation of channels.

Single Channel Per Carrier

SCPC is one of the oldest transmission techniques used in satellite communications. Initially it was used to provide thin-route analog telephone services. The SCPC technique utilizes a single voice or data channel per carrier. Recent developments in technology have moved SCPC into the digital domain and the majority of services are now adopting digital services. SCPC/FDMA techniques are typically employed for the majority of DAMA systems in operation today, where the MIDAS Controller provides active control of these channels.

TDM/TDMA

Time Division Multiplexing (TDM) achieves multi-user utilization by partitioning the time domain of the RF carrier into discreet slots.

Time Division Multiple Access (TDMA) systems utilize a similar format to TDM, but each time slot is pre-assigned to a specific user. Each earth station transmits a burst within their assigned TDMA slot. All users are synchronized to a master reference, so that only one RF burst occupies the carrier position (slot) at a given time, ensuring that the data bursts from different users never overlap (collide).

Aloha Protocol

Aloha is a random access protocol where the users send data at will, because collisions of data from different users are possible, each user must listen for an acknowledgement from the destination. The user either receives a negative acknowledgement from the destination, or no acknowledgement for the pre-determined timeout period. In both cases, the user must backoff a random amount of time before retransmitting.

Slotted Aloha

Pure Aloha scheme can be improved with a small coordination between the sending stations. Each user must transmit between synchronized pulses. These slot-producing pulses are broadcasted to all stations.

MIDAS Control Channels

Dedicated satellite channels are used to transfer all network management and call control information between the MIDAS Controller and the traffic nodes. Two types of control channels are used in a MIDAS network:

- Outbound control channel
- Inbound control channel

Outbound Control Channel

All network management and call control messages from the MIDAS Controller to the traffic nodes are sent on a dedicated outbound control channel whose characteristics can be summarized as follows:

- Pre-assigned digital SCPC channel using TDM.
- Transmits in ***continuous*** mode at 19.2 kbps, QPSK, FEC = 1/2.
- Slot size is 55 ms.
- Messages are contained in an HDLC frame.
- Each message contains the address of the destination traffic node(s), or is broadcast to all the traffic nodes.
- Provides the synchronization pulses for the Slotted Aloha inbound control channel.

Inbound Control Channel

All network management and call control messages from the traffic nodes to the MIDAS Controller are sent on a dedicated inbound control channel. The inbound control channel characteristics can be summarized as follows:

- Pre-assigned digital SCPC channel using slotted aloha access scheme.
- Transmission in ***burst*** mode at 19.2 kbps, QPSK, FEC = 1/2.
- Messages are contained in an HDLC frame.
- As the inbound control channel operates in a ***contention*** mode, after transmitting a message the traffic node waits for an acknowledgment from the MIDAS Controller on the outbound control channel. A lack of acknowledgment leads to message re-transmission after a random delay.

Bandwidth Management

MIDAS allocates satellite bandwidth and power on demand for establishing satellite circuits. The MIDAS Controller is capable of managing 36, 54, and 72 MHz transponders. The managed bandwidth consists of one or more segments of satellite transponder. The bandwidth segments do not have to be contiguous. The managed bandwidth is also referred to as the owned bandwidth.

The MIDAS Controller also supports bandwidth pools, which allows bandwidth to be reserved for exclusive use of the customers. This allows a better control over the grade of service.

Bandwidth Allocation

The channel allocation unit for traffic and control channels is 2.5 kHz. The carrier spacing (allocation factor) is user-configurable, from 1.2 to 1.5 in steps of 0.05.

Using the specified data rate, modulation type, and coding rate, the allocated bandwidth for a carrier is computed as follows (and rounded up to the nearest multiple of the channelization):

$$\text{Bw} = \text{Data Rate} * \frac{1}{\text{Modulation Factor}} * \frac{1}{\text{FEC Rate}} * \text{Reed Solomon} * \text{Carrier Spacing}$$

where:

Bw	Allocated bandwidth in kHz, after rounding up to the nearest multiple of the channels.
Data Rate	User data rate in kbps.

Modulation Factor	1 for BPSK 2 for QPSK 2 for OQPSK 3 for 8PSK 4 for 16QAM In general, "n" modulation factor for 2^n constellation.
FEC Rate	Viterbi, Sequential, or Turbo, TCM coding rate (1/2, 2/3, 3/4, 5,6, 7/8, 8/9, 5/16, or 21/44)
Reed-Solomon	1 if option is OFF 225/205 if option is On
Carrier Spacing	User-selectable between 1.2 and 1.5 in steps of 0.05

The difference in center frequencies of adjacent traffic carriers is given by:

$$\Delta f = [bw_1 + bw_2] * 0.5$$

where:

Δf = spacing between the two carrier center frequencies.

bw_1 = allocated bandwidth of carrier 1.

bw_2 = allocated bandwidth of carrier 2.

Example

Assume that 1.1 MHz of bandwidth (starting at 0.0 MHz) is available to a user. The channels are 2.5kHz, carrier spacing of 1.3, Reed-Solomon is not used, and the additional acquisition range for the inbound control channel is 10 kHz.

Of the owned bandwidth, 25.0 kHz (24.96 kHz rounded up to the nearest multiple of 2.5 kHz) is allocated to the outbound control channel, and 45.0 kHz (24.96 kHz plus 20 kHz for the acquisition, rounded up to the nearest multiple of 2.5 kHz) is allocated to the inbound control channel, leaving 1030.0 kHz for user traffic.

At QPSK, FEC Rate = 1/2, a 64 kbps data channel requires 85 kHz (83.2 kHz rounded up to the nearest multiple of 2.5 kHz). A full duplex circuit with two channels (one for each direction) requires 170 kHz. 510.0 kHz is allocated to three full duplex data circuits of 64 kbps each.

At QPSK, FEC Rate = 1/2, a 256 kbps simplex data circuit requires 335.0 kHz (332.8 kHz rounded up to the nearest multiple of 2.5 kHz). 335.0 kHz is allocated to the simplex data circuit, leaving 185 kHz for other traffic. Figure 3-1 illustrates the frequency allocation (center frequencies) for this example.

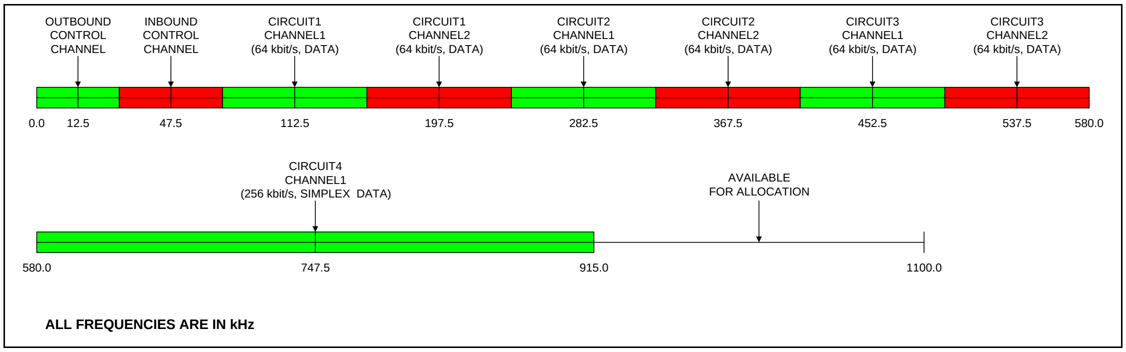

Figure 3-1. (Center) Frequency Allocation

Bandwidth Pools

The MIDAS Controller allows for partitioning the owned (managed) bandwidth for exclusive use by the customers. Owned bandwidth can be divided into one or more private pools and a public pool. A private pool is then assigned to a customer for exclusive use. The public pool is available to all customers that do not have an assigned private pool. Customers with assigned private pools also have the option of overflowing to the public pool, if space is not available within their private pool. Space from the public pool is allocated on a first-come first-served basis to the requesting customers.

Access to the pools is assigned on a per-traffic-channel basis. Different traffic channels in a traffic node can be assigned to different bandwidth pools. By default, all new bandwidth is added to the public pool. If a private pool is deleted, the bandwidth is returned to the public pool. The MIDAS operator can add/delete private pools and transfer bandwidth between pools. Usage statistics are also available on a pool basis.

The key features of the bandwidth pools can be summarized as:

- The owned bandwidth can be divided into private pools.
- Owned bandwidth not assigned to private pools is referred to as the public pool.
- The public pool always exists.
- The control channels are allocated bandwidth from the public pool.
- Each customer can have access to one private pool and/or the public pool.
- A customer has exclusive access to the private pool.
- Bandwidth cannot be shared between pools.
- The call detail record indicates which pool an allocated bandwidth came from.

Carrier Power

MIDAS handles different antenna sizes, carrier levels, and data rates. The MIDAS operator enters the carrier transmit power level for all the pre-defined circuits.

- If Circuit Power Management feature of LinkSync™ is enabled, the transmit power level for traffic node initiated circuits is calculated dynamically by the MIDAS Controller and sent to the traffic nodes as part of the circuit assignment message.
- If Circuit Power Management is not enabled, default power level settings are used for traffic node initiated circuits.

Traffic Channels

All the owned bandwidth (on a transponder, except those reserved for the control channels) can be allocated for user traffic. The traffic channels operate in an FDMA/SCPC mode. The MIDAS Controller allocates them in pairs for point-to-point full duplex circuits and individually for point-to-point and point-to-multipoint simplex circuits.

For full duplex circuits, the channel pair can be allocated anywhere in the customer’s transponder allocation and need not be adjacent. MIDAS allows for symmetric circuits where the two traffic channels have the same characteristics (data rate, modulation and encoding), and asymmetric circuits where the two traffic channels have different characteristics (data rate, modulation and/or encoding).

LinkSync™

LinkSync™ is a unique MIDAS feature providing:

- Automatic Frequency Control (AFC)
- Uplink Power Control (UPC) at the MIDAS Controller
- Circuit Power Management (Option)
  - ♦ Site level call blocking based on HPA power

Automatic Frequency Control

MIDAS provides automatic frequency control (AFC) to reduce the traffic modem acquisition time for continuous mode operation and to improve the burst acquisition performance of the SNM-1001 Network Control Modem and the Node Control Modems[1], by keeping the frequency drift to within ± 500 Hz.

The outbound control channel is used as the system-wide reference, which is continuously monitored by the LinkSync™ Modem at the MIDAS Controller site and all the Node Control Modems[2]. The AFC process does not depend on the absolute accuracy in any part of the system.

The AFC process consists of three steps:

1. Removing the receive offset of the Network Control Modem at the MIDAS Controller.

2. Removing the receive offset of the Node Control Modems and the traffic modems at the traffic sites.

3. Removing the transmit offset of the Node Control Modems and the traffic modems at the traffic sites.

[1] Includes SNM-1000 and the integrated traffic/control modems (SNM-1010 and SNM-1010L).

[2] The integrated traffic/control modems and the network terminals in a standard configuration monitor the outbound control channel in the “control mode”.

These three steps are performed as follows:

1. The LinkSync™ Modem measures the receive frequency of the outbound control channel and provides this information to the MIDAS Controller periodically, the period being user-configurable.
    a. The MIDAS Controller then calculates the offset from the nominal, which is used to correct the Network Control Modem's TX frequency.

2. The Node Control Modem determines the receive offset by measuring the receive frequency of the outbound control channel.
    a. This offset is used to calibrate the RX frequency of the Node Control Modem and all the traffic modems (during call setup) at the node.
    b. The traffic modems that have active calls are not adjusted. Calibrations are periodically performed where the period is user – configurable.
3. MIDAS Controller periodically polls a Node Control Modem to transmit exclusively, and measures the receive frequency for the incoming bursts from the Node Control Modem on the inbound control channel.
    a. It then estimates the offset and provides this information to the Node Control Modem.
    b. The Node Control Modem then applies this offset to correct its TX frequency and that of all the traffic modems (during call setup).
    c. The traffic modems that have active calls are not adjusted. This process is repeated periodically, the period being user-configurable.

Uplink Power Control

Uplink Power Control at the MIDAS Controller site compensates for outbound control channel uplink degradation so that it always downlinks at a constant power at the satellite.

A reference E_b/N_o is calculated for the received outbound control channel at the MIDAS Controller site for clear sky conditions. The LinkSync™ Modem, at the MIDAS Controller site, measures the received outbound control channel E_b/N_o on a continuous basis.

- If the measured E_b/N_o differs from the calculated reference, the MIDAS Controller calculates the offset to be applied to the transmit power level of the outbound control channel to achieve the desired reference E_b/N_o.
- The transmit power is adjusted only when the difference exceeds a threshold, which is configurable.

Circuit Power Management (Option)

Circuit power management is provided as an option. It includes:

- Circuits at setup.
- Site level call blocking based on available High power Amplifiers (HPA) power.

Site Level Call Blocking

The MIDAS Controller supports dynamic site level call blocking based on the available HPA power. The MIDAS Controller keeps track of the HPA power for each site. A call originating from a site is blocked if it would cause the total transmit power for that site to exceed the recommended HPA power (less backoff). This leads to improved system stability.

AUPC Bw Calculation

AUPC bandwidth calculation is as follows:

1. Use the data rate as the initial number of Hz for the carrier.

2. Multiply or divide by various factors to account for other link parameters, such as:

   a. For modulation:

BPSK	No Change
QPSK	Divide by 2
8PSK	Divide by 3
16QAM	Divide by 4

   b. For FEC Rate, divide by the FEC rate, such as:

FEC 1/2	Divide by 0.5
FEC 3/4	Divide by 0.75

   c. Reed-Solomon, multiply by:

225/205	or
1.0976	

3. Multiply by the “Allocation Factor”, (suggested is 1.4) to add some extra room for sidebands and small frequency offsets.

Example: For 6400bps carrier, QPSK and FEC 3/4, No AUPC or Reed-Solomon, the bandwidth would be:

Modulation:

6400 * 0.5 = 32000

FEC:

3200/0.75 = 42667

Allocation Factor:

42667 * 1.4 = 59734 Hz

Note: If Reed-Solomon was available, the bandwidth would increase to 65564 Hz.

Circuit Setup and Termination

MIDAS supports the following circuit types:

- Full duplex data and video circuits
- Point-to-point simplex data and video circuits
- Point-to-multipoint simplex data and video circuits

Full Duplex Circuits

MIDAS supports full duplex circuits for data and video applications. The full duplex data and video circuits could be symmetric or asymmetric.

Circuit Setup

A full duplex data circuit setup could be initiated by:

- The MIDAS Controller, due to
  - ♦ Permanent circuit establishment by the MIDAS operator
  - ♦ Activation of a pre-defined circuit by the MIDAS operator
  - ♦ The passing of the start time for a scheduled circuit
- The traffic node, due to
  - ♦ User port command
  - ♦ RTS/DTR going active
  - ♦ IP packet destination address matches CiM Modem route entry

A user[3] could request a data circuit via the user port by providing all the required parameters, or it can request a pre-defined circuit by indicating the pre-defined circuit identifier. A typical user-initiated circuit, where both the traffic nodes have dedicated Node Control Modems, proceeds as follows:

1. The user requests a data circuit by specifying the destination, data rate, encoding and modulation scheme, or a pre-defined circuit by specifying the circuit ID through the user port.

2. The Node Control Modem formats a request message and forwards this to the MIDAS Controller on the inbound control channel.

3. The request is validated by the MIDAS Controller. If the required resources are available, the MIDAS Controller allocates bandwidth and sends an assignment message to both the Node Control Modems.

4. Both the Node Control Modems configure the traffic modems and enable the transmit and receive. They also respond with a status message indicating the current traffic modem status. (If either Node Control Modem reports a bad status, the MIDAS Controller terminates the sequence.)

5. The data circuit is established when the traffic modems lock.

6. The user is informed of the progress of the data circuit setup through the user port.

[3] In this section, the term “user” excludes the NMS operator.

The sequence is illustrated in Figure 3-2.

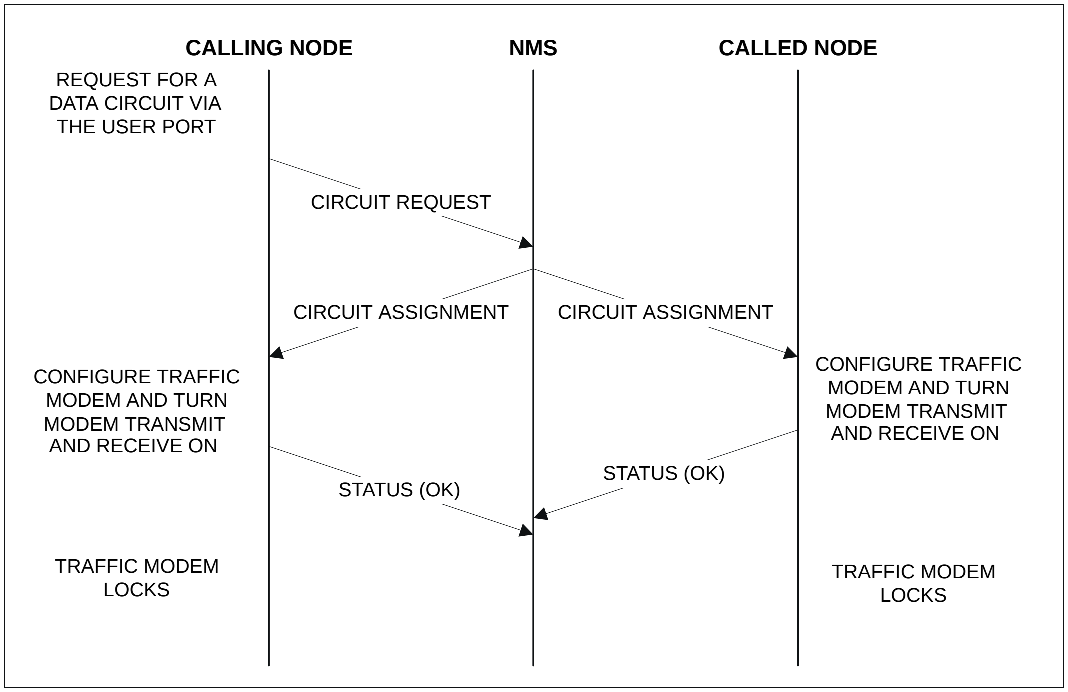

Figure 3-2. User-Initiated Circuit Setup

The video circuit setup is similar to that of the data circuit.

Circuit Termination

A data or video circuit termination could be initiated by:

- The MIDAS Controller, in response to operator action
- The traffic node, due to the following:
  - User port command
  - RTS/DTR goes inactive
  - Traffic modem loses lock[4]
  - Call duration expires (for a scheduled circuit)
  - (For CiM Modems only) - Absence of IP packets destined for a satellite route through the duration of the user configurable timeout period.

[4] The time from the modem losing lock to circuit termination is configurable.

The circuit termination initiated by the traffic node where both the traffic nodes have dedicated Node Control Modems proceeds as follows:

1. The Node Control Modem disables the traffic modem transmits and receives and sends a “path terminated” message to the NMS.

2. The MIDAS Controller responds by sending a terminate message to the other Node Control Modem.

3. On receiving the terminate message, the other Node Control Modem disables the traffic modem’s transmit and receive, and acknowledges the terminate message.

4. On receiving the acknowledgment to the terminate message, the MIDAS Controller releases the bandwidth and the traffic modems.

The sequence is illustrated in Figure 3-3.

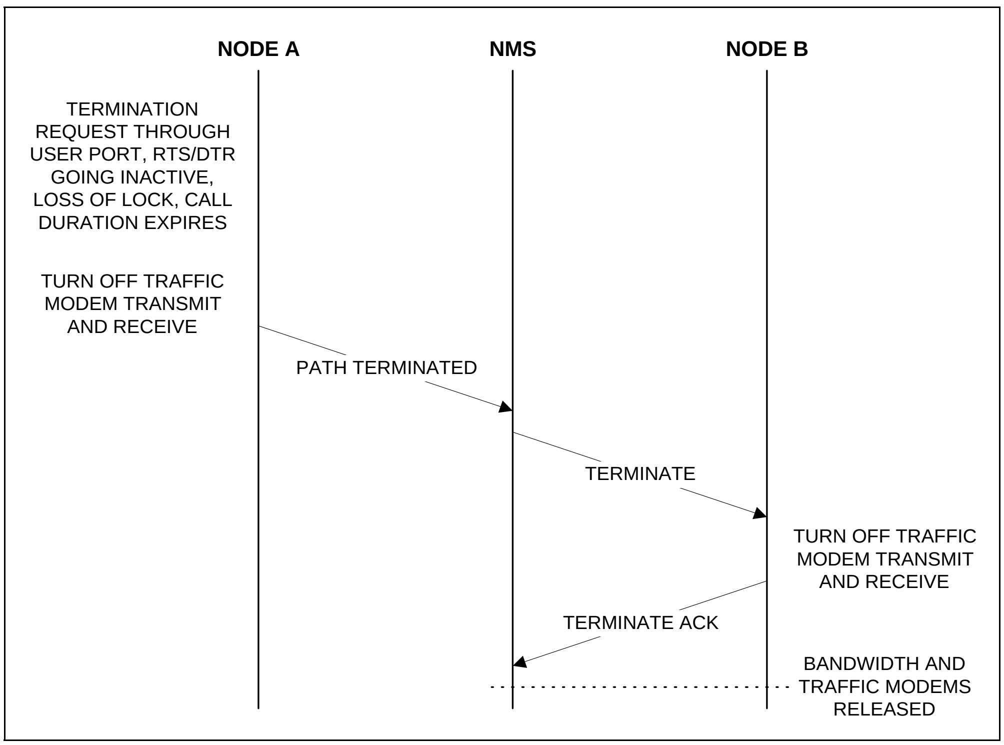

Figure 3-3. Node Initiated Circuit Termination

The termination sequence is similar to that of a data circuit.

To terminate circuits involving two integrated traffic/control modems, the NMS transmits an interfering carrier using the LinkSync™ Modem. This causes the modems/terminals to lose lock and return to the control channels.

Point-to-Point Simplex Circuits

MIDAS supports point-to-point simplex data and video circuits. The establishment and termination of point-to-point simplex circuits is similar to that of full duplex circuits except for the following:

- Only one traffic channel is allocated as part of the circuit.
- Only the transmitting traffic node can request a simplex circuit establishment by specifying the pre-defined circuit ID. The traffic node cannot request the establishment of a simplex circuit if it is not pre-defined.
- Since the transmitting traffic modem is not receiving, it will not report loss of lock.

Point-to-Multipoint Simplex Circuits

MIDAS supports point-to-multipoint simplex data and video circuits for applications like video conferencing, data broadcast/multicast, etc. Only one traffic channel is allocated as part of the circuit.

Circuit Setup

A point-to-multipoint simplex circuit setup could be initiated by:

- The MIDAS Controller, due to activation of a pre-defined circuit by the MIDAS operator
- The traffic node[5], due to
  - ♦ User port command

[5] Only the transmitting traffic node can request the establishment of a point-to-multipoint circuit.

The MIDAS Controller could initiate the establishment of a point-to-multipoint simplex data circuit due to the activation of a pre-defined point-to-multipoint circuit by the MIDAS operator. A typical MIDAS Controller initiated point-to-multipoint circuit setup proceeds as follows:

1. The MIDAS operator defines a point-to-multipoint circuit by specifying the transmitting traffic channel, the receiving traffic channels, data rate, encoding, modulation scheme, etc., and activates it, or activates a pre-defined circuit by specifying the circuit ID.
   - For a point-to-multipoint circuit utilizing Comtech EF Data CiM Modems, the CiM Modems require (predefined) route table entries.
2. If the required resources are available, the MIDAS Controller allocates bandwidth and sends an assignment message to all the participating traffic nodes.
3. The Node Control Modem at the transmitting traffic node configures the traffic modem and enables the transmit. It also responds with a status message indicating the current traffic modem status. (If the Node Control Modem reports a bad status, the MIDAS Controller terminates the sequence.)
4. The Node Control Modems at the receiving traffic nodes configure the traffic modem and enable the receive. They also respond with a status message indicating the current traffic modem status.
5. The data circuit is established when one of the receiving traffic modem locks.
6. The MIDAS operator is informed of the progress of the circuit setup through the operator workstation.

Circuit Termination

The point-to-multipoint circuit termination could be initiated by:

- The MIDAS Controller, in response to operator action
- The traffic node, due to the following:
  - ♦ User port command
  - ♦ Traffic modem loses lock[6]

The point-to-multipoint circuit termination initiated by the MIDAS Controller proceeds as follows:

1. The MIDAS Controller sends terminate messages to the Node Control Modem at the transmitting traffic node and all the receiving traffic nodes.

2. The Node Control Modem at the transmitting traffic node disables the traffic modem transmit and acknowledges with a “path terminated” message.

3. The Node Control Modems at the receiving traffic nodes disable the traffic modem receive and acknowledge with “path terminated” messages.

4. On receiving the acknowledgment to the terminate messages, the MIDAS Controller releases the bandwidth and the traffic modems.

Circuit Priority and Circuit Preemption

Circuit priority and circuit preemption provide multiple grades of service to the users.

The priority can be assigned on a per-circuit basis for pre-defined circuits and/or per-traffic-channel basis. If both circuit-based and traffic channel-based priorities are used, the higher of the two priorities is used to derive the priority for a pre-defined circuit initiated from a traffic channel.

Based on priority, MIDAS supports:

High priority circuits,	Which can preempt normal-priority circuits if there is no available bandwidth. Once established, they cannot be

[6] Only the modem losing lock will drop out. The circuit will only be terminated when the last receiving modem reports loss of lock.

	preempted.
Normal priority circuits,	Which cannot preempt other circuits. Other high-priority circuits can preempt these circuits.

The traffic channels can have the following priorities associated with them:

High priority,	Which means that all the circuits originating from this traffic channel would be "high priority circuits" as defined above.
Normal priority,	Which means that all the circuits originating from this traffic channel would be "normal priority circuits" as defined above.

Performance

Nominal Call Setup Delay

The nominal call setup delay is 3 to 10 seconds, depending on the network configuration, data rates, modems involved, and network load.

Network Size

MIDAS can support up to 300 traffic nodes. Each node can support up to 30 traffic channels. Refer to Chapter 1 for descriptions and illustrations of a Single-Channel traffic node and Multi-Channel traffic nodes.

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4 Network Management System

MULTIMEDIA INTEGRATED DIGITAL ACCESS SYSTEM

Overview

MIDAS is responsible for managing the network and transponder bandwidth and power to ensure maximum performance and most efficient resource utilization. The MIDAS functions include:

- Bandwidth and Power Management
  - C- or Ku-Band operation
  - Bandwidth and power allocation on demand
  - Dedicated bandwidth pools with overflow option
  - Configurable channelization and carrier spacing
  - LinkSync™
- Network Configuration and Administration
- Network Monitoring & Control
- Network Data Collection and Processing
- Color Even Summary
- Historical Event Log
- Event Management (Ver: 4.X)
  - 2- Event
- Security Management (Ver: 4.X with NMS Server)
  - Password Protection
  - User Group
  - Functional and Device Access Control
- Circuit Definition, Setup, Termination, and Scheduling
- Call Detail Recording
- Printable Logs and Reports

IMPORTANT

The MIDAS Controller can be located separately at an Earth Station, or can be co-located with one or more traffic nodes sharing RF equipment and the antenna. The Earth Station hosting the site is typically referred to as the MIDAS Controller site.

NMS Architecture

MIDAS consists of the following and is shown in Figure 4-1:

- The MIDAS Controller that also hosts the network database
- MIDAS Operator Workstation with a Graphical User Interface (GUI)
- Network Control Modem
- LinkSync™ Modem
- Printer (customer-supplied, optional)

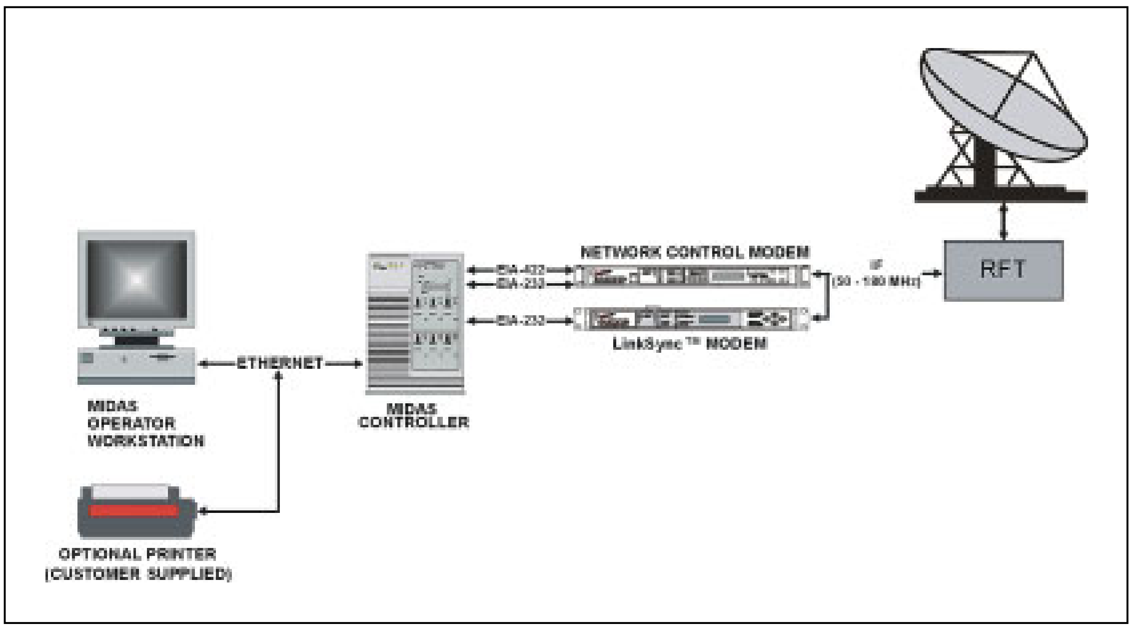

Figure 4-1. MIDAS Network Management System

MIDAS Controller

The MIDAS controller operates on a Pentium®-based server and is responsible for:

- Network startup and shutdown
- Network operation
- Network monitoring and control
- Bandwidth and power management
- LinkSync™ calculations
- Servicing call setup and termination requests from the traffic nodes
- Logging Call Detail Records (CDR)
- Logging events and alarms

The MIDAS Controller can manage networks with up to 300 traffic nodes. Each node can support up to 30 traffic channels. Refer to Chapter 1 for descriptions and illustrations of a Single-Channel traffic node and Multi-Channel traffic nodes.

The database server, which also shares the hardware platform with the MIDAS Controller, is responsible for storing, retrieving, and maintaining the integrity of the network information.

This information includes network configuration, network events and alarms, call detail records, etc. All the information is stored in a proprietary database and can be viewed by the MIDAS operator.

The call detail records can be exported (in comma-delimited format) for billing purposes.

Operator Workstation

The MIDAS operator workstation connects to the MIDAS Controller through an Ethernet LAN and provides the network operator with an easy-to-use GUI for configuring and administering the network. Access to network management functions is controlled through passwords and access lists.

The operator workstation functions include:

- Providing system administration utilities for setting up operator accounts and access rights.
- Providing operator access for network configuration.
- Displaying real time resource usage including transponder occupancy graph.
- Displaying event logs and customer reports.
- Exporting billing records (CDRs).
- Displaying alarm and status information received from network components.

1. If required, the operator workstation can be located remotely.
2. If an NMS Server is utilized, then Multiple Point of Control (i.e. Multiple Remote NMS workstations) can be connected.

SNM-1001 Network Control Modem

The Comtech EF Data's SNM-1001 Network Control Modem allows communication with the traffic nodes over the control channels. It transmits on the outbound control channel to the traffic nodes and receives the incoming messages from the traffic nodes on the inbound control channel.

The outbound control channel is a continuous, Time Division Multiplexed (TDM) channel transmitted by the MIDAS Controller to all the traffic nodes in the network. The inbound control channel is a burst channel using Slotted Aloha access protocol. The traffic nodes send requests and report status to the MIDAS Controller and respond to MIDAS Controller commands.

System Specifications	
Operating IF Range	50 to 180 MHz, in 100 Hz steps
Continuous Mode: TX only : Digital Data	 QPSK, 1/2 rate, 19.2 kbps
Forward Error Correction	Viterbi soft decision
Doppler Buffer	64 to 65536 bits, or 1 to 50 ms in total depth
Data Scrambling	Intelsat V.35
Burst Mode: RX only Digital Data	 QPSK, 1/2 rate, 19.2 kbps
Forward Error Correction	Viterbi soft decision
Carrier Acquisition Range	± 4 kHz at E_b/N_0 = 8 dB, > 99% probability
Acquisition Time: 19.2 kbps, QPSK, R=1/2	 < 30 ms
Data Interfaces	EIA-422/449
Phase Noise	Per IESS-308
Modulator Specifications	
Output Power	-5 to -30 dBm, adjustable in 0.1 dB steps
Spurious	-55 dBc (4 kHz)
Data Clock Source	Internal or External
Internal Clock Stability	$\pm 1 \times 10^{-5}$
Output Impedance	75Ω
Output Return Loss	≥ 20 dB
Demodulator Specifications	
Input Level (Desired Carrier)	-30 to -55 dBm
Maximum Composite Carrier	-5 dBm or +30 dBc, within 2 MHz of desired carrier
Input Impedance	75Ω
Input Return Loss	≥ 20 dB
Monitor & Control Specifications	
Serial Interface Type	EIA-232
Data Rate	19.2 kbps
Commands	ASCII

SNM-1002 LinkSync™ Modem

The Comtech EF Data's SNM-1002 LinkSync™ Modem is responsible for monitoring the receive frequency and the receive E_b/N_o of the outbound control channel at the MIDAS Controller site.

The outbound control channel is used as the frequency and power reference for LinkSync™ calculations. The modem also is used for transmitting the interfering carrier to terminate circuits involving integrated traffic/control modems and/or network terminals.

System Specifications	
Operating IF Range	50 to 180 MHz, in 1 Hz steps
Digital Data Rate:	
Receive	19.2 kbps
Transmit	2.4 kbps to 4.375 Mbit/s
Demodulation	QPSK 1/2 rate
Modulation	BPSK 1/2 rate QPSK 1/2, 3/4, and 7/8 rates
Forward Error Correction	Viterbi, K=7, 1/2, 3/4 and 7/8 rates
Data Scrambling	Intelsat V.35
External Reference Input	1, 5, 10, 20 MHz
Modulator Specifications	
Output Power	-5 to -30 dBm, adjustable in 0.1 dB steps
Output Spurious	< -55 dBc, 0 to 500 MHz (4 kHz band)
Output Spectrum	Meets IESS-308/309 power spectral mask
Output Return Loss	> 20 dB
Output Impedance	75Ω (Optional: 50Ω)
Data Clock Source	Internal or External
Demodulator Specifications	
Input Power	
Desired Carrier	-30 to -55 dBm
Maximum Composite	-5 dBm or +40 dBc
Input Impedance	75Ω (Optional: 50Ω)
Input Return Loss	> 20 dB
Carrier Acquisition Range	± 35 kHz, from 100 Hz to 35 kHz in 1Hz steps
Acquisition Time 19.2 kbps, QPSK, R=1/2	< 2 second
Sweep Reacquisition	0 to 999 seconds, in 1 second steps
Data Clock	Internal, External, TX, Recovered RX
Monitor & Control Specifications	
Interface Type	EIA-232
Data Rate	19.2 kbps
Commands	ASCII

MIDAS Controller Options

The following options are available for the MIDAS Controller:

- Redundant MIDAS Controller with automatic switchover
- Redundant Network Control Modem with automatic switchover
- Redundant LinkSync™ Modem with automatic switchover
- Site power blocking

Redundant Controller

Two methods are available for redundant MIDAS Controller configuration with automatic switchover.

- Method 1 - Locally redundant Ethernet LAN MIDAS Controller configuration is shown in Figure 4-2.
- Method 2 – Geo-redundant Dedicated Circuit (satellite transmitted) MIDAS Controller configuration is shown in Figure 4-3.

One MIDAS Controller is configured to be the primary while the other MIDAS Controller is configured to be the backup. The two NMS monitor each other over the LAN. The backup MIDAS Controller also monitors the outbound control channel. In case of failure, the backup MIDAS Controller assumes the active role. When the failed MIDAS Controller is repaired, it assumes the backup role. The two MIDAS Controllers keep the databases synchronized over the LAN.

The MIDAS operator can:

- Configure and reconfigure the MIDAS Controller as primary or backup.
- Switch between primary and backup MIDAS Controller without changing the configuration.

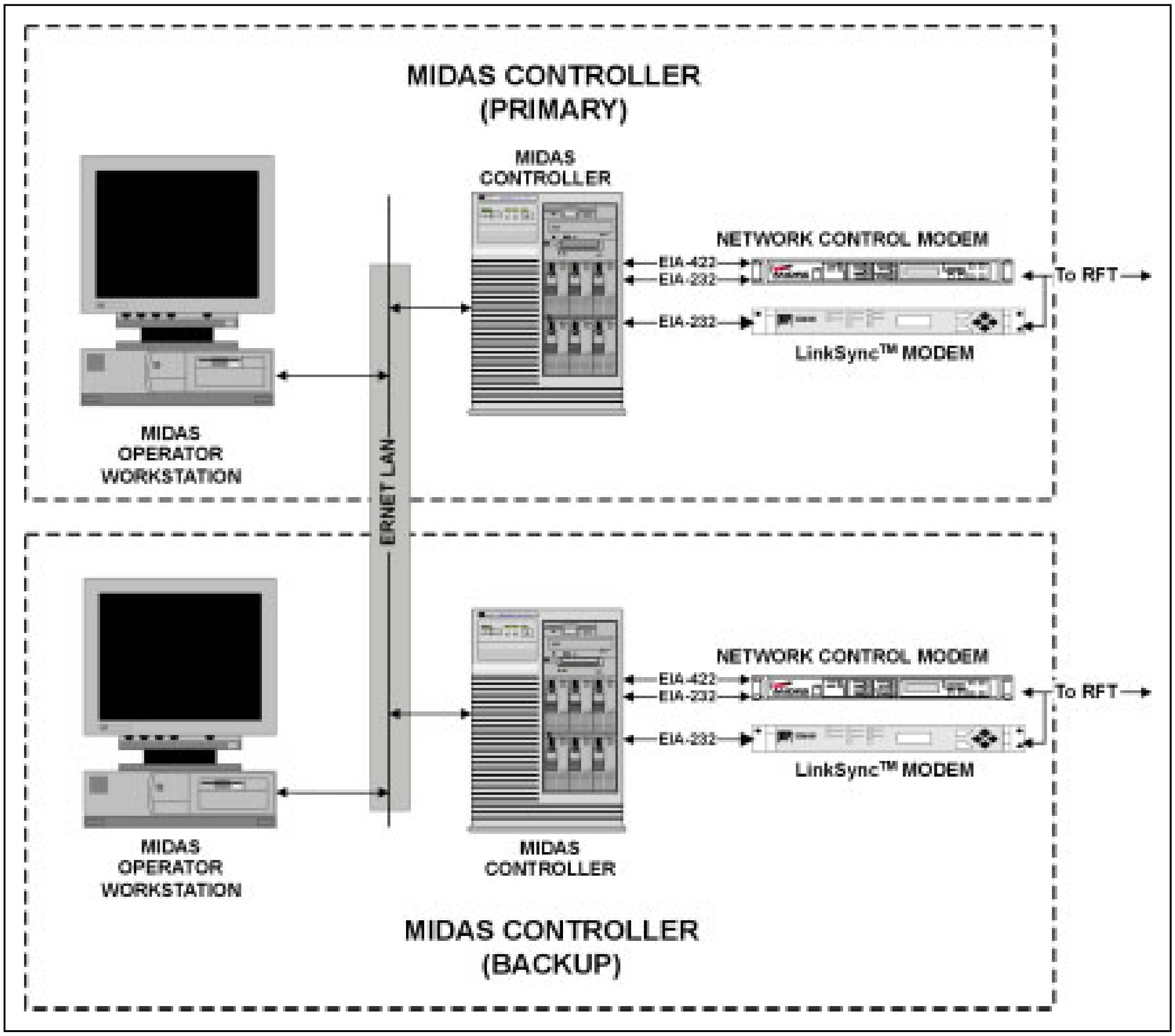

Figure 4-2. Locally Redundant MIDAS Controller Configuration (Method 1)

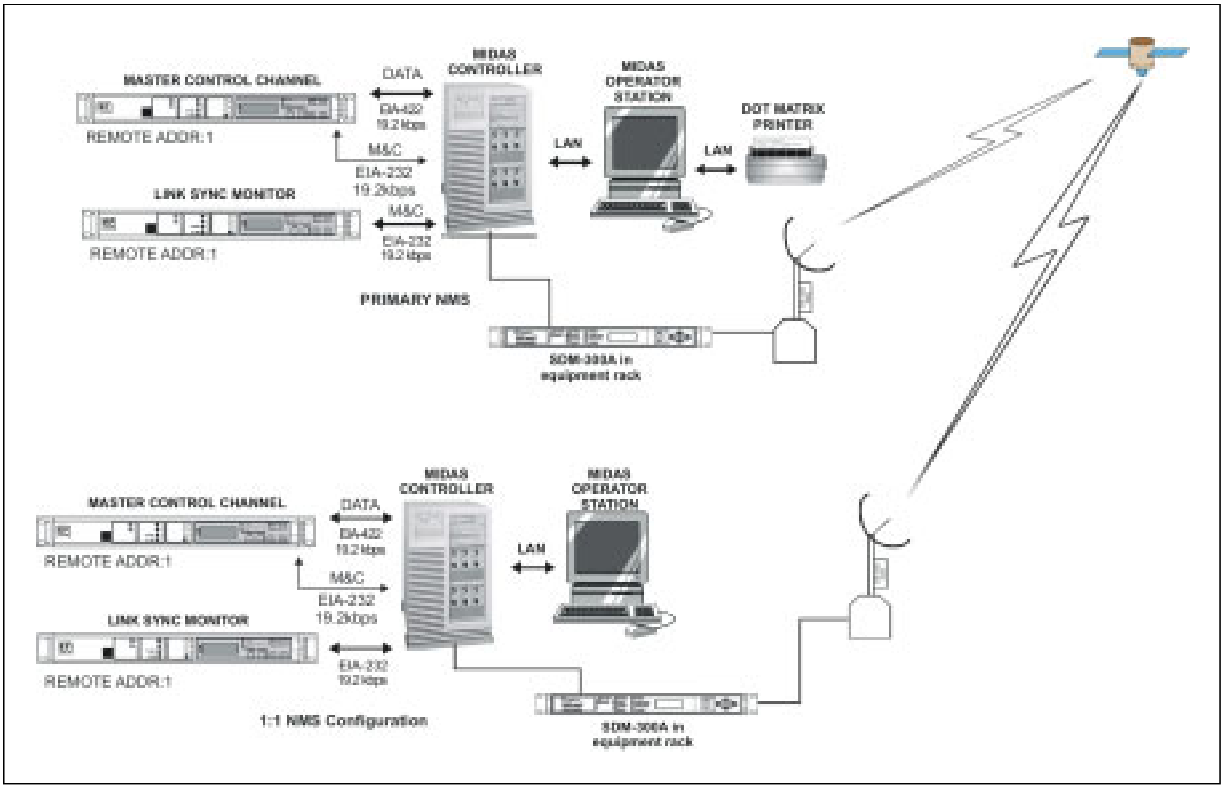

Figure 4-3. Geo-Redundant MIDAS Controller Configuration (Method 2)

Redundant Network Control Modem

As an option, a 1:1 redundancy can be provided for the Network Control Modem to ensure continued network operation in case of failure. The redundancy is provided via Comtech EFData's SMS-301 Modem Protection Switch. It can simultaneously switch data and IF, and can be ordered with either independent or dependent switching of the modulator and the demodulator.

When a fault is detected in the online modulator or demodulator, a switch to the backup modem occurs, provided it is not in a faulted condition. The transmit data is buffered and sent to the backup modem by the switch to prevent false transmit fault indications. The actual switching is accomplished within 20 ms, with programmable modulator and demodulator delays in the range of 0 to 127 seconds.

Redundant LinkSync™ Modem

As an option, a 1:1 redundancy can be provided for the LinkSync™ Modem to ensure continued network operation in case of failure. The redundancy is provided via Comtech EFData's SMS-301 Modem Protection Switch. It can simultaneously switch data and IF, and can be ordered with either independent or dependent switching of the modulator and the demodulator.

When a fault is detected in the online modulator or demodulator, a switch to the backup modem occurs, provided it is not in a faulted condition. The transmit data is buffered and sent to the backup modem by the switch to prevent false transmit fault indications. The actual switching is accomplished within 20 ms, with programmable modulator and demodulator delays in the range of 0 to 127 seconds.

5. Operator Functions

User Management and Security

The system supports multiple users accessing the NMS via the operator workstation. The users can be added or deleted as required. Each user can be configured to have different access rights. The system has a default "super user" with every access privilege. The system must maintain one super user at all times. Figure 5-1 illustrates a sample User Security Settings screen.

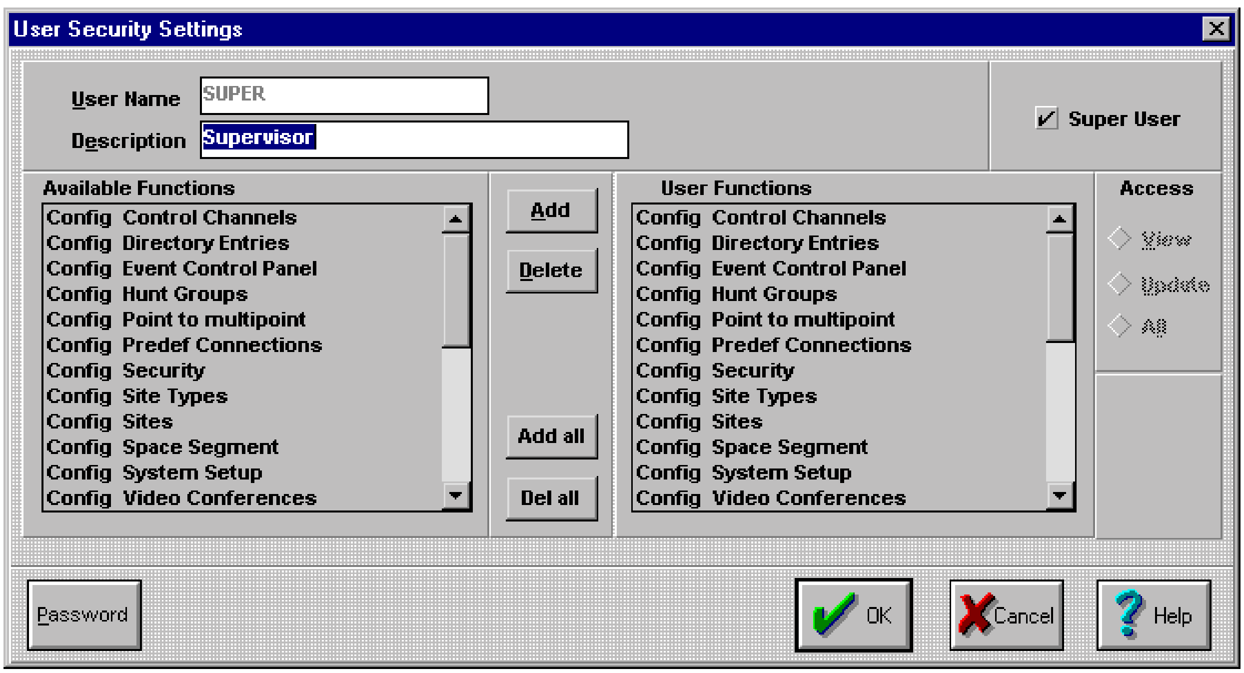

Figure 5-1. User Security Settings

The NMS, being the central point of configuration and control for the entire network, employs a two-level security mechanism for regulating access:

- Passwords: A password is required to gain access to the operator workstation. Every authorized user is allocated a password for logging on to the operator workstation.

- Access list: For each user, an access list is maintained. The list contains the user's privileges with respect to the commands and functions available on the operator workstation.

    - A user can have a *View* privilege for read-only access, *Update* privilege for read and modify, and *All* for read, write, add, and delete.

    - Not all functions can have all the access privileges.

    - Example, a report-generating function can only have a view privilege.

System Setup

The System Setup screen is used to configure the system-specific parameters such as transponder characteristics, allocation factor (carrier spacing), step size (channelization), etc.

- It also provides for enabling and disabling the LinkSync™ features; enabling and disabling the redundant NMS; and defining the default characteristics for data, and video circuits.
- A sample System Setup screen is illustrated in Figure 5-2.

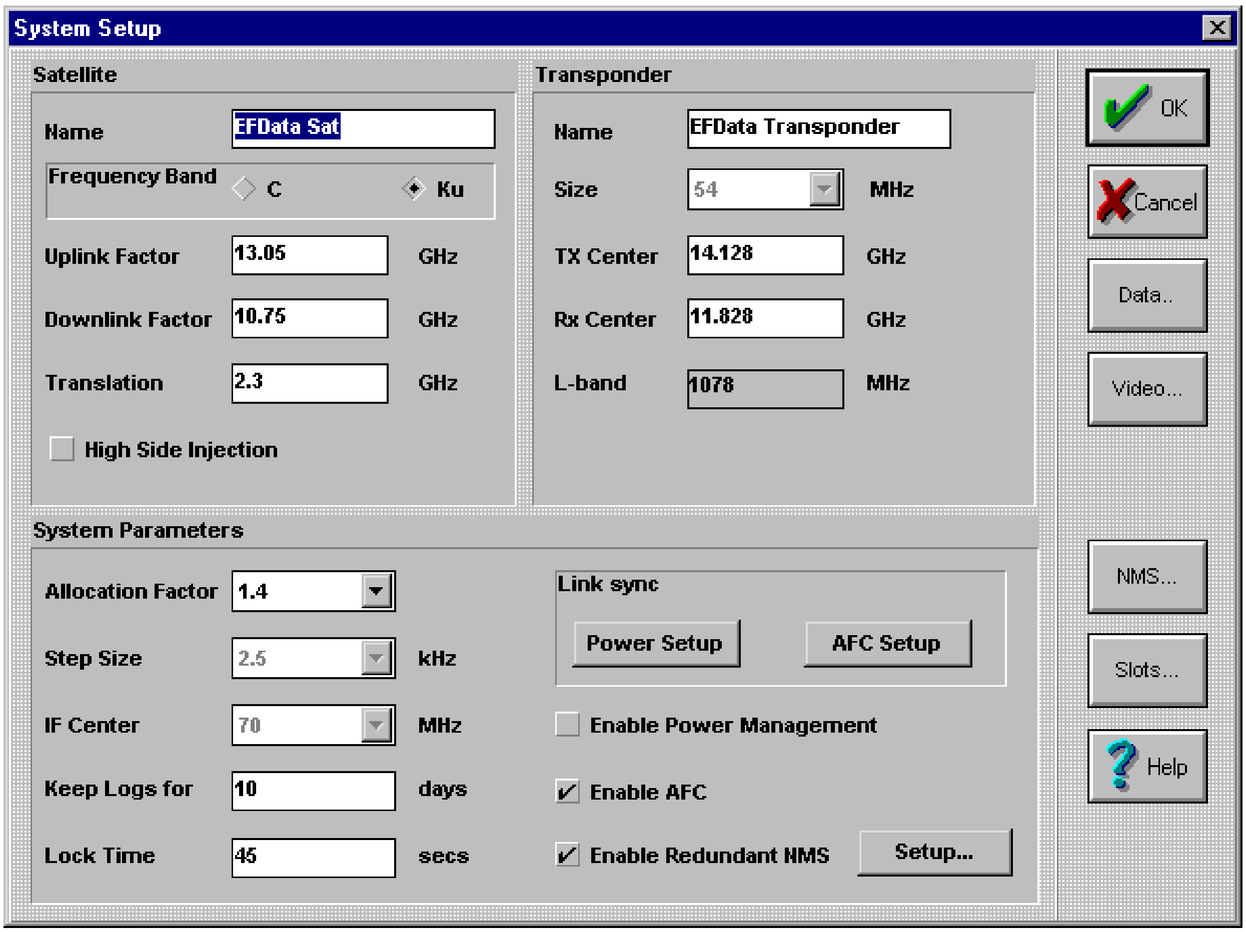

Figure 5-2. System Setup

Site Configuration

A MIDAS network has two types of sites:

- MIDAS Controller (Hub) site
- Remote sites

The Site configuration screen allows for configuring site-specific parameters such as antenna type, HPA power, etc.

- It also allows for configuring the traffic nodes at the site.
- A sample site configuration screen is illustrated in Figure 5-3.

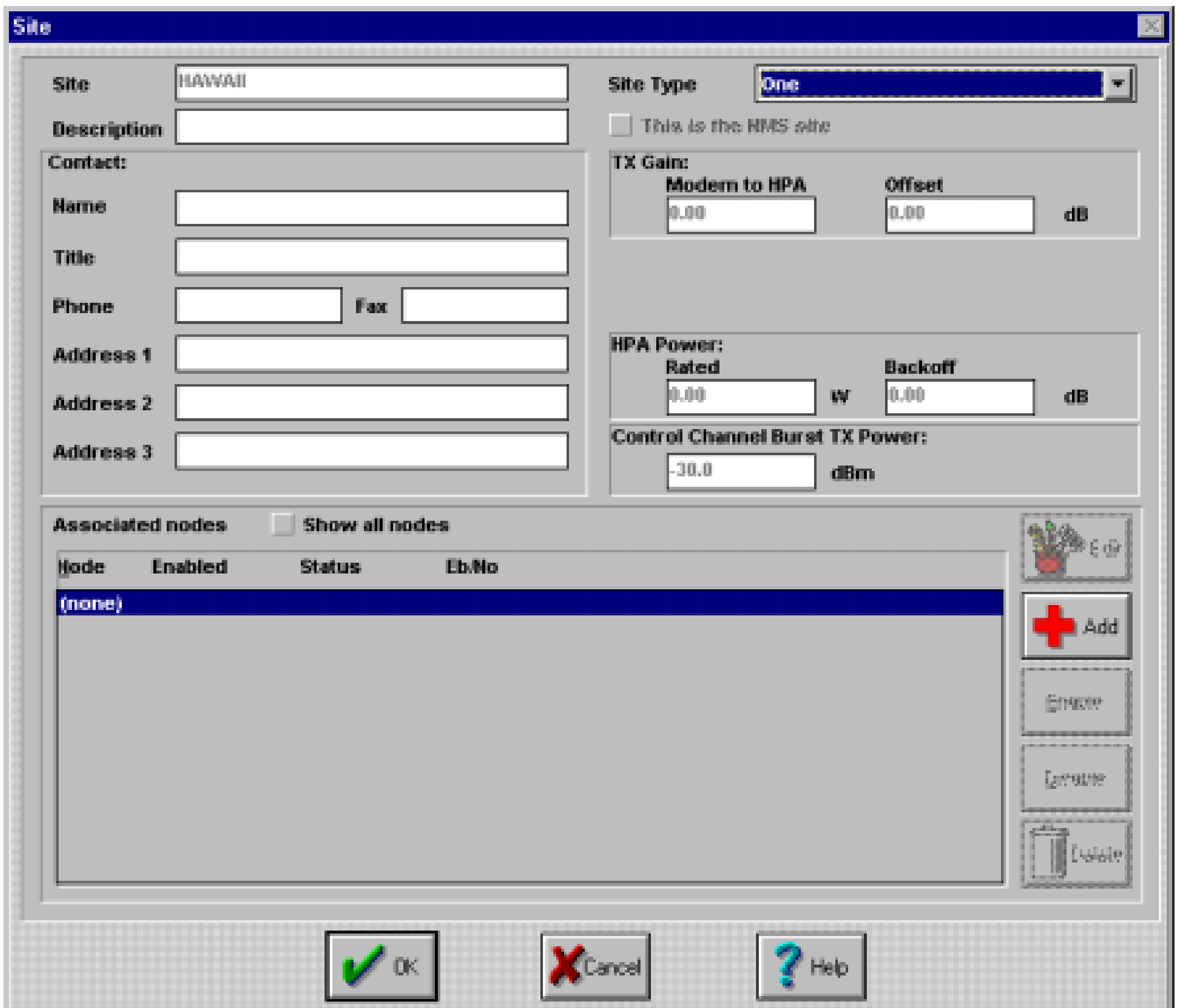

Figure 5-3. Site Configuration

Traffic Node Configuration

The traffic node provides the traffic channels, performs call setup and termination under MIDAS control, and provides the user port for requesting establishment and termination of circuits, and sending and receiving service messages.

- A sample Node configuration screen is illustrated in Figure 5-4.

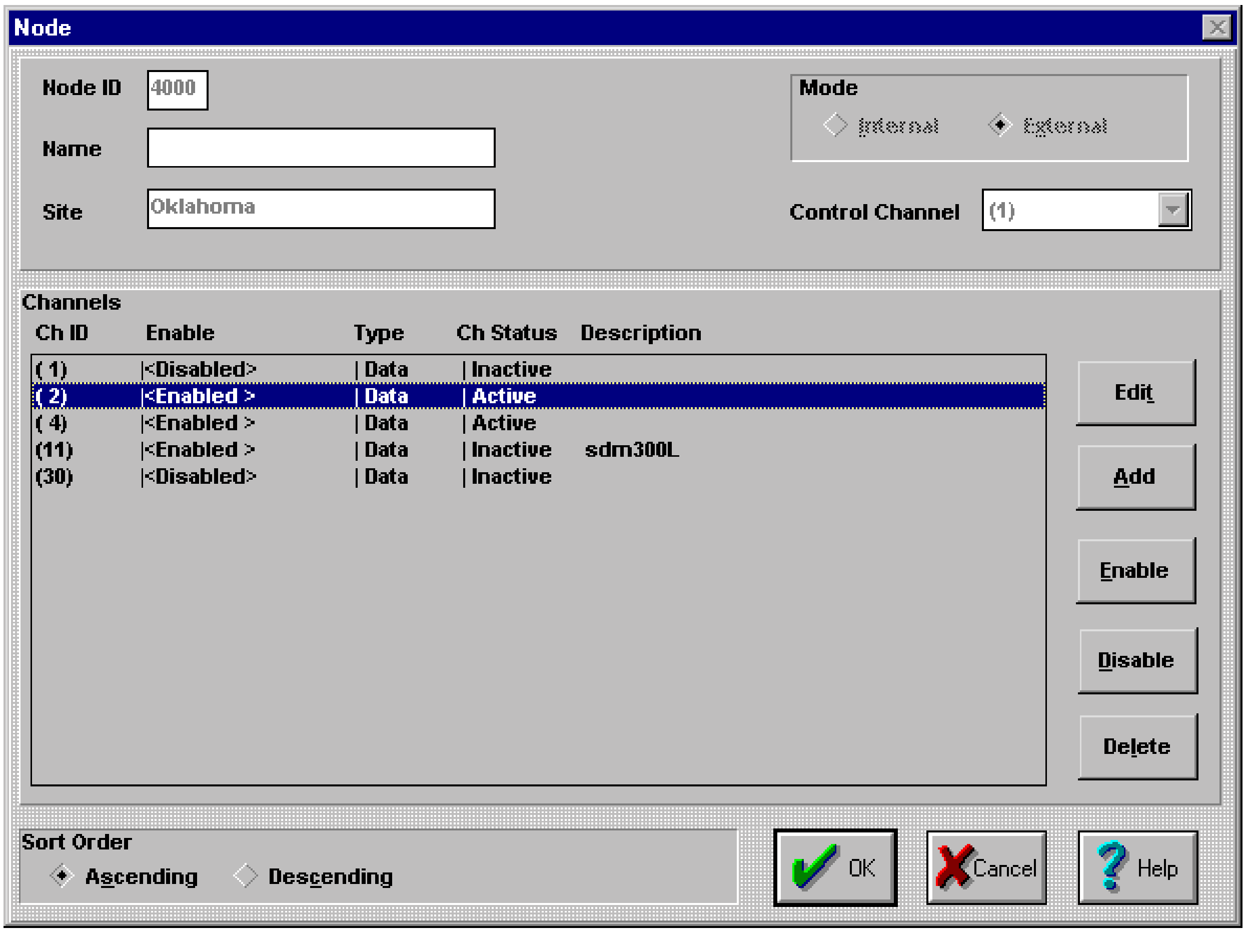

Figure 5-4. Node Configuration

Traffic Channel Configuration

Traffic channels provide the terrestrial interface for user traffic. Each traffic channel in a traffic node is identified by a unique address, which ranges from 1 to 30.

- A sample Channel Details screen is illustrated in Figure 5-5.

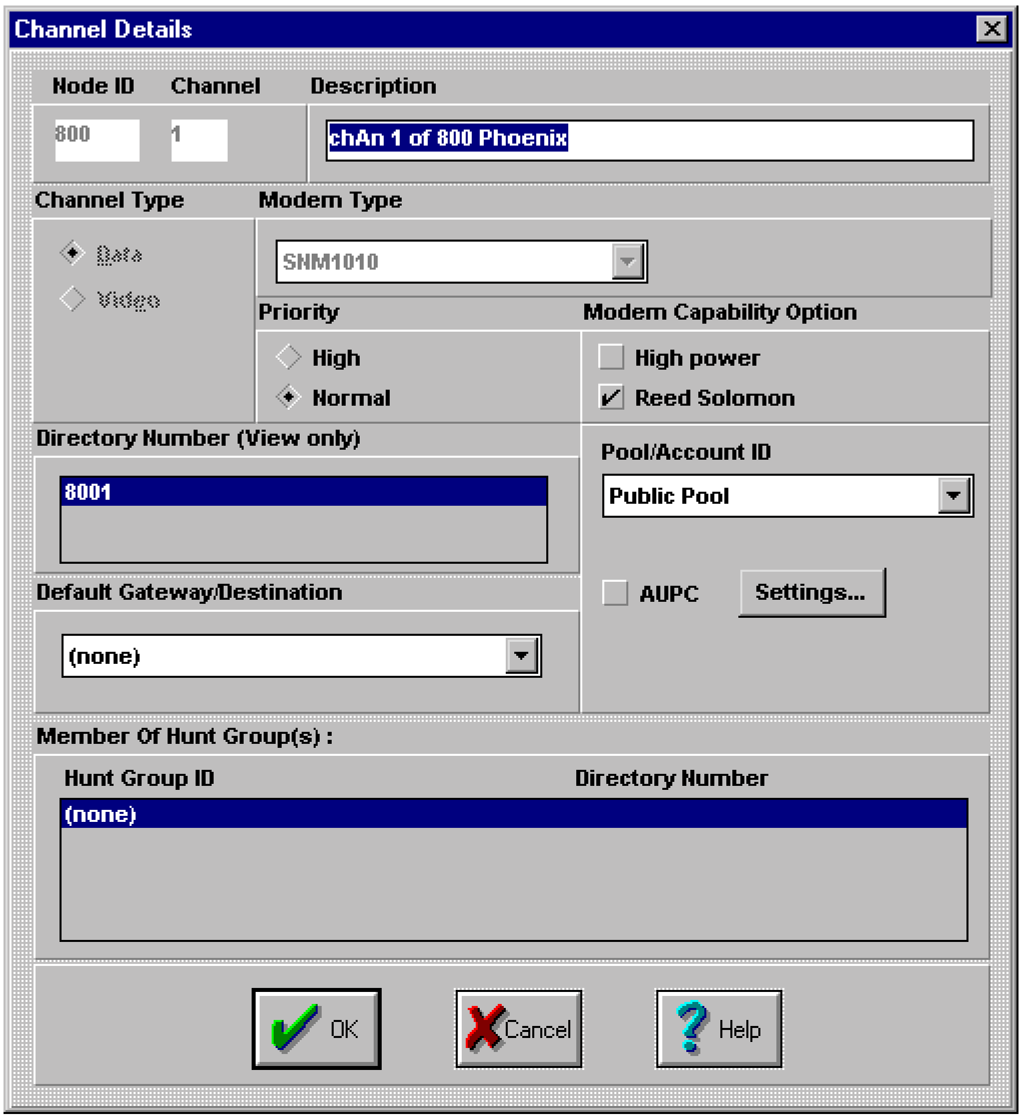

Figure 5-5. Channel Details

Directory

The system supports the concept of logical addresses to identify traffic channels.

- A logical address could identify individual traffic channel(s) or hunt group(s).
- Wild card characters are permitted when defining logical addresses.
- A directory is maintained of all the logical addresses defined in the system.
- A sample screen to create a directory number is illustrated in Figure 5-6.

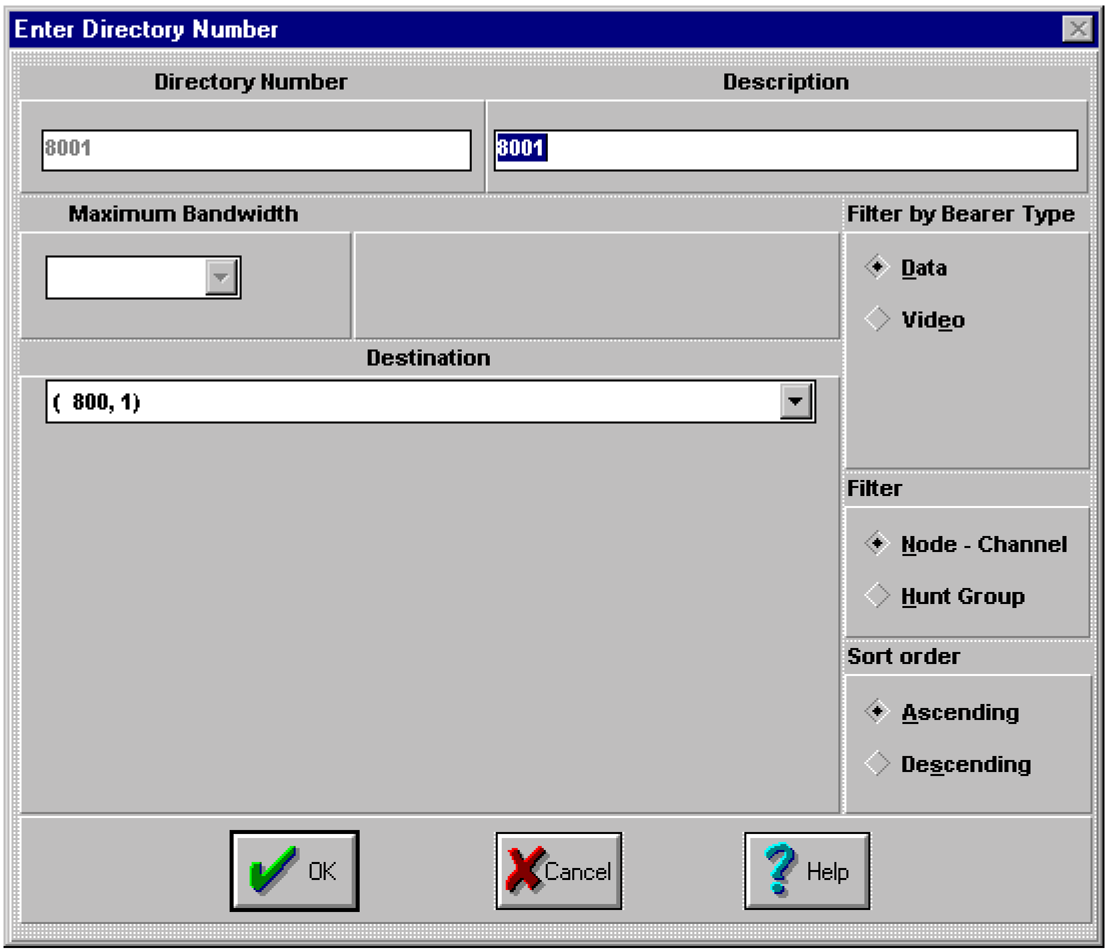

Figure 5-6. Enter Directory Number

Hunt Groups

The system supports hunt groups for logical grouping . A hunt group is a list of traffic channels and could span multiple nodes. One or more directory numbers can address all the channels in a hunt group.

- If a user dials a directory number that identifies a hunt group, the system searches for an available traffic channel in the group to which the call is then awarded.
    - ♦ Multiple channel search options are available including forward, reverse, and always from the beginning (pack).
- The hunt groups also can be used for providing redundancy by having additional modems configured in the hunt group.
    - ♦ If one of the modem fails, the system selects another modem in that hunt group when a new call is placed to that hunt group.
- Figure 5-7 illustrates a sample Hunt Group Details screen.

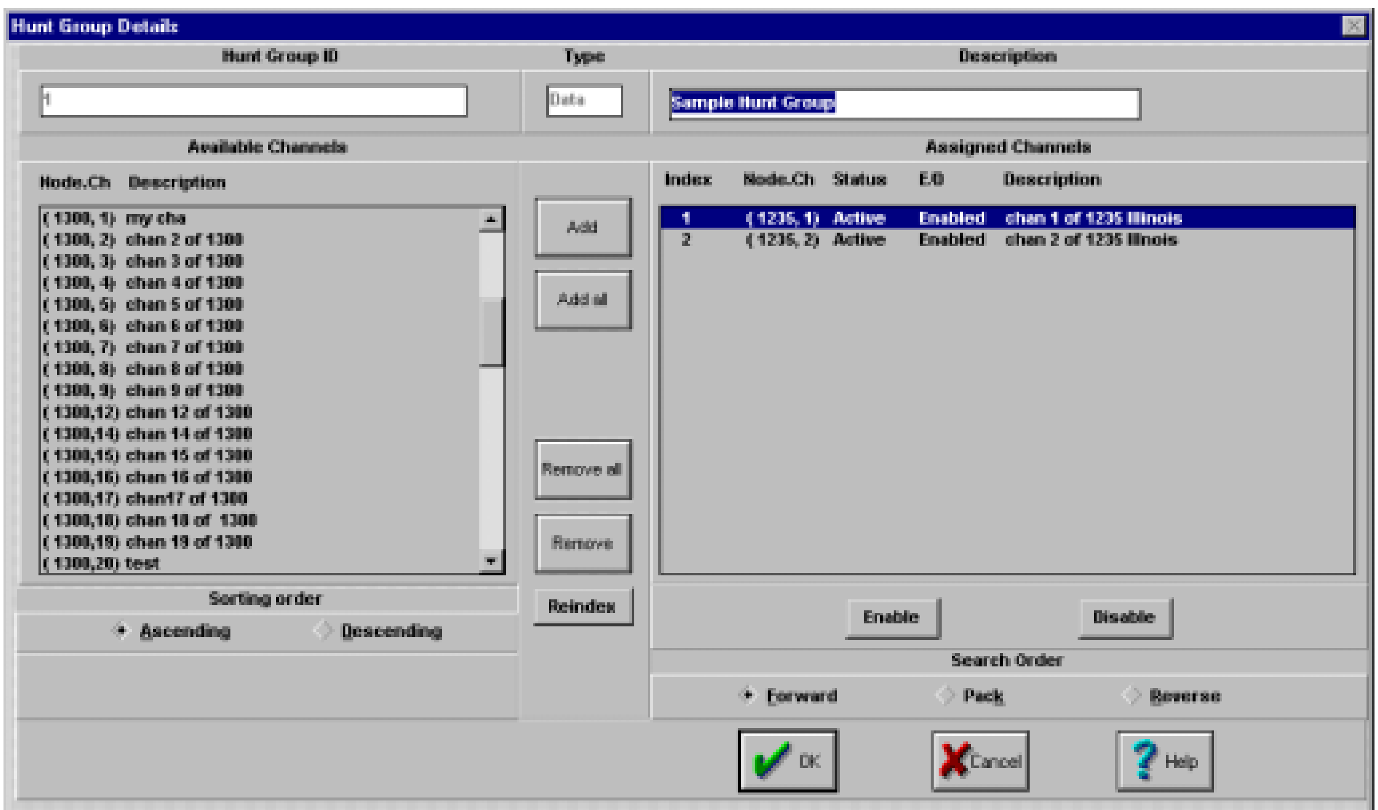

Figure 5-7. Hunt Group Details

Data Circuit

A point-to-point full duplex or simplex data circuit can be pre-defined at the MIDAS Controller, and a unique identifier associated with it.

- This definition is used for establishing permanent circuits.
- The data circuit definitions are also used for automatic call initiation by the customer equipment via RTS/DTR signal or alternately a CiM Modem.
- This feature is useful for applications such as automatic circuit restoral and congestion reduction.
- Figure 5-8 illustrates a sample data circuit details screen.

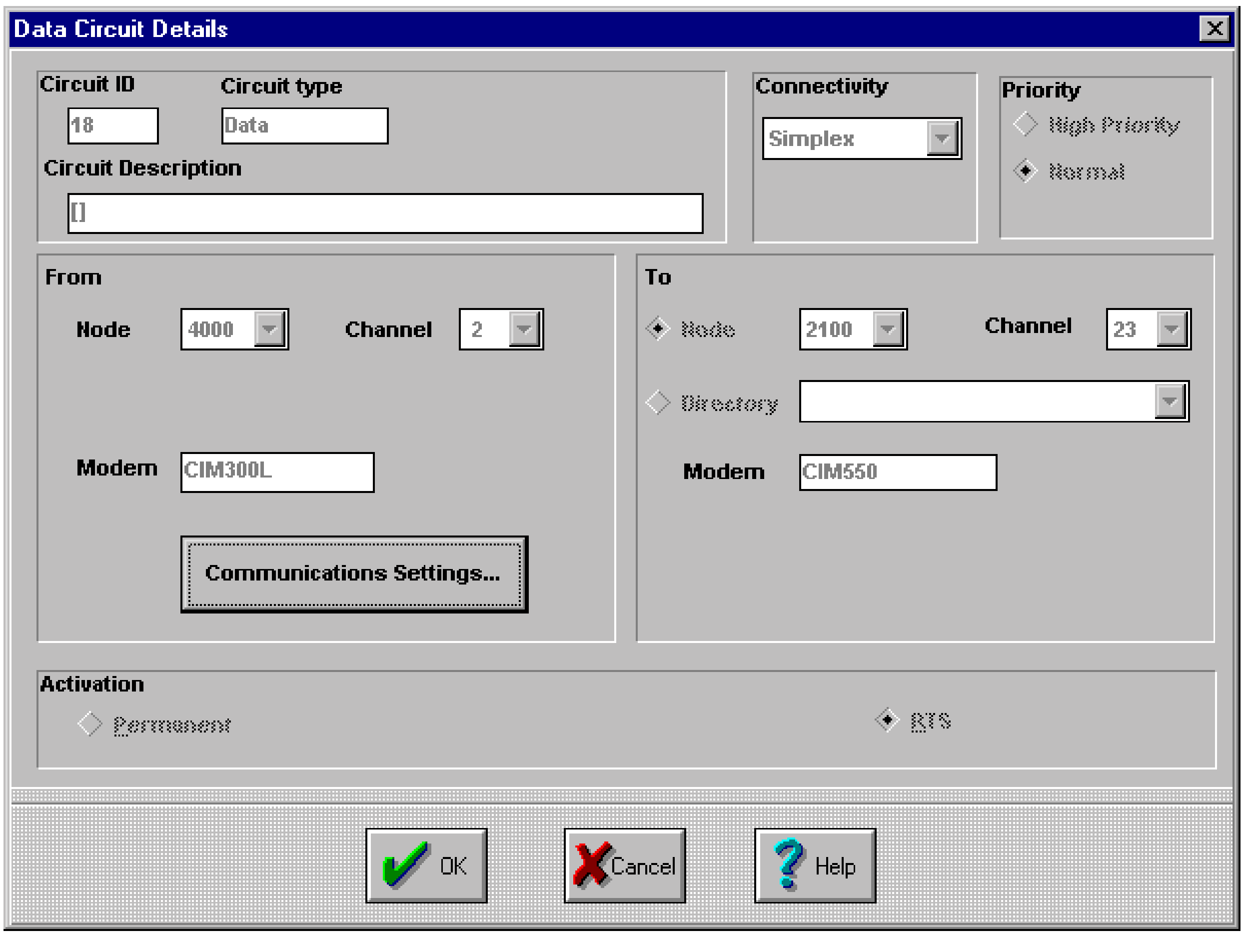

Figure 5-8. Data Circuit Details

Point-to-Multipoint Data Circuit

A point-to-multipoint simplex data circuit can be pre-defined at the MIDAS Controller, and a unique identifier associated with it.

- The circuit definition is used for establishing circuits via the MIDAS Controller.

Figure 5-9 illustrates a sample point-to-multipoint data circuit details screen and Figure 5-10 illustrates a sample point-to-multipoint communication settings screen.

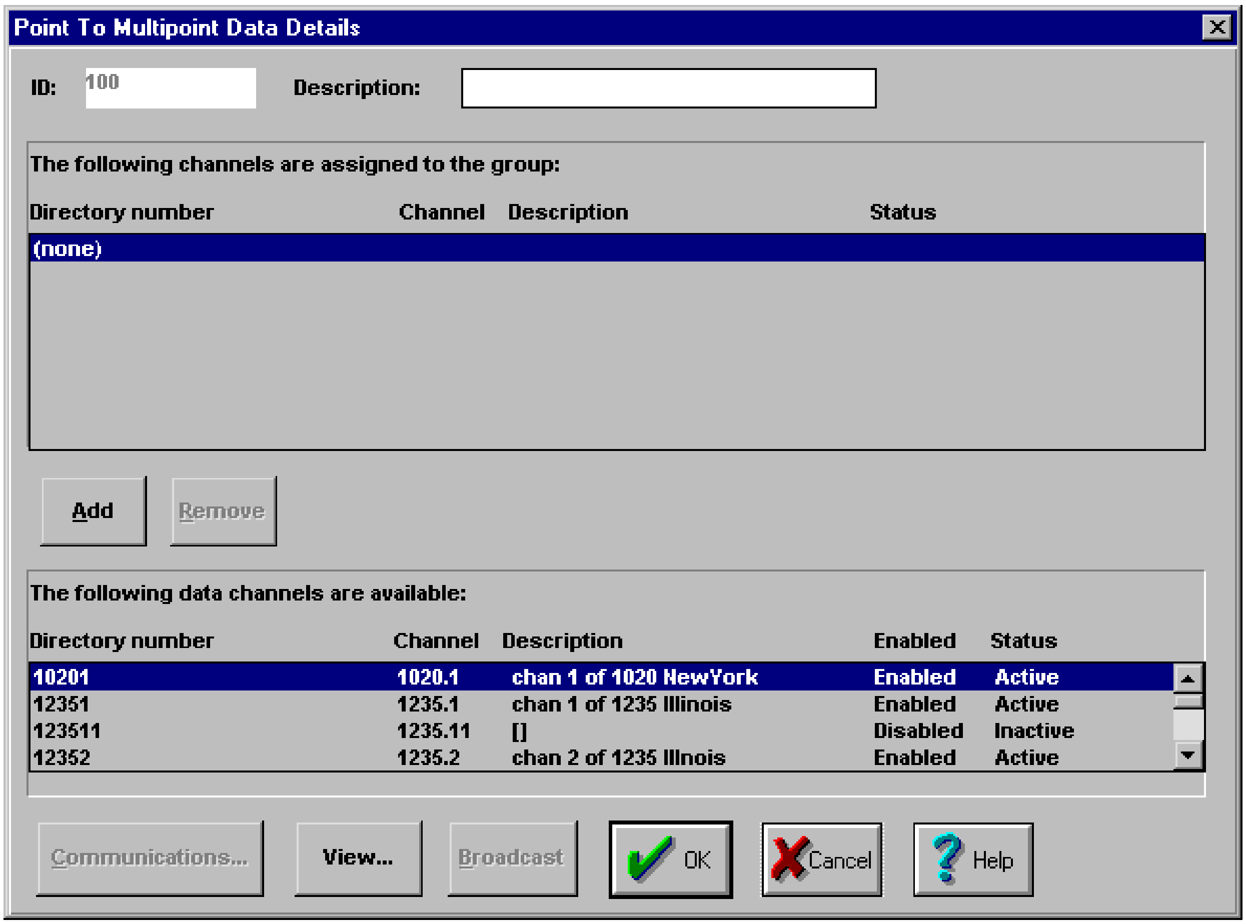

Figure 5-9. Point To Multipoint Data Circuit Details

The first traffic channel in the list is always the broadcaster. Its Directory Number is also prefixed with "**" to indicate its status as the broadcaster.

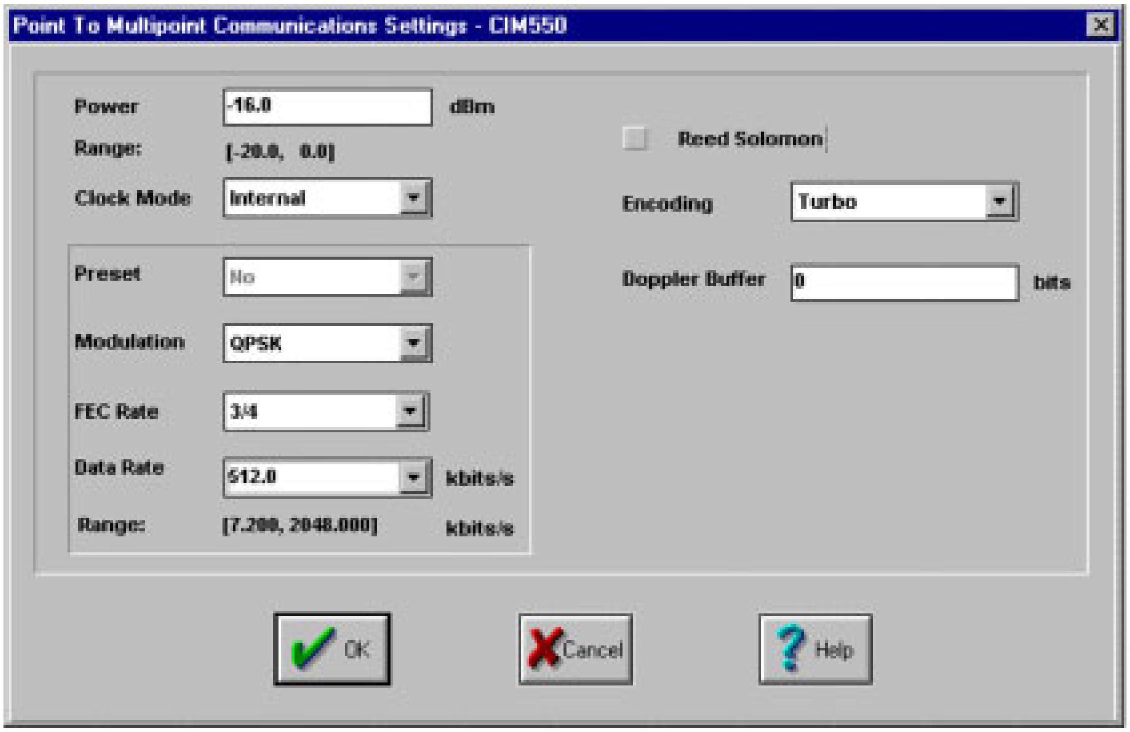

Figure 5-10. Point To Multipoint Communication Settings

Video Conference

MIDAS supports end-user initiated videoconference sessions that are managed by the Chairperson using the Video Conference Control System (VCCS™). The videoconference groups are defined at the MIDAS Controller and distributed to all the potential Chairperson sites. The Chairperson at the remote site to select participants for the conference uses the group definitions.

A sample screen to define videoconference groups is illustrated in Figure 5-11.

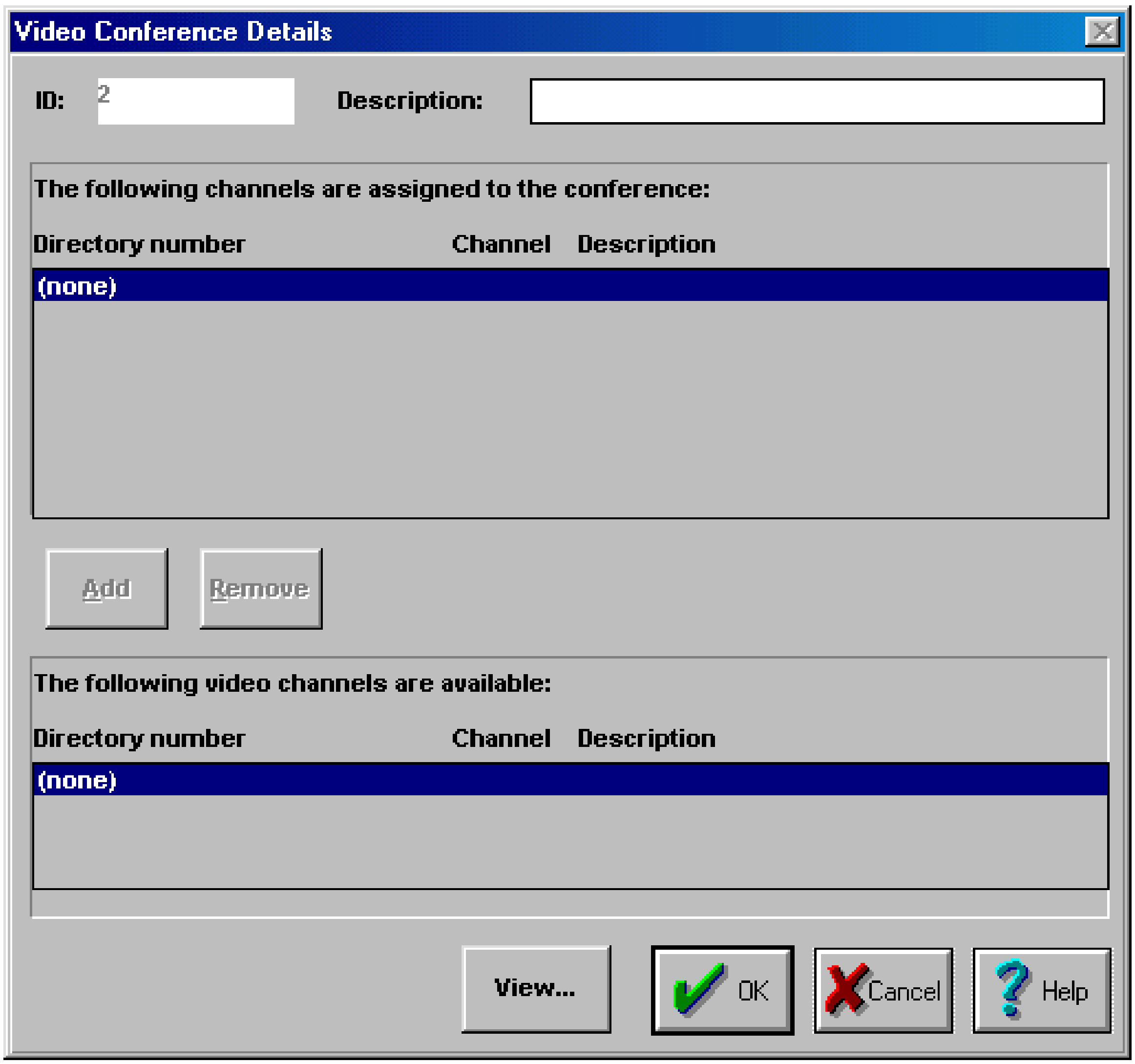

Figure 5-11. Video Conference Details

Space Segment Configuration

MIDAS is capable of managing bandwidth on 36, 54 or 72 MHz wide transponders. The system maintains a record of all the owned bandwidth, allocates bandwidth for circuits on demand and returns it to the free pool on circuit termination. The bandwidth allocation granularity (channelization) and allocation factor (carrier spacing) is user configurable during system setup. Figure 5-12 illustrates a sample space segment configuration screen.

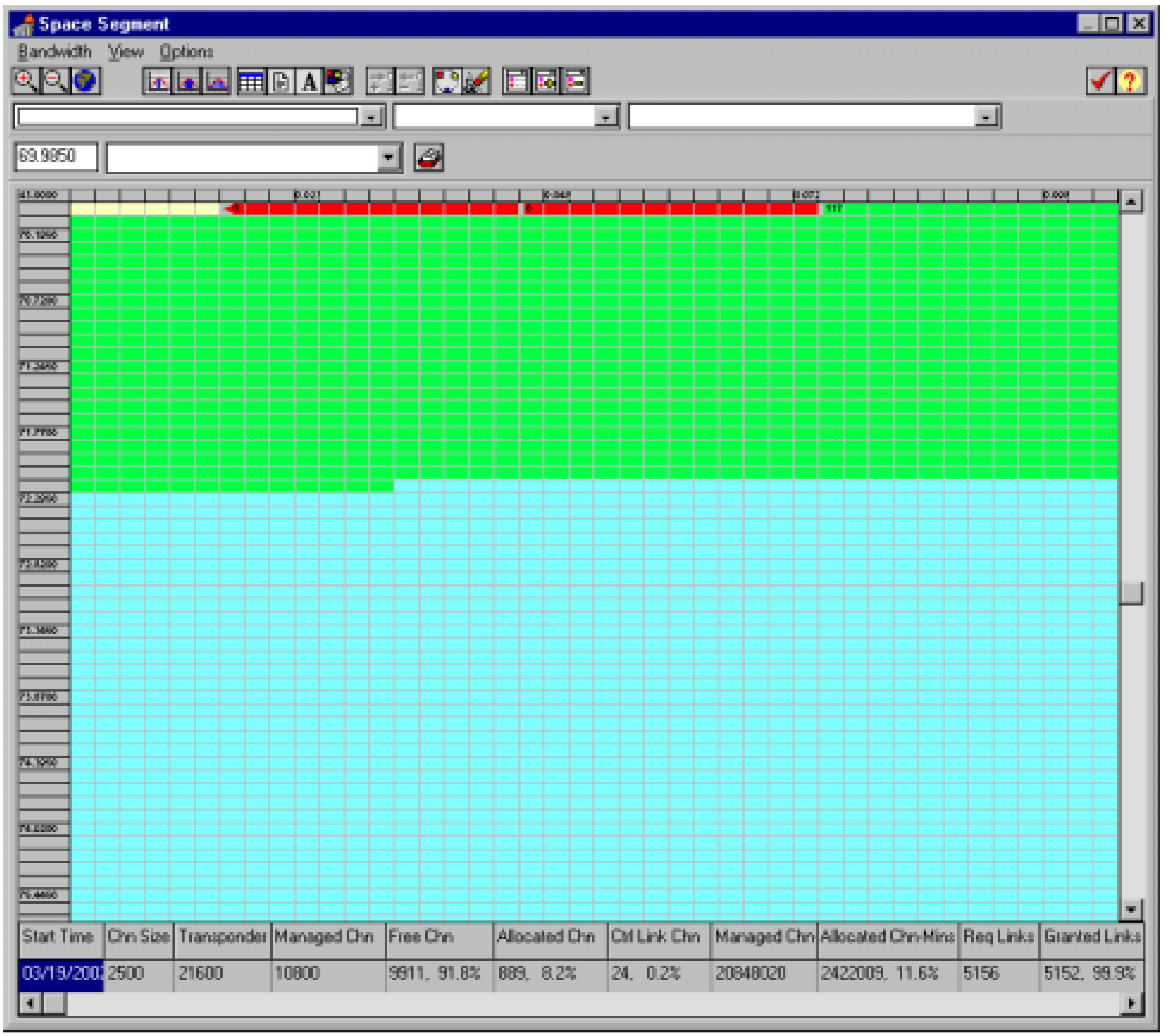

Figure 5-12. Space Segment Configuration

Bandwidth Pools

The bandwidth pools allow the reservation of bandwidth for exclusive use by customers. Customers with private pool also have the option of using the public pool, if all the available bandwidth in the private pool is in use.

Figure 5-13 illustrates a sample screen for configuring pools.

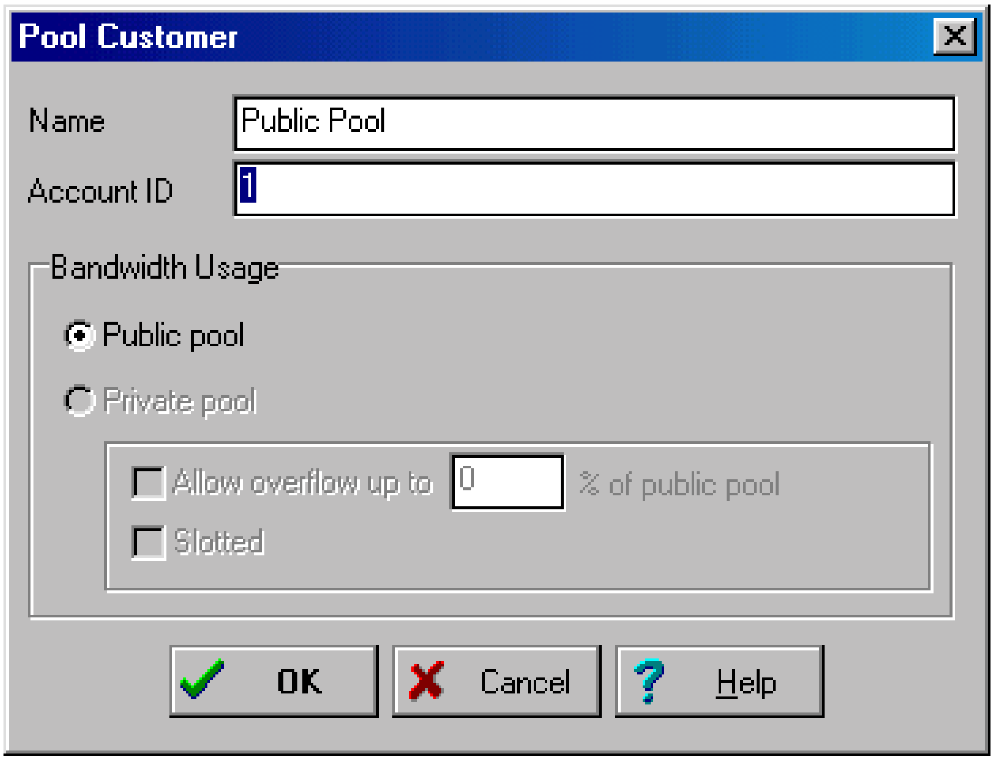

Figure 5-13. Pool Configuration

Control Channels

Dedicated satellite channels from the owned public bandwidth pool are used to distribute all network management and call control information between the MIDAS Controller and the traffic nodes. The bandwidth assigned to control channels is not available for user traffic.

Figure 5-14 illustrates a sample Control Channel configuration screen.

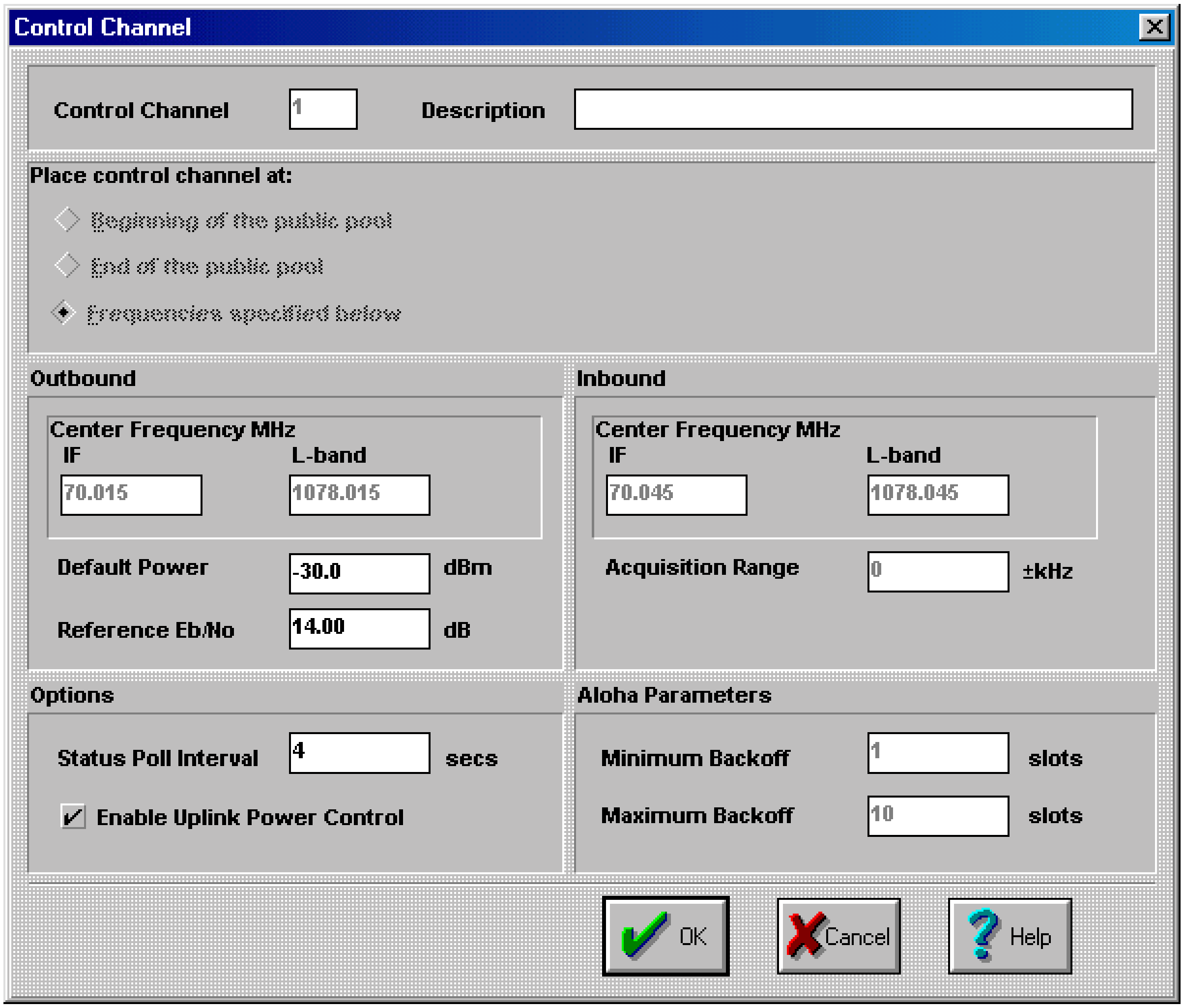

Figure 5-14. Control Channel Configuration

Backup and Restore

A backup function is available on the operator workstation to protect the contents of the database from unforeseen disasters. To avoid conflicts, it is preferable to backup when there is minimal traffic. There are two options when backing up the database - the database can either be backed up to the local operator workstation’s hard drive or to a diskette.

The restore process requires that the MIDAS Controller tasks are not running. The database is restored from the backup diskette using the uncompress utility. This causes the database files on the server to be overwritten with the files from the diskette. Once the database is restored, the MIDAS Controller can be restarted.

If the database was backed up to the operator workstation's hard disk, the backup file has to be copied to diskette before it can be restored.

Reports and Logs

For effective control and maintenance of the system, the user requires information on the performance and behavior of the system while operational. To achieve this goal, the system maintains logs and provides the capability for viewing logs and generating reports. The logs are maintained on a daily basis. A separate file is created each day for each log. The operator can specify the number of days for which the logs are to be maintained. The system automatically deletes the oldest log file. The available logs and reports include:

- Event Log
- Occupancy Report
- Completed Call Log
- Active Call Log
- Control Channel Statistics
- Node Channel Status
- Customized Reports are:
    - Site Configuration Report
    - Directory Report
    - Connection Report

Event Log

The Event Log contains all the system events that have occurred. An event can be an error, alarm, or any other information that has been selected to appear in the Event Log.

The Event Log can be viewed for a particular day and defaults to showing the current day's events. The report includes the time and date that each event occurred.

A sample Event Log screen is illustrated in Figure 5-15.

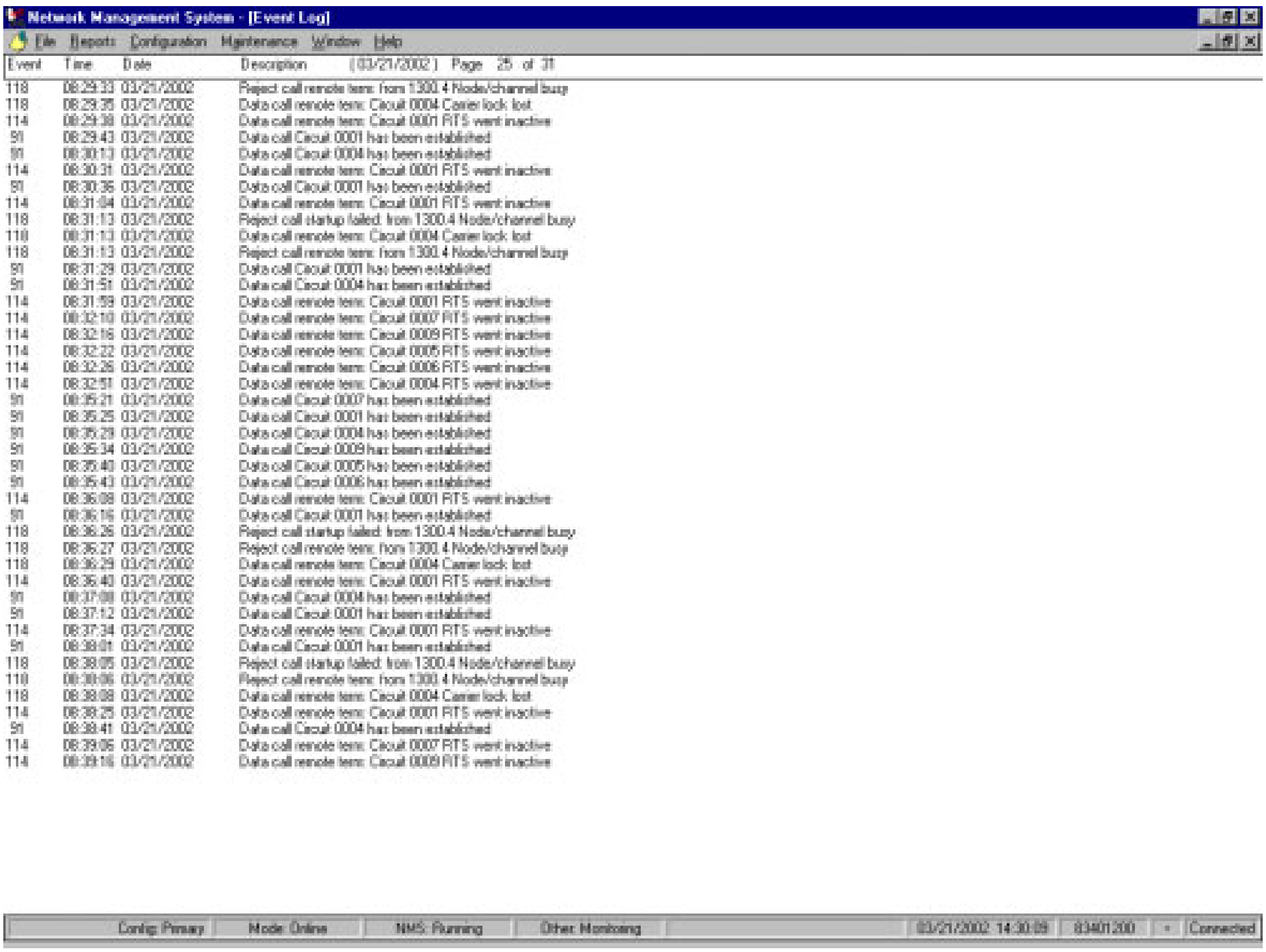

Figure 5-15. Event Log

Occupancy Graph

The Occupancy Graph is a color-coded graphical representation of the current status of the owned bandwidth showing both free and allocated bandwidth. The frequency blocks, corresponding to the minimum allocation granularity, are displayed as squares on the graph that “wrap around” from left to right. Different colors are used to indicate the state of each of the frequency blocks, i.e. owned, free, control channel or active circuit. The users have the option of displaying the frequency blocks allocated to active circuits color-coded by data rate or the circuit type, i.e. data or Video. The graph is automatically updated every 10 seconds.

Figure 5-16 illustrates a sample Occupancy Graph screen.

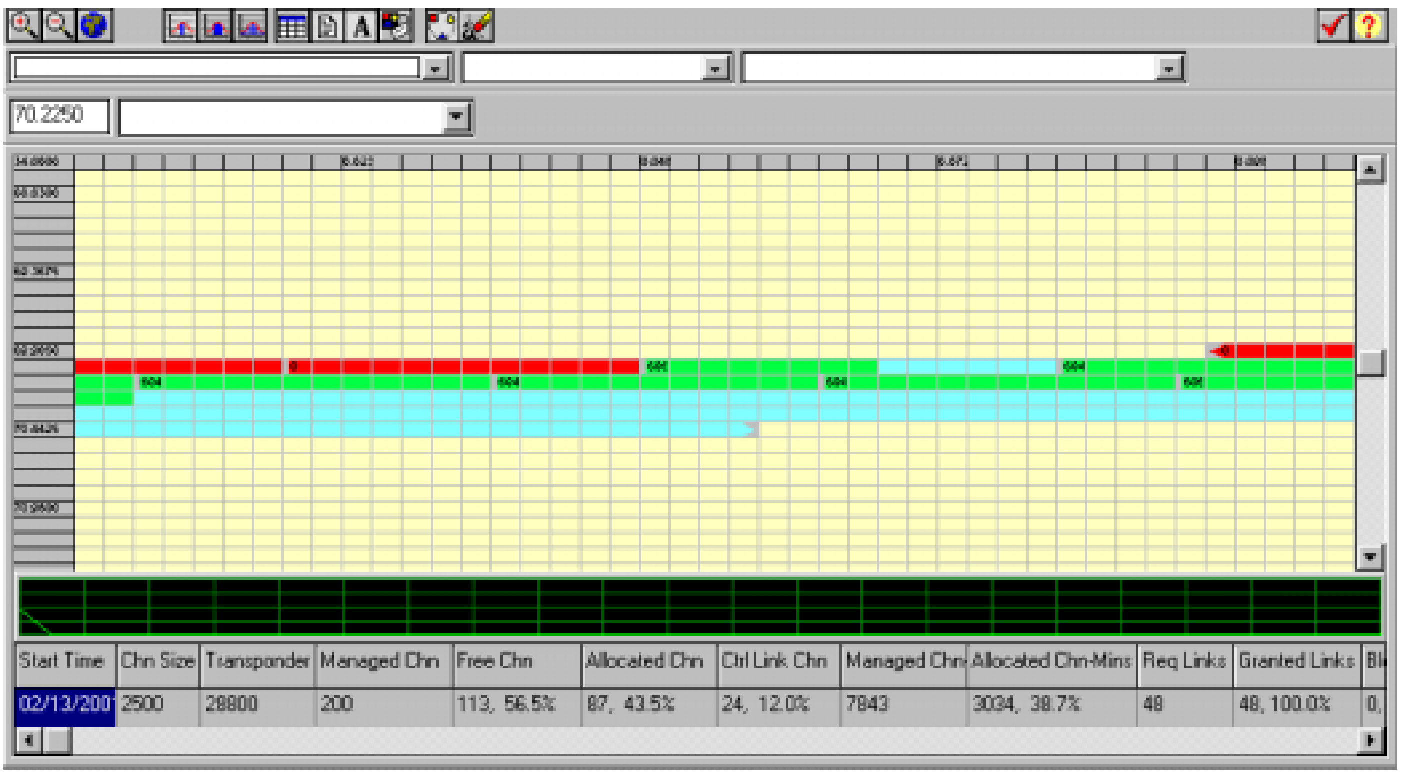

Figure 5-16. Occupancy Graph

The occupancy graph provides statistics for the owned bandwidth and can be viewed on a pool basis.

Color-coding is used with text messages as follows:

Channel Status		
Color	**Text**	**Description**
Green	CIP	Channel is currently in use (active call)
Blue	Idle	Channel has no CIP, but fully functional
Red	Fault	Channel modem is not in a functional state
Yellow	Warning	Channel is reporting a modem fault, but is still in a functional state
Gray	Disabled	Channel has been disabled by operator

Node Status		
Color	**Text**	**Description**
Green	Online-CIP	Node is communicating with NMS, is fully functional, at least one channel with CIP
	Online	Node is fully functional, but has no channels with CIP
Red	Fault	Node modem is not in a functional state, or node has all enabled channels faulted
	Warning	Node has some, but not all, channels faulted
Blue	Disabled	Node has been disabled by operator

Site Status		
Color	**Text**	**Description**
Green	Online-CIP	Site has all associated nodes online, at least one node online-CIP
	Online	SITE has all associated nodes online, but none with CIP
Red	Fault	site has all nodes faulted
Yellow	Warning	Site has some, but not all, nodes faulted, or site has nodes reporting a warning status
Blue	Disabled	All nodes at site are disabled

Completed Call Log

The Completed Call Log lists all the successful and unsuccessful call attempts (indicating the failure reason). The report can be generated for a particular day and defaults to showing the current day's calls.

The MIDAS Controller maintains the call detail records, which can be exported in a comma-delimited format on a floppy disk for delivery to an off-line billing service.

Figure 5-17 illustrates a sample Completed Calls screen.

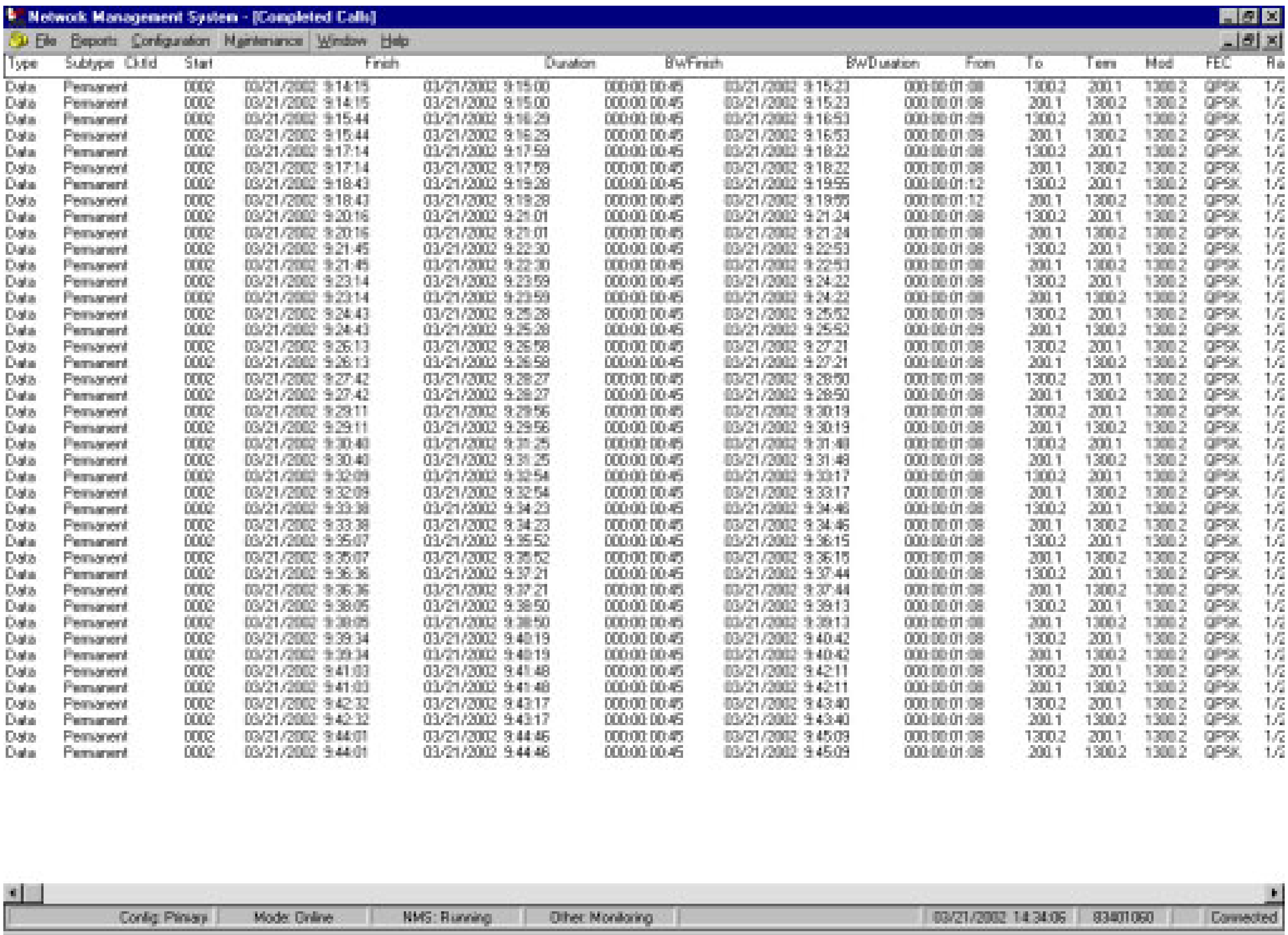

Figure 5-17. Completed Call Log

Active Call Log

The Active Call Log lists all the active circuits in the system. For each active circuit it displays the circuit ID, start time and date, calling and called addresses, circuit type, circuit status etc.

Figure 5-18 illustrates a sample Active Calls screen.

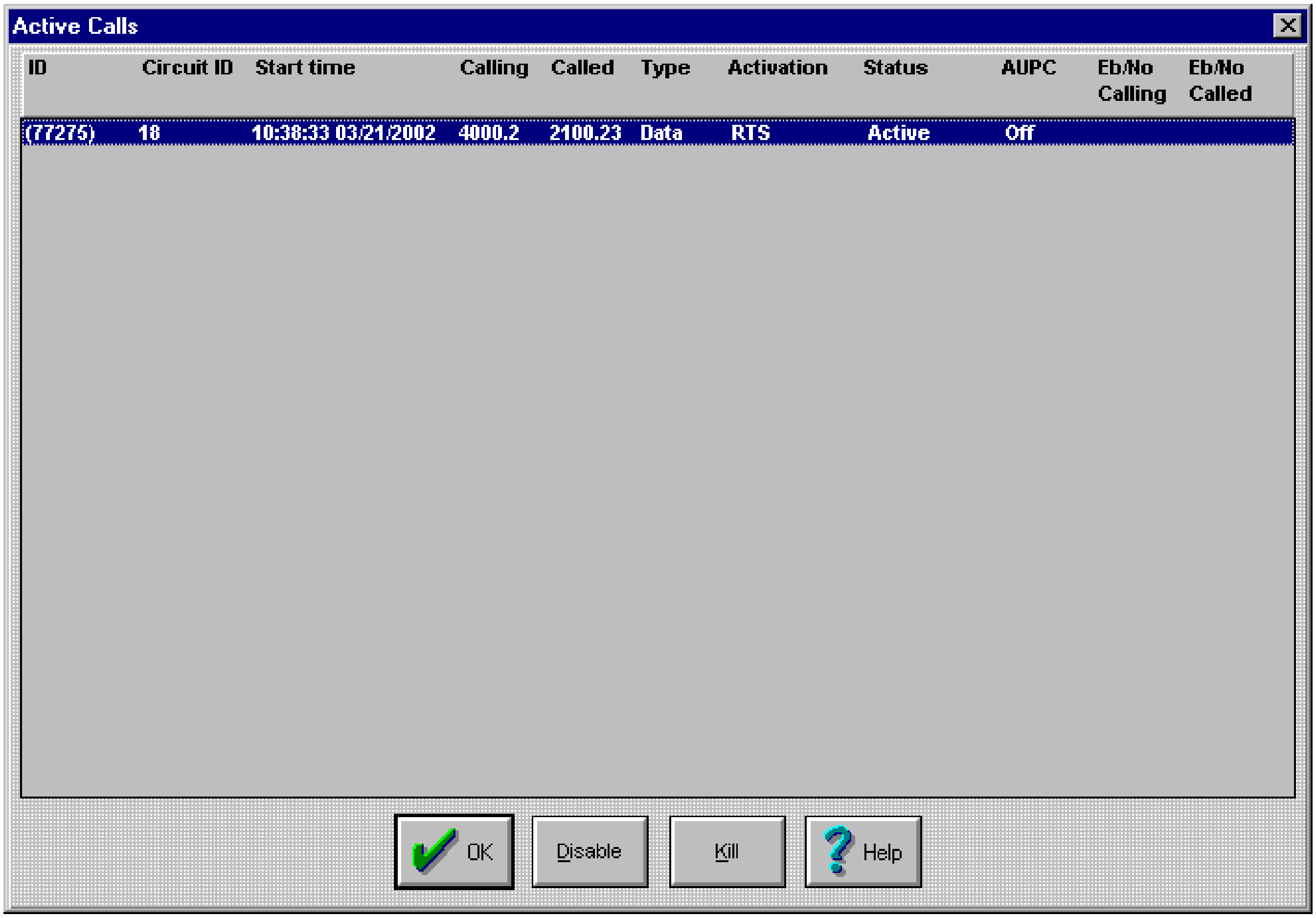

Figure 5-18. Active Calls

Control Channel Statistics

The Control Channel Statistics lists the configuration parameters and statistics for a control channel. The report is updated every 10 seconds.

Figure 5-19 illustrates a sample Control Channel Statistics screen.

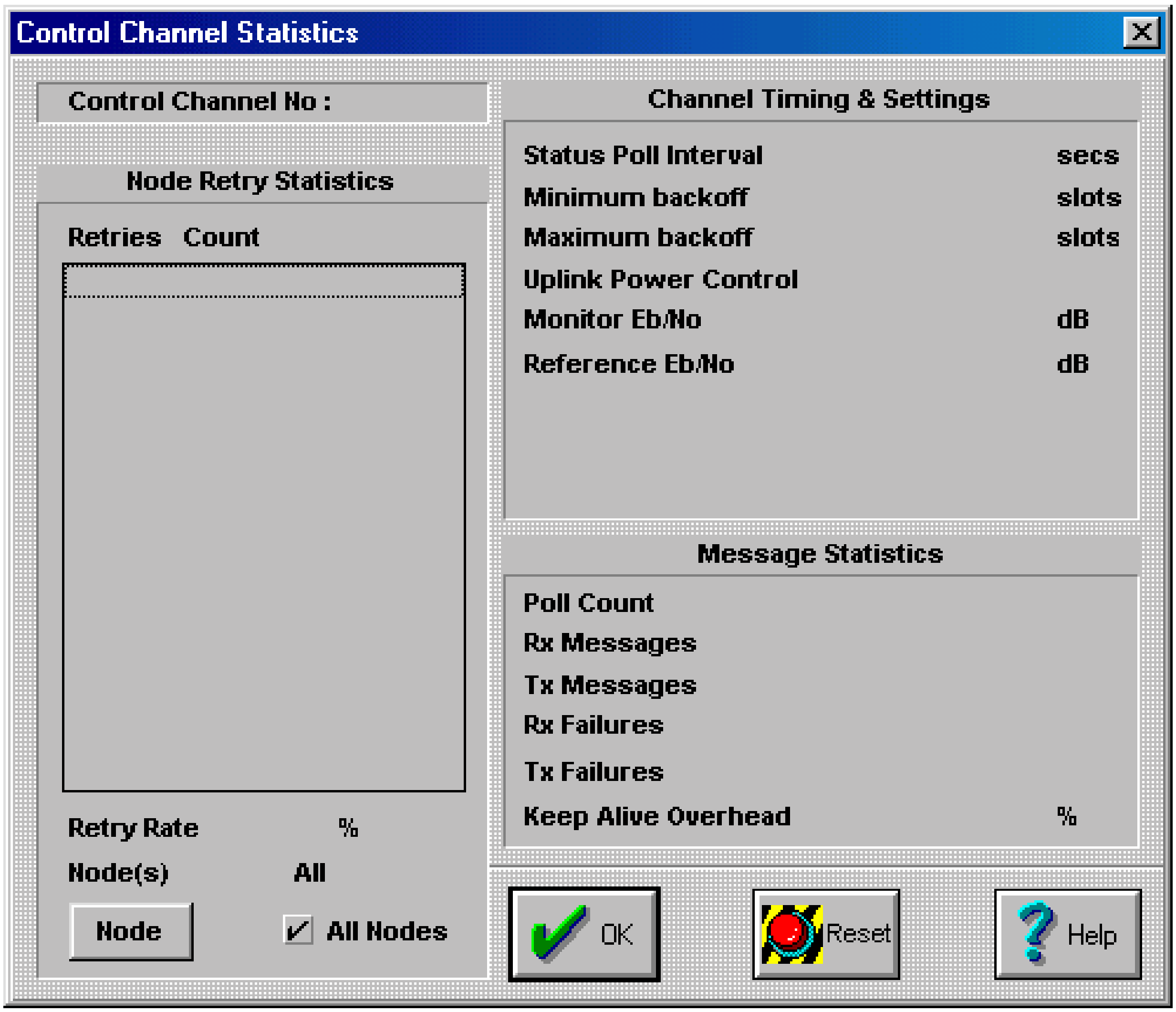

Figure 5-19. Control Channel Statistics

Node-Channel Status

The Node-Channel Status is a color-coded status report indicating the current status of all sites, nodes, and channels within the network. The report can be configured to show the status of all channels within the network, or just faulted channels.

Channel status is summarized into node and site status as well. Channel status changes are reported within 10 seconds of the physical event occurrence.

Figure 5-20 illustrates a sample Node-Channel Status screen.

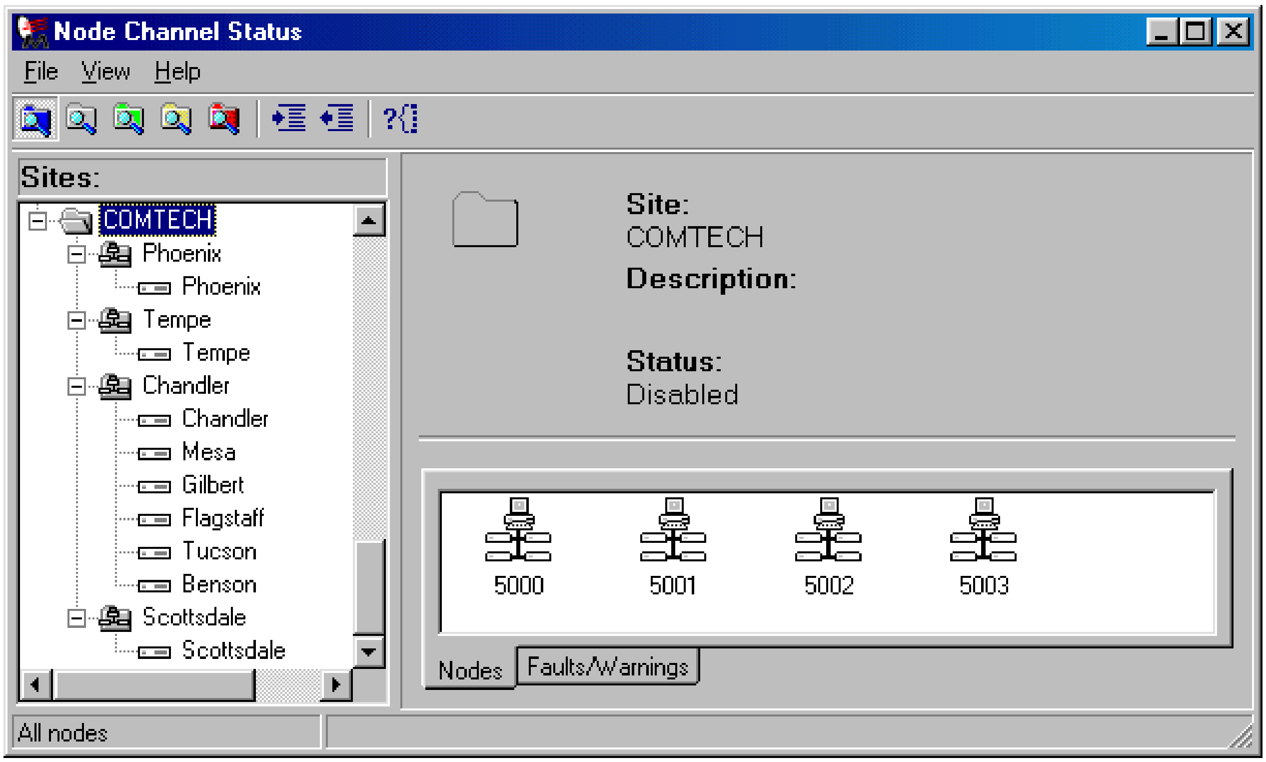

Figure 5-20. Node-Channel Status

File

The File consists of the following:

- File Header
- File Record

File Header

The first line of the exported file contains information about the file contents and is in the following format:

NumRecs,StartDate,EndDate,StartTime,EndTime

where:

Field	Length	Format	Description
NumRecs	1 to 6	ASCII	The number of call records in the file.
StartDate	10	DD/MM/YYYY	The start date of the call records in the file.
EndDate	10	DD/MM/YYYY	The end date of the call records in the file.
StartTime	8	HH:MM:SS	The start time of the call records in the file.
EndTime	8	HH:MM:SS	The end time of the call records in the file.

File Record

The remaining lines in the exported file are call detail records, in comma-delimited format:

CallType,CallSubType,CallingAcct,CalledAcct,CalledNo,FromNode.Channel,ToNode.Channel,StartDate,StartTime,EndDate,EndTime,BwRelDate,BwRelTime,TermCode,FromFEC,FromModulation,FromPowerLevel,FromEbNo,FromDataRate,FromReedSol,FromViSeq,ToFEC,ToModulation,ToPowerLevel,ToEbNo,ToDataRate,ToVarDataRate,ToReedSol,ToViSeq,BwFrom,BwTo where:

Field	Description
CallType	Indicates if a data or video call.
CallSubType	Permanent, Scheduled, Remote, or RTS.
CallingAcct	Calling user’s account number.
CalledAcct	Called user’s account number.
CalledNo	The destination channel’s logical address.
FromNode.Channel	The originating node/channel number.
ToNode.Channel	The destination node/channel number.
StartDate	Start date of call in DD:MM:YYYY format.
StartTime	Start time of call in HH:MM:SS format.
EndDate	End date of call in DD:MM:YYYY format.
EndTime	End time of call in HH:MM:SS format.
BwRelDate	Bandwidth release date in DD:MM:YYYY format.
BwRelTime	Bandwidth release time in HH:MM:SS format.
TermCode	Reason for call termination: NORMAL, CONTROL CHANNEL CONGESTION, NO SPACE SEGMENT AVAILABLE, FAR SIDE OFF-LINE, FAR SIDE BUSY, UNDEFINED.
FromFEC	FEC rate of the originating traffic modem: 1/2, 2/3, 3/4, 5/6, 7/8, 8/9, 5/16, and 21/44.
FromModulation	Modulation used by originating modem: BPSK, QPSK, OQPSK, 8PSK, and 16QAM.
FromPowerLevel	Transmit power level of the originating traffic modem.
FromEbNo	Receive Eb/No of the originating traffic modem.
FromDataRate	Data Rate of the originating traffic modem in kbit/s.
FromReedSol	Originating traffic modem used Reed-Solomon or not.
FromViSeq	Originating traffic modem used Viterbi, Sequential, or Turbo encoding.
ToFEC	FEC rate of the destination traffic modem: 1/2, 2/3, 3/4, 5/6, 7/8, 8/9, 5/16, and 21/44.
ToModulation	Modulation used by destination modem: BPSK, QPSK, OQPSK, 8PSK, 16QAM.

ToPowerLevel	Transmit power level of the destination traffic modem.
ToEbNo	Receive Eb/No of the destination traffic modem.
ToDataRate	Data Rate of the destination traffic modem in kbit/s.
ToReedSol	Destination traffic modem used Reed-Solomon or not.
ToViSeq	Destination traffic modem used Viterbi, Sequential, or Turbo encoding.
BwFrom	Bandwidth pool used for allocating the transmit channel: PUBLIC, PRIVATE, OVERFLOW, NONE.
BwTo	Bandwidth pool used for allocating the receive channel: PUBLIC, PRIVATE, OVERFLOW, NONE.

Service Messages

Service messages are provided for exchanging short text messages between the MIDAS Controller and a traffic node. The length of the service message is 28 characters.

Traffic Node to MIDAS Controller Service Message

At the traffic node, the service message is entered through the user port for delivery to the MIDAS Controller. On receiving the message, MIDAS displays it on the operator workstation.

NMS to Traffic Node Service Message

The service message is entered at the MIDAS operator workstation for delivery to the traffic node. On receiving the message, the traffic node sends the message to the device connected to the user port. The MIDAS will not accept a service message for delivery if the message is addressed to a traffic node that is not in the database.

There is no acknowledgment or re-transmission for MIDAS to traffic node service messages. It is the operator's responsibility to recover from lost service messages.

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6. Traffic Node

Overview

The traffic node provides users with access to network services. It operates under MIDAS control to support circuit management and local resource management. The traffic node responsibilities can be summarized as:

- Managing local resources under MIDAS control.
- Providing user traffic interface.
- Accepting user requests for circuit setup and termination.

The traffic node typically consists of a Comtech EF Data SNM-1000 Node Control Modem and traffic modems for data and video. Sites requiring a single data circuit could use the integrated traffic/control modems.

One or more traffic nodes (not co-located with the MIDAS Controller), together with the RF equipment, antenna and the customer equipment, are referred to as a *remote site*.

Architecture

MIDAS supports two different traffic node configurations:

- Multi-channel node
- Single-channel node

Multi-Channel Traffic Node

A multi-channel traffic node consists of:

- SNM-1000 Node Control Modem
- Traffic modems

The SNM-1000 can manage up to 30 traffic modems using an EIA-485 bus. The traffic modems recommended by Comtech EF Data are the SDM-300A CDM-550, CDM-600, or CiM-550 Satellite Modem, (however, other Comtech EF Data modems may be used). The SNM-1000 has an EIA-232 user port for requesting circuit setup and termination, sending and receiving service terminal messages, installation and diagnostics. A multi-channel traffic node configuration is illustrated in Figure 6-1.

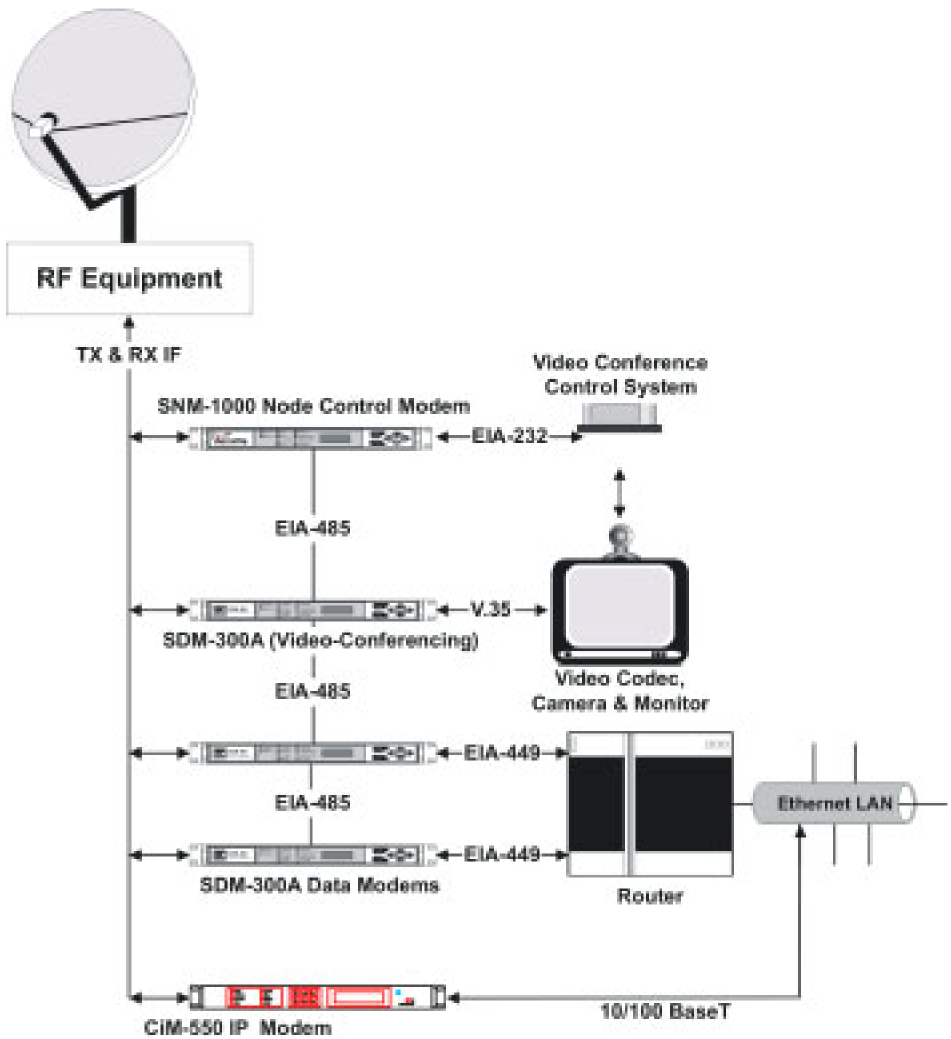

Figure 6-1. MIDAS Multi-Channel Traffic Node Configuration

Single-Channel Traffic Node

For sites requiring a single data circuit, an economical solution is to use the integrated traffic/control modems. The following modems are available for single channel traffic nodes:

Modem	Description
SNM-1010 Data/Control Modem	Integrated data and control modem, capable of supporting up to 5 Mbps in traffic mode.
SNM-1010L Data/Control Modem (L-Band)	Integrated data and control modem, capable of supporting up to 5 Mbps in traffic mode.

A single channel site configuration based on SNM-1010/1010L is illustrated in Figure 6-2.

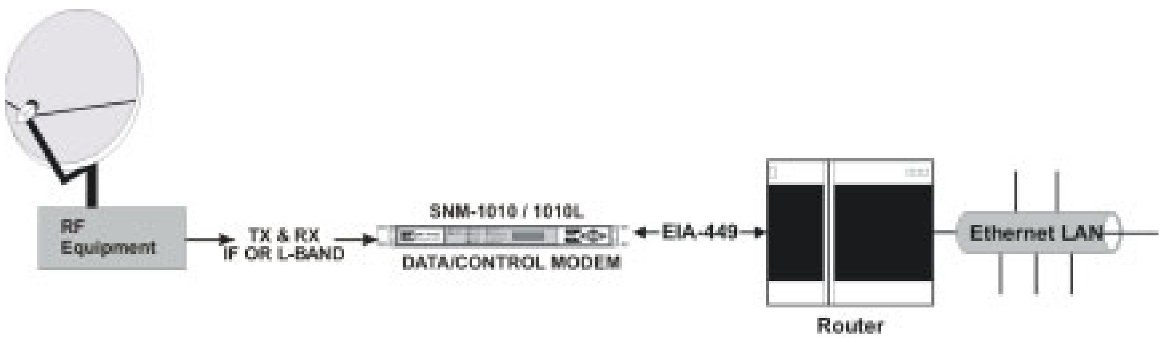

Figure 6-2. MIDAS Single-Channel Traffic Node

SNM-1000 Node Control Modem

The MIDAS SNM-1000 Node Control Modem is an all-digital, integrated, satellite modem and Demand Assigned Multiple Access (DAMA) controller. Utilizing the latest digital signal processing techniques, it is designed to provide maximum flexibility when used as the node controller in the Bandwidth-on-Demand MIDAS system. The SNM-1000 is responsible for:

- Receiving the MIDAS messages on the outbound control channel, and transmitting messages to the MIDAS Controller on the inbound control channel.
- Monitoring and managing local resources under MIDAS Controller control.
- Informing the MIDAS Controller of local configuration changes.
- Reporting channel status, events, alarms and Call Detail Records to the MIDAS Controller.
- Accepting and processing requests for circuits from end users.
- Call setup and termination under MIDAS control.
- Local diagnostics.

Applications

The MIDAS SNM-1000 is used as a dedicated node controller within MIDAS. At the traffic node, it provides the interface to MIDAS and manages local resources under MIDAS control. It performs circuit setup, termination, local M&C, diagnostics, and reports call detail records to the MIDAS Controller.

The modulator, operating in burst mode, always remains tuned to the inbound control channel. The demodulator, operating in continuous mode, always remains tuned to the outbound control channel.

The SNM-1000 also provides the user port interface for requesting services from MIDAS, installation, diagnostics, and for sending and receiving service terminal messages.

All traffic requirements are met by external traffic modems, which operate in continuous mode. The SNM-1000 is capable of managing up to 30 data and video modems via the multi-drop EFBUS1 modem control interface.

Note: Comtech EF Data considers the IDC-150D, SDM-100, -140, -150, -300, and -6000 are obsolete, contact Customer Support if this presents a problem.

Comtech EF Data network supported modems and standard modems include, but not limited to:

- SDM-300A/300L
- SDM-2020 Mod/Demod
- SDM-8000
- CDM-550/550T
- CDM-600
- CiM-550
- CiM-300L

Built-in Self-Test

Comtech EF Data's unique built-in self-test feature allows the SNM-1000 to initiate a bit error rate (BER) measurement on traffic channel modems that support BIST without the use of expensive noise generators and BER test equipment. The built-in self test:

- Provides fully functional modem testing with noise
- Returns pass or fail results
- Establishes modem confidence
- Eliminates BER test equipment

When commanded to the self-test mode through, the SNM-1000, the SDM-300A disables the transmit and receive IF ports and internally tests modulator, demodulator, and interface functions using BER measurement. The BER measurement is achieved by an internal IF noise generator and BER test equipment built into the SDM-300A.

The built-in self-test mode operates for less than 30 seconds, and returns a "Pass" or "Fail" test result. If desired, this feature can be enabled for automatic execution at power On.

SNM-1000/1010/1010L Control Channel Specifications

System Specifications	
Operating Frequency Range	For SNM-1000/1010: 50 to 180 MHz, in 1 Hz steps For SNM-1010L: 950 to 1750 MHz, 100 Hz steps
Digital Data	
Continuous Mode:	
Receive Data Rate	19.2 kbps
Symbol Rate	19.2 kHz
Demodulation	QPSK
Forward Error Correction	Viterbi, K=7, 1/2
Data Scrambling	Intelsat V.35
External Reference	1, 5, 10, 20 MHz
Burst Mode:	
Transmit Data Rate	19.2 kbps
Modulation	QPSK
Forward Error Correction	Viterbi soft-decision, R=1/2
Plesiochronous Buffer	2 to 98 ms, in 2 ms steps
Modulator	
Data Clock Source	Internal or External
Output Spectrum	Meets IESS-308/309 EFD Closed
Output Power	For SNM-1000/1010: -5 to -30 dBm, adjustable in 0.1 dB steps For SNM-1010L: 0 to –40 dBm, in 0.1 dB steps
Output Spurious	For SNM-1000/1010: < -55 dBc, 0 to 500 MHz (4 kHz band) For SNM-1010L: < -50 dBc(4 kHz band)
Output Return Loss	For SNM-1000/1010: ≥ 20 dB For SNM-1010L: ≥ 14 dB
Output Impedance	For SNM-1000/1010: 75Ω For SNM-1010L: 50Ω
Internal Stability	For SNM-1000/1010: ± 10 ppm For SNM-1010L: ± 0.01 ppm
Outdoor Reference (Center conductor of IF output connector)	For SNM-1010L: On or Off, 10 MHz ± 0.01 ppm @ 0 dBm ± 0.5 dB
Output Unit Voltage (Center conductor of IF output connector)	For SNM-1010L: On or Off, 24 VDC @ 4.0 amps or 48 VDC @ 3.0 amps
Output Stability	For SNM-1010L: ± 0.5 dB
Output Phase Noise	For SNM-1010L: < -63 dBc/Hz @ 100 Hz < -73 dBc/Hz @ 1 kHz < -83 dBc/Hz @ 10 kHz < -93 dBc/Hz @ 100 kHz

Demodulator	
Sweep Reacquisition	0 to 999 seconds, in 1 second steps
Buffer Clock	TX, RX, Internal, External
Plesiochronous Buffer	32 to 262122 bps, in 16 bit steps
Input Impedance	75Ω
Input Power: Composite Level, Maximum Desired Carrier Composite to Desired Carrier	 -5 dBm For SNM-1000/1010: -30 to -55 dBm For SNM-1010L: -85 dBm +10log (SR) to –135 dBm +10log (SR) For SNM-1000/1010: +40 dBc For SNM-1010L: +40 dBc, > 64 ksym/s (+50 dBc, < 64 ksym/s)
Acquisition Time (E_b/N_o = 8 dB)	For SNM-1000/1010: < 2 second For SNM-1010L: <1 second
Carrier Acquisition Range	For SNM-1000/1010: ± 35 kHz, from 100 Hz to 35 kHz in 1Hz steps For SNM-1010L: 0 to 1 MHz, in 1 Hz steps
Input Frequency	For SNM-1000/1010: 50 to 180 MHz, in 1 Hz steps For SNM-1010L: 950 to 1750 MHz, in 100 Hz steps
Input Return Loss	For SNM-1000/1010: > 20 dB For SNM-1010L: >10 dB Type F (Female)
AGC Range	For SNM-1010L: 50 dB above minimum input level
LNB Voltage	For SNM-1010L: ON/Off +13, +18, and +24 VDC

Traffic Modems and Terminals

CDM-550 Data/Symbol Rates

CDM-550 2,400 2,048,000

Modulation Type	Encoding Type	Data Rates (bps)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,024,000	4,800	2,048,000
{O}QPSK 1/2	Viterbi	4,800	2,048,000	4,800	2,048,000
{O}QPSK 3/4	Viterbi	7,200	2,048,000	4,800	1,365,333
{O}QPSK 7/8	Viterbi	8,400	2,048,000	4,800	1,170,286
BPSK 1/1	Uncoded	4,800	2,048,000	4,800	2,048,000
{O}QPSK 1/1	Uncoded	9,600	2,048,000	4,800	1,024,000
BPSK 1/2	Sequential	2,400	1,024,000	4,800	2,048,000
QPSK 1/2	Sequential	4,800	2,048,000	4,800	2,048,000
QPSK 3/4	Sequential	7,200	2,048,000	4,800	1,365,333
QPSK 7/8	Sequential	8,400	2,048,000	4,800	1,170,286
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
{O}QPSK 3/4	Viterbi and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
{O}QPSK 7/8	Viterbi and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
QPSK 1/2	Sequential and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
QPSK 3/4	Sequential and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
QPSK 7/8	Sequential and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
	Output power	0 to -20 dBm, .1 dB steps			
	Clocking options	Internal, External, and Loop timing			
	Doppler Buffer	Selectable 512, 1024, 2048, 4096, and 8192 bits			

CDM-550T Data/Symbol Rate

CDM-550T 2,400 2,048,000

Modulation Type	Encoding Type	Data Rates (bps)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,024,000	4,800	2,048,000
{O}QPSK 1/2	Viterbi	4,800	2,048,000	4,800	2,048,000
{O}QPSK 3/4	Viterbi	7,200	2,048,000	4,800	1,365,333
{O}QPSK 7/8	Viterbi	8,400	2,048,000	4,800	1,170,286
BPSK 1/1	Uncoded	4,800	2,048,000	4,800	2,048,000
{O}QPSK 1/1	Uncoded	9,600	2,048,000	4,800	1,024,000
BPSK 1/2	Sequential	2,400	1,024,000	4,800	2,048,000
QPSK 1/2	Sequential	4,800	2,048,000	4,800	2,048,000
QPSK 3/4	Sequential	7,200	2,048,000	4,800	1,365,333
QPSK 7/8	Sequential	8,400	2,048,000	4,800	1,170,286
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
{O}QPSK 3/4	Viterbi and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
{O}QPSK 7/8	Viterbi and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
QPSK 1/2	Sequential and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
QPSK 3/4	Sequential and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
QPSK 7/8	Sequential and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
BPSK 21/44	Turbo	2,400	1,145,000	4,800	2,399,048
BPSK 5/16	Turbo	2,400	750,000	4,800	2,400,000
{O}QPSK 3/4	Turbo	7,200	2,048,000	4,800	1,365,333
	Output power	0 to -20 dBm, .1 dB steps			
	Clocking options	Internal, External (Terrestrial), and Sat Loop timing			
	Doppler Buffer	Selectable 512, 1024, 2048, 4096, and 8192 bits			

CDM-600 Data/Symbol Rate

CDM-600 2,400 20,000,000

Modulation Type	Encoding Type	Data Rates (bps)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	5,000,000	4,800	10,000,000
{O}QPSK 1/2	Viterbi	4,800	10,000,000	4,800	10,000,000
{O}QPSK 3/4	Viterbi	7,200	15,000,000	4,800	10,000,000
{O}QPSK 7/8	Viterbi	8,400	17,500,000	4,800	10,000,000
BPSK 1/1	Uncoded	4,800	10,000,000	4,800	10,000,000
{O}QPSK 1/1	Uncoded	9,600	20,000,000	4,800	10,000,000
BPSK 1/2	Sequential	2,400	1,024,000	4,800	2,048,000
QPSK 1/2	Sequential	4,800	2,048,000	4,800	2,048,000
QPSK 3/4	Sequential	7,200	2,048,000	4,800	1,365,333
QPSK 7/8	Sequential	8,400	2,048,000	4,800	1,170,286
BPSK 1/2	Viterbi and Reed-Solomon	2,400	4,545,454	4,800	10,000,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,800	9,090,909	4,800	10,000,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	7,200	13,636,363	4,800	10,000,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	8,400	15,909,090	4,800	10,000,000
16QAM 3/4	Viterbi and Reed-Solomon	14,400	18,000,000	4,800	6,600,000
16QAM 7/8	Viterbi and Reed-Solomon	16,800	18,000,000	4,800	5,657,143
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
QPSK 1/2	Sequential and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
QPSK 3/4	Sequential and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
QPSK 7/8	Sequential and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
8PSK 2/3	TCM + Reed-Solomon	9,600	18,181,818	4,800	10,000,000
8PSK 2/3	TCM No Reed-Solomon	9,600	20,000,000	4,800	10,000,000
BPSK 21/44	Turbo	4,800	3,200,000	4,800	6,704,762
BPSK 5/16	Turbo	4,800	2,048,000	4,800	6,553,600
{O}QPSK 3/4	Turbo	7,200	5,000,000	4,800	3,333,333
8PSK 3/4	Turbo	10,800	5,000,000	4,800	2,222,222
16QAM 3/4	Turbo	14,400	5,000,000	4,800	1,666,667
	Output power	0 to -20 dBm, 0.1 dB steps			
	Clocking options	Internal, Ext Ref, Tx Terrrestrial, and Sat Loop Timing			
	Doppler Buffer	64 to 262144 bits, in 16 bit increments			

CiM-300L Data/Symbol Rates

CIM-300L 2,400 5,000,000

Modulation Type	Encoding Type	Data Rates (bps)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
{O}QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
{O}QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
8PSK 2/3	Viterbi	9,600	5,000,000	4,800	2,500,000
BPSK 5/16	Turbo	2,400	781,250	4,800	2,500,000
BPSK 21/44	Turbo	2,400	1,193,000	4,800	2,500,000
{O}QPSK 3/4	Turbo	7,200	3,750,000	4,800	2,500,000
8PSK 3/4	Turbo	384,000	5,000,000	4,800	2,500,000
BPSK 1/1	Uncoded	4,800	2,500,000	4,800	2,500,000
{O}QPSK 1/1	Uncoded	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
8PSK 2/3	Viterbi and Reed-Solomon	8,746	4,555,555	4,800	2,500,000
	Output power	0 to -40 dBm, adjustable in 0.1 dB steps			
	Clocking options	SCT Internal, Ext Reference, TX Terrestrial, and Sat Loop Timing			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

CiM-550 Data/Symbol Rates

CIM-550 2,400 2,048,000

Modulation Type	Encoding Type	Data Rates (bps)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,024,000	4,800	2,048,000
{O}QPSK 1/2	Viterbi	4,800	2,048,000	4,800	2,048,000
{O}QPSK 3/4	Viterbi	7,200	2,048,000	4,800	1,365,333
{O}QPSK 7/8	Viterbi	8,400	2,048,000	4,800	1,170,286
BPSK 1/1	Uncoded	4,800	2,048,000	4,800	2,048,000
{O}QPSK 1/1	Uncoded	9,600	2,048,000	4,800	1,024,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,024,000	4,800	2,252,800
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,800	2,048,000	4,800	2,252,800
{O}QPSK 3/4	Viterbi and Reed-Solomon	7,200	2,048,000	4,800	1,501,867
{O}QPSK 7/8	Viterbi and Reed-Solomon	8,400	2,048,000	4,800	1,287,314
BPSK 21/44	Turbo	2,400	1,145,000	4,800	2,399,048
BPSK 5/16	Turbo	2,400	750,000	4,800	2,400,000
{O}QPSK 3/4	Turbo	7,200	2,048,000	4,800	1,365,333
	Output power	0 to -20 dBm, .1 dB steps			
	Clocking options	Internal, External (Terrestrial), and Sat Loop timing			
	Doppler Buffer	Selectable 512, 1024, 2048, 4096, and 8192 bits			

SDM-300A Data/Symbol Rates

SDM-300A 2,400 bit/s 5,000,000 bit/s

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
{O}QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
{O}QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
8PSK 2/3	Viterbi	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Sequential	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Sequential	4,800	2,500,000	4,800	2,500,000
QPSK 3/4	Sequential	7,200	3,750,000	4,800	2,500,000
QPSK 7/8	Sequential	8,400	4,375,000	4,800	2,500,000
BPSK 5/16	Turbo	2,400	781,250	4,800	2,500,000
BPSK 21/44	Turbo	2,400	1,193,000	4,800	2,500,000
{O}QPSK 3/4	Turbo	7,200	3,750,000	4,800	2,500,000
8PSK 3/4	Turbo	384,000	5,000,000	4,800	2,500,000
BPSK 1/1	Uncoded	4,800	2,500,000	4,800	2,500,000
{O}QPSK 1/1	Uncoded	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
8PSK 2/3	Viterbi and Reed-Solomon	8,746	4,555,555	4,800	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
	Output power	-5 to -30 dBm, adjustable in 0.1 dB steps +5 to -20 dBm high-power output (optional)			
	Clocking options	SCT Internal, Ext Reference, TX Terrestrial, and Sat Loop Timing			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

SDM-300L Data/Symbol Rates

SDM-300L 2,400 5,000,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
{O}QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
{O}QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
8PSK 2/3	Viterbi	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Sequential	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Sequential	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Sequential	7,200	3,750,000	4,800	2,500,000
BPSK 5/16	Turbo	2,400	781,250	4,800	2,500,000
BPSK 21/44	Turbo	2,400	1,193,000	4,800	2,500,000
{O}QPSK 3/4	Turbo	7,200	3,750,000	4,800	2,500,000
8PSK 3/4	Turbo	384,000	5,000,000	4,800	2,500,000
BPSK 1/1	Uncoded	4,800	2,500,000	4,800	2,500,000
{O}QPSK 1/1	Uncoded	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
8PSK 2/3	Viterbi and Reed-Solomon	8,746	4,555,555	4,800	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
	Output power	0 to -40 dBm, adjustable in 0.1 dB steps			
	Clocking options	SCT Internal, Ext Reference, TX Terrestrial, and Sat Loop Timing			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

SDM-2020 Modulator Data/Symbol Rates

SDM-2020M 1,500,000 100,000,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
QPSK 1/2	Viterbi (188 Frame)	1,500,000	34,558,824	1,627,660	37,500,001
QPSK 2/3	Viterbi (188 Frame)	1,500,000	46,078,431	1,220,744	37,500,000
QPSK 3/4	Viterbi (188 Frame)	1,500,000	51,838,235	1,085,106	37,500,000
QPSK 5/6	Viterbi (188 Frame)	1,500,000	57,598,039	976,595	37,500,000
QPSK 7/8	Viterbi (188 Frame)	1,500,000	60,477,941	930,091	37,500,000
8PSK 2/3	Viterbi (188 Frame)	1,500,000	69,117,647	813,829	37,500,000
8PSK 5/6	Viterbi (188 Frame)	1,500,000	86,397,059	651,063	37,500,000
8PSK 8/9	Viterbi (188 Frame)	1,500,000	92,156,863	610,372	37,500,000
16QAM 3/4	Viterbi (188 Frame)	1,500,000	100,000,000	542,000	36,170,213
16QAM 7/8	Viterbi (188 Frame)	1,500,000	100,000,000	465,045	31,003,040
QPSK 1/2	Viterbi (204 Frame)	1,500,000	37,500,000	1,500,000	37,500,000
QPSK 2/3	Viterbi (204 Frame)	1,500,000	50,000,000	1,125,000	37,500,000
QPSK 3/4	Viterbi (204 Frame)	1,500,000	56,250,000	1,000,000	37,500,000
QPSK 5/6	Viterbi (204 Frame)	1,500,000	62,500,000	900,000	37,500,000
QPSK 7/8	Viterbi (204 Frame)	1,500,000	62,625,000	857,142	37,500,000
8PSK 2/3	Viterbi (204 Frame)	1,500,000	75,000,000	750,000	37,500,000
8PSK 5/6	Viterbi (204 Frame)	1,500,000	93,750,000	600,000	37,500,000
8PSK 8/9	Viterbi (204 Frame)	1,500,000	100,000,000	562,500	37,500,000
16QAM 3/4	Viterbi (204 Frame)	1,500,000	100,000,000	500,000	33,333,333
16QAM 7/8	Viterbi (204 Frame)	1,500,000	100,000,000	428,571	28,571,429
QPSK 1/2	Viterbi (187 Frame) None	1,500,000	34,375,000	1,636,363	37,500,000
QPSK 2/3	Viterbi (187 Frame) None	1,500,000	45,833,333	1,227,272	37,500,000
QPSK 3/4	Viterbi (187 Frame) None	1,500,000	51,562,500	1,090,909	37,500,000
QPSK 5/6	Viterbi (187 Frame) None	1,500,000	57,291,667	981,818	37,500,000
QPSK 7/8	Viterbi (187 Frame) None	1,500,000	60,156,250	935,064	37,500,000
8PSK 2/3	Viterbi (187 Frame) None	1,500,000	68,750,000	818,181	37,500,000
8PSK 5/6	Viterbi (187 Frame) None	1,500,000	85,937,500	654,545	37,500,000
8PSK 8/9	Viterbi (187 Frame) None	1,500,000	91,666,667	613,632	37,500,000
16QAM 3/4	Viterbi (187 Frame) None	1,500,000	100,000,000	545,454	36,363,636
16QAM 7/8	Viterbi (187 Frame) None	1,500,000	100,000,000	467,532	31,168,831
	Output power	+5 to -20 dBm, adjustable in .1 dB steps			
	Clocking options	Internal			
	Doppler Buffer	NONE			

SDM-2020 Demodulator Data/Symbol Rates

SDM-2020D 1,375,000 100,000,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
QPSK 1/2	Viterbi (188 Frame)	1,382,353	34,558,823	1,500,000	37,500,000
QPSK 2/3	Viterbi (188 Frame)	1,843,137	46,078,431	1,500,000	37,500,000
QPSK 3/4	Viterbi (188 Frame)	2,073,529	46,078,431	1,500,000	33,333,333
QPSK 5/6	Viterbi (188 Frame)	2,303,922	46,078,431	1,500,000	30,000,000
QPSK 7/8	Viterbi (188 Frame)	2,419,118	46,078,431	1,500,000	28,571,428
8PSK 2/3	Viterbi (188 Frame)	2,764,706	69,117,647	1,500,000	37,500,000
8PSK 5/6	Viterbi (188 Frame)	3,455,882	86,397,059	1,500,000	37,500,000
8PSK 8/9	Viterbi (188 Frame)	3,686,275	92,156,863	1,500,000	37,500,000
16QAM 3/4	Viterbi (188 Frame)	4,147,058	92,156,862	1,500,000	33,333,333
16QAM 7/8	Viterbi (188 Frame)	4,838,235	92,156,862	1,500,000	28,571,428
QPSK 1/2	Viterbi (204 Frame)	1,500,000	37,500,000	1,500,000	37,500,000
QPSK 2/3	Viterbi (204 Frame)	2,000,000	50,000,000	1,500,000	37,500,000
QPSK 3/4	Viterbi (204 Frame)	2,250,000	50,000,000	1,500,000	33,333,333
QPSK 5/6	Viterbi (204 Frame)	2,500,000	50,000,000	1,500,000	30,000,000
QPSK 7/8	Viterbi (204 Frame)	2,625,000	50,000,000	1,500,000	28,571,429
8PSK 2/3	Viterbi (204 Frame)	3,000,000	75,000,000	1,500,000	37,500,000
8PSK 5/6	Viterbi (204 Frame)	3,750,000	93,750,000	1,500,000	37,500,000
8PSK 8/9	Viterbi (204 Frame)	4,000,000	100,000,000	1,500,000	37,500,000
16QAM 3/4	Viterbi (204 Frame)	4,500,000	100,000,000	1,500,000	33,333,333
16QAM 7/8	Viterbi (204 Frame)	5,250,000	100,000,000	1,500,000	28,571,428
QPSK 1/2	Viterbi (187 Frame) None	1,375,000	34,375,000	1,500,000	37,500,000
QPSK 2/3	Viterbi (187 Frame) None	1,833,333	45,833,333	1,500,000	37,500,000
QPSK 3/4	Viterbi (187 Frame) None	2,062,500	45,833,333	1,500,000	33,333,333
QPSK 5/6	Viterbi (187 Frame) None	2,291,667	45,833,333	1,500,000	30,000,000
QPSK 7/8	Viterbi (187 Frame) None	2,406,250	45,833,333	1,500,000	28,571,428
8PSK 2/3	Viterbi (187 Frame) None	2,750,000	68,750,000	1,500,000	37,500,000
8PSK 5/6	Viterbi (187 Frame) None	3,437,500	85,937,500	1,500,000	37,500,000
8PSK 8/9	Viterbi (187 Frame) None	3,666,667	91,666,667	1,500,000	37,500,000
16QAM 3/4	Viterbi (187 Frame) None	4,125,000	91,666,667	1,500,000	33,333,333
16QAM 7/8	Viterbi (187 Frame) None	4,812,500	91,666,667	1,500,000	28,571,429
	RX Signal Input	-30 to -55 dBm for 70/140 MHz Input			
	Clocking options	Internal			
	Doppler Buffer	2 to 32 ms in 2 ms steps for G.703 INTF, None for other INTF.			

SDM-8000 Data/Symbol Rates

SDM-8000 9,600 9,300,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	9,600	3,150,000	19,200	6,300,000
QPSK 1/2	Viterbi	19,200	6,300,000	19,200	6,300,000
QPSK 3/4	Viterbi	28,500	9,312,000	19,200	6,208,000
QPSK 7/8	Viterbi	33,600	9,312,000	19,200	5,321,142
8PSK 2/3	Viterbi	38,400	9,312,000	19,200	4,656,000
8PSK 5/6	Viterbi	48,000	9,312,000	19,200	3,724,800
16QAM 3/4	Viterbi	57,600	9,312,000	19,200	3,104,000
16QAM 7/8	Viterbi	67,200	9,312,000	19,200	2,660,571
QPSK 1/1	Uncoded	38,400	8,484,266	19,200	4,242,133
BPSK 1/2	Sequential	9,600	1,544,000	19,200	3,088,000
QPSK 1/2	Sequential	19,200	2,185,000	19,200	2,185,000
QPSK 3/4	Sequential	28,500	3,277,000	19,200	2,184,666
QPSK 7/8	Sequential	33,600	3,823,000	19,200	2,184,571
BPSK 1/2	Viterbi and Reed-Solomon	9,600	2,870,000	19,200	6,300,000
QPSK 1/2	Viterbi and Reed-Solomon	19,200	5,740,000	19,200	6,300,000
QPSK 3/4	Viterbi and Reed-Solomon	28,500	8,484,266	19,200	6,207,999
QPSK 7/8	Viterbi and Reed-Solomon	33,600	8,484,266	19,200	5,321,142
8PSK 2/3	Viterbi and Reed-Solomon	38,400	8,484,266	19,200	4,655,999
8PSK 5/6	Viterbi and Reed-Solomon	48,000	8,484,266	19,200	3,724,799
16QAM 3/4	Viterbi and Reed-Solomon	57,600	8,484,266	19,200	3,103,999
16QAM 7/8	Viterbi and Reed-Solomon	67,200	8,484,266	19,200	2,660,571
BPSK 1/2	Sequential and Reed-Solomon	9,600	1,544,000	19,200	3,389,268
QPSK 1/2	Sequential and Reed-Solomon	19,200	1,990,777	19,200	2,184,999
QPSK 3/4	Sequential and Reed-Solomon	28,500	2,985,711	19,200	2,184,666
QPSK 7/8	Sequential and Reed-Solomon	33,600	3,483,177	19,200	2,184,570
8PSK 2/3	Sequential and Reed-Solomon	38,400	8,484,266	19,200	4,655,999
8PSK 5/6	Sequential and Reed-Solomon	48,000	8,484,266	19,200	3,724,799
16QAM 3/4	Sequential and Reed-Solomon	57,600	8,484,266	19,200	3,103,999
16QAM 7/8	Sequential and Reed-Solomon	67,200	8,484,266	19,200	2,660,571
	Output power	-5 to -30 dBm, adjustable in .1 dB steps (+5 to -20 dBm optional)			
	Clocking options	SCT Internal, Ext Reference, and TX Terrestrial			
	Doppler Buffer	0 Bypass, 32 to 251984 bit/s in 16 bit/s steps, or 0 Bypass 1 to 99 ms in 1 ms steps			

SNM-1010 Data/Symbol Rate

SNM-1010 2,400 5,000,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
{O}QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
{O}QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
8PSK 2/3	Viterbi	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Sequential	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Sequential	4,800	2,500,000	4,800	2,500,000
QPSK 3/4	Sequential	7,200	3,750,000	4,800	2,500,000
QPSK 7/8	Sequential	8,400	4,375,000	4,800	2,500,000
BPSK 5/16	Turbo	2,400	781,250	4,800	2,500,000
BPSK 21/44	Turbo	2,400	1,193,000	4,800	2,500,000
{O}QPSK 3/4	Turbo	7,200	3,750,000	4,800	2,500,000
8PSK 3/4	Turbo	384,000	5,000,000	4,800	2,500,000
BPSK 1/1	Uncoded	4,800	2,500,000	4,800	2,500,000
{O}QPSK 1/1	Uncoded	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
8PSK 2/3	Viterbi and Reed-Solomon	8,746	4,555,555	4,800	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
	Output power	-5 to -30 dBm, adjustable in .1 dB steps +5 to -20 dBm high-power output (optional)			
	Clocking options	SCT Internal, Ext Reference, TX Terrestrial, and Sat Loop Timing			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

SNM-1010L Data/Symbol Rates

SNM-1010L 2,400 5,000,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
{O}QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
{O}QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
{O}QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
8PSK 2/3	Viterbi	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Sequential	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Sequential	4,800	2,500,000	4,800	2,500,000
QPSK 3/4	Sequential	7,200	3,750,000	4,800	2,500,000
QPSK 7/8	Sequential	8,400	4,375,000	4,800	2,500,000
BPSK 5/16	Turbo	2,400	781,250	4,800	2,500,000
BPSK 21/44	Turbo	2,400	1,193,000	4,800	2,500,000
{O}QPSK 3/4	Turbo	7,200	3,750,000	4,800	2,500,000
8PSK 3/4	Turbo	384,000	5,000,000	4,800	2,500,000
BPSK 1/1	Uncoded	4,800	2,500,000	4,800	2,500,000
{O}QPSK 1/1	Uncoded	9,600	5,000,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
{O}QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
{O}QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
{O}QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
8PSK 2/3	Viterbi and Reed-Solomon	8,746	4,555,555	4,800	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
	Output power	0 to -40 dBm, adjustable in 0.1 dB steps			
	Clocking options	SCT Internal, Ext Reference, TX Terrestrial, and Sat Loop Timing			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

Legacy Products

IDC-150D Data/Symbol Rates

IDC-150D 9,600 224,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	9,600	64,000	19,200	128,000
QPSK 1/2	Viterbi Continuous	19,200	128,000	19,200	128,000
QPSK 1/2	Viterbi Burst Mode	19,200	19,200	19,200	128,000
QPSK 3/4	Viterbi	28,800	192,000	19,200	128,000
QPSK 7/8	Viterbi	33,600	224,000	19,200	128,000
	Output power	-5 to -30 dBm, adjustable in .1 dB steps (+5 dBm optional)			
	Clocking options	SCT Internal, TX Terrestrial, and RX Satellite			
	Doppler Buffer Continuous Mode	0 Bypass, 64 to 65536 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 50 ms in 1 ms steps selectable from front panel			
	Doppler Buffer (Burst Mode)	NONE			

SDM-100 Data/Symbol Rates

SDM-100 9,600 224,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	9,600	64,000	19,200	128,000
QPSK 1/2	Viterbi	19,200	128,000	19,200	128,000
QPSK 3/4	Viterbi	28,800	192,000	19,200	128,000
QPSK 7/8	Viterbi	33,600	224,000	19,200	128,000
BPSK 1/2	Sequential	9,600	64,000	19,200	128,000
QPSK 1/2	Sequential	19,200	128,000	19,200	128,000
QPSK 3/4	Sequential	28,800	192,000	19,200	128,000
QPSK 7/8	Sequential	33,600	224,000	19,200	128,000
	Output power	-5 to -30 dBm, adjustable in .1 dB steps			
	Clocking options	SCT Internal, TX Terrestrial, and RX Satellite			
	Doppler Buffer	0 Bypass, 64 to 65536 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 50 ms in 1 ms steps selectable from front panel			

SDM-150 Data/Symbol Rates

SDM-150 9,600 224,000

Modulation Type	Encoding Type	Data Rates (bit/s)		Symbol Rates (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	9,600	64,000	19,200	128,000
QPSK 1/2	Viterbi Continuous	19,200	128,000	19,200	128,000
QPSK 1/2	Viterbi Burst Mode	19,200	19,200	19,200	128,000
QPSK 3/4	Viterbi	28,800	192,000	19,200	128,000
QPSK 7/8	Viterbi	33,600	224,000	19,200	128,000
BPSK 1/2	Sequential	9,600	64,000	19,200	128,000
QPSK 1/2	Sequential	19,200	128,000	19,200	128,000
QPSK 3/4	Sequential	28,800	192,000	19,200	128,000
QPSK 7/8	Sequential	33,600	224,000	19,200	128,000
	Output power	-5 to -30 dBm, adjustable in .1 dB steps (+5 dBm optional)			
	Clocking options	SCT Internal, TX Terrestrial, and RX Satellite			
	Doppler Buffer	0 Bypass, 64 to 65536 bit/s in 16 bit/s steps, or 0 Bypass,			
	Continuous Mode	1 to 50 ms in 1 ms steps selectable from front panel			
	Doppler Buffer (Burst Mode)	None			

SDM-300 Data/Symbol Rates

SDM-300 2,400 bit/s 4,375,000 bit/s

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Viterbi	4,800	2,500,000	4,800	2,500,000
QPSK 3/4	Viterbi	7,200	3,750,000	4,800	2,500,000
QPSK 7/8	Viterbi	8,400	4,375,000	4,800	2,500,000
BPSK 1/2	Sequential	2,400	1,250,000	4,800	2,500,000
QPSK 1/2	Sequential	4,800	2,500,000	4,800	2,500,000
QPSK 3/4	Sequential	7,200	3,750,000	4,800	2,500,000
QPSK 7/8	Sequential	8,400	4,375,000	4,800	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Viterbi and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Viterbi and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Viterbi and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	2,400	1,138,888	4,800	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	4,373	2,277,777	4,800	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	6,560	3,416,666	4,800	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	7,653	3,986,111	4,800	2,500,000
	Output power	-5 to -30 dBm, in .1 dB steps, +5 to -20 dBm high-power			
	Clocking options	SCT Internal, Ext Clock, and TX Terrestrial			
	Doppler Buffer	0 Bypass, 16 to 256000 bit/s in 16 bit/s steps, or 0 Bypass, 1 to 99 ms in 1 ms steps			

SDM-6000 Data/Symbol Rates

SDM-6000 9,600 4,375,000

Modulation Type	Encoding Type	Data Rate (bps)		Symbol Rate (sym/s)	
		Minimum	Maximum	Minimum	Maximum
BPSK 1/2	Viterbi	9,600	1,250,000	19,200	2,500,000
QPSK 1/2	Viterbi	19,200	2,500,000	19,200	2,500,000
QPSK 3/4	Viterbi	28,800	3,750,000	19,200	2,500,000
QPSK 7/8	Viterbi	33,600	4,375,000	19,200	2,500,000
BPSK 1/2	Sequential	9,600	1,250,000	19,200	2,500,000
QPSK 1/2	Sequential	19,200	2,500,000	19,200	2,500,000
QPSK 3/4	Sequential	28,800	3,750,000	19,200	2,500,000
QPSK 7/8	Sequential	33,600	4,375,000	19,200	2,500,000
BPSK 1/2	Viterbi and Reed-Solomon	9,600	1,138,888	19,200	2,500,000
QPSK 1/2	Viterbi and Reed-Solomon	19,200	2,277,777	19,200	2,500,000
QPSK 3/4	Viterbi and Reed-Solomon	28,800	3,416,666	19,200	2,500,000
QPSK 7/8	Viterbi and Reed-Solomon	33,600	3,986,111	19,200	2,500,000
BPSK 1/2	Sequential and Reed-Solomon	9,600	1,138,888	19,200	2,500,000
QPSK 1/2	Sequential and Reed-Solomon	19,200	2,277,777	19,200	2,500,000
QPSK 3/4	Sequential and Reed-Solomon	28,800	3,416,666	19,200	2,500,000
QPSK 7/8	Sequential and Reed-Solomon	33,600	3,986,111	19,200	2,500,000
	Output power	-5 to -30 dBm, adjustable in .1 dB steps			
	Clocking options	SCT Internal, Ext Reference, and TX Terrestrial			
	Doppler Buffer	0 Bypass, 32 to 262144 bit/s in 16 bit/s steps, or 0 Bypass 1 to 99 ms in 1 ms steps			

70/140 MHz IF Interface

The traffic node connects to the RF equipment via the IF interface, whose characteristics are as follows:

Operating IF Range	50 to 180 MHz
Characteristic Impedance	75Ω
Transmit Level:	
SNM-1000, SNM-1010	-30 to -5 dBm
SDM-100, SDM-300/300A	-30 to -5 dBm
CDM-550, CDM-600, CiM-550	-20 to 0 dBm
Receive Level (at Modem):	
SNM-1000, SNM-1010	-55 to -30 dBm
SDM-100, SDM-300/300A	-55 to -30 dBm
CDM-550, CDM-600, CiM-550	-60 to –30 dBm

L-Band RF Interface

Operating RF Range	950 to 1750 MHz
Transmit Level:	
SNM-1010L	-40 to 0 dBm
Receive Level (at Modem):	
SNM-1010L	-135 dBm + 10log(symbol rate) to –85 dBm +10log (symbol rate)

User Port Interface

The SNM-1000 provides a user port interface for requesting establishment and termination of data and video circuits, sending and receiving service messages, installation and diagnostics. The user port can also be used by customer equipment such as routers for requesting circuit establishment and termination. The port is configured as a DCE with the pinout described in Table 6-1.

Table 6-1. User Port Pinout

Connector Type	9-pin DIN Connector
Signal type	EIA-232

Pin	Name
1	US_RR-232
2	US_RD-232
3	US_SD-232
4	US_TR-232
5	GND
6	US_DM-232
7	US_RS-232
8	US_CS-232
9	US_RI-232

The interface operates at 19.2 kbps, 8 data bits, 1 stop bit, no parity and responds to ASCII characters in the range of 0x00 to 0x7F. The 8th bit (most significant) is not generated on the transmit side and is ignored on the receive side.

EFBUS1

EFBUS1 is the SNM-1000 to Comtech EF Data Modem/Radio Frequency Terminal (RFT) EIA-485 bus interface. This interface allows the SNM-1000 to communicate with and control Comtech EF Data's data and video modems.

The EFBUS1 uses a master-slave architecture, with SNM-1000 being the master. All other devices are slaves, and cannot transmit on the bus until the master requests a response.

The physical transmission protocol of the bus is asynchronous, 19.2 kbps, 8 data bits, no parity and one stop bit. EFBUS1 shares the 9-pin connector with EFBUS2. The pinout is described in Table 6-2

Table 6-2. EFBUS1 Port Pinout

Connector Type	9-pin D subminiature, female
Signal type	EIA-485

Pin #	Name	Pin #	Name
1	MSGND	5	MS_RD/SD-
2	BP_DF	6	MC_RD/SD+
3	BP_MF	7	MC-RD/SD-
4	MS_RD/SD+	8	MCGND

Each end of the bus is terminated with 120Ω resistors. The EIA-485 bus can support up to 30 physical devices with a maximum of 50 feet (15.24 ms.) of twisted pair cable when properly terminated.

EFBUS2

EFBUS2 is reserved for future releases and is not currently utilized.

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
C = (F - 32) * 0.555
F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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