



MissionSpan™ Network Management System User Manual

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1 Introduction

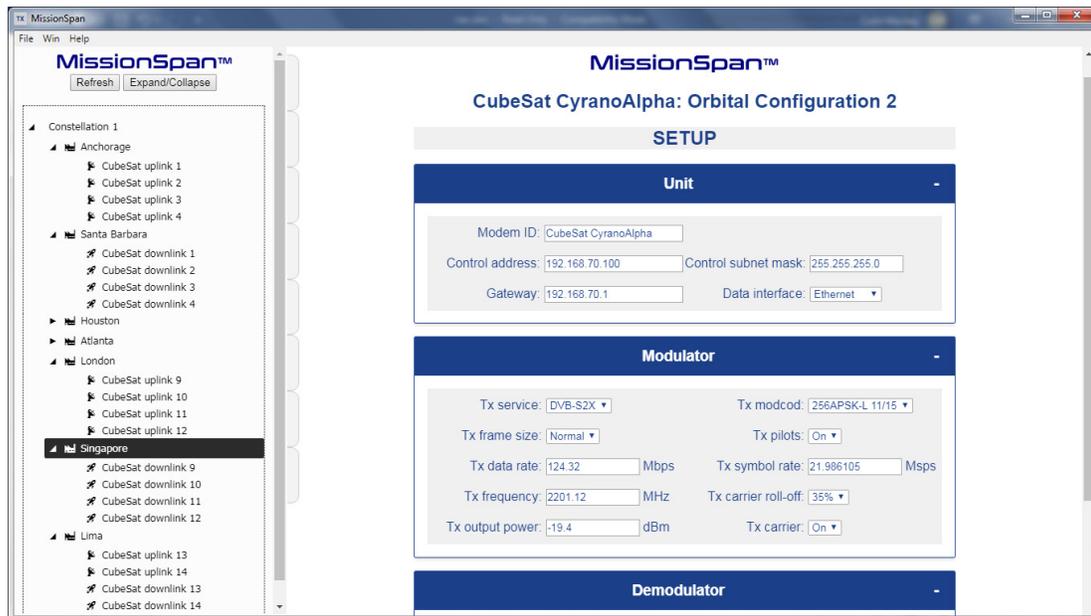


Figure 1-1 MissionSpan™ NMS User Interface

MissionSpan™ NMS (Figure 1-1) is a lightweight network control application for one or more constellations of smallsats or airborne communications systems. It is principally used for configuration of our software defined radios (**Quest™** and **Connect™** satellite modems) but is easily adapted for wider system application. Key features and benefits include:

- Support for up to 10,000 satellites and up to 100 different constellations.
- Multi-operator application with secure individualised operator login.
- Centralized database for storing any number of modem configurations.
- Ability to create and distribute modem configurations across the network and upgrade modem software over the air.
- Centralized monitoring and control of all ground and satellite onboard network equipment. **MissionSpan™** provides a view of all the TXMission (and potentially other) devices in the network. Networks are structured as one or more constellations, sites and devices that are displayed in a navigation tree. Clicking on any device connects to and displays the user interface for that device, which can be used to monitor and control its functions.
- Automated datalogging of status, logs, metrics, alarms, etc. as well as operator-entered commands and system responses. Logs are timestamped and entries are clearly delineated to simplify post-processing analysis.
- As part of datalogging function, support for execution of preset and custom command scripts at periodic intervals.

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- **MissionSpan™** uses password protection and secure network communications to ensure security.
- Integrated test tools such as an OOPS! command line terminal emulator that can be used to build up or modify modem configurations held in the local **MissionSpan™** database or to directly control any modem in the network (OOPS! is our open-source protocol for communicating with smallsats and airborne vehicles).
- Provides continuous background status polling and alarm reporting of all equipment.
- Application runs on standard Windows by default (Linux and macOS installations are available on demand).
- Virtual Network Operator (VNO) operation is supported, giving third parties a controlled degree of access to part of the network.
- Application runs on standard Windows by default (Linux and macOS installations are available on demand).
- Based on open standards that allow easy integration of third-party equipment.

In future, **MissionSpan™** will support the ability for users to manage their own applications running on our modems, including automated uploading of new software versions to a targeted subset of the devices in the network.

This manual will guide you through the process of installing and using **MissionSpan™** in your ground station or test environment.

2 Installation

MissionSpan™ NMS is a Windows application that runs on Windows computers. (Installables for Linux and macOS are available on request.)

The computer should meet the following specification as a minimum:

1. Microsoft Windows 10
2. Intel i5 processor
3. 8GB memory
4. 500MB of free disk space



MissionSpan™ is provided as a compressed 7-Zip file (**Figure 2-1**). 7-Zip is an archiving tool that can be downloaded freely from the internet. WinZip can also be used. Ensure that 7-Zip or a compatible archive tool is available before proceeding.

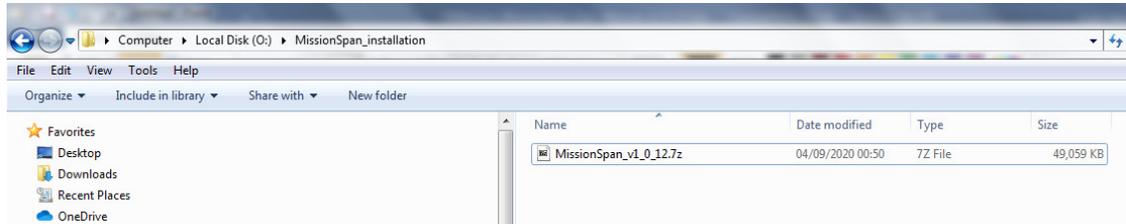


Figure 2-1 Installation Zip File

The installation process for the application is as follows:

1. Navigate to the destination folder where **MissionSpan™** is to be installed and open the archive (you may need to right-click on the file and select 'Open' or 'Open archive'). The archive tool will display the contents of the zip file (see **Figure 2-2**).

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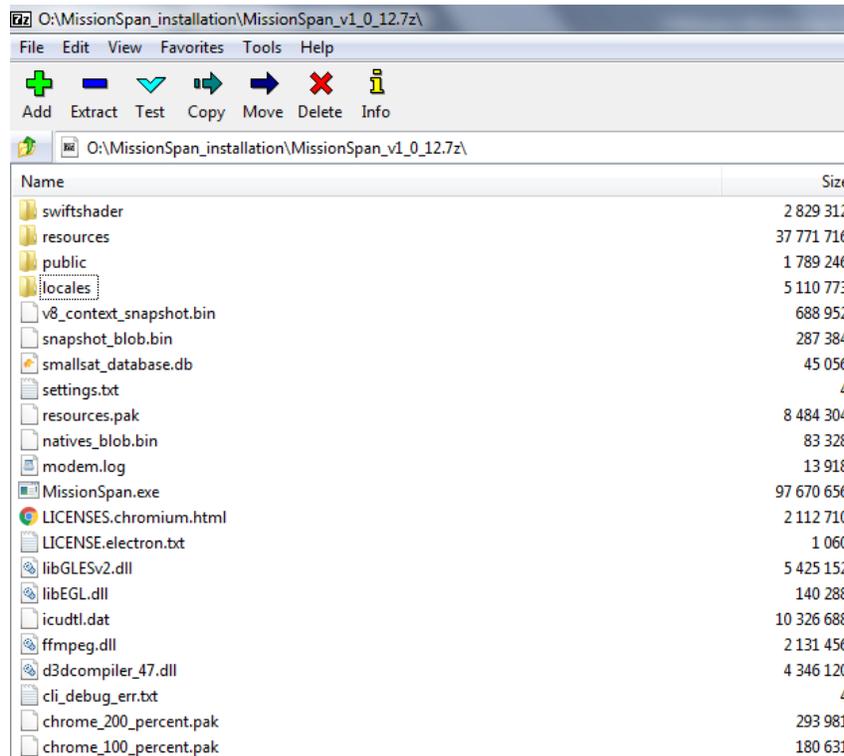


Figure 2-2 Installation Zip File Contents

2. Select the *Extract* button in order to extract all files and choose the destination folder as shown in **Figure 2-3**.

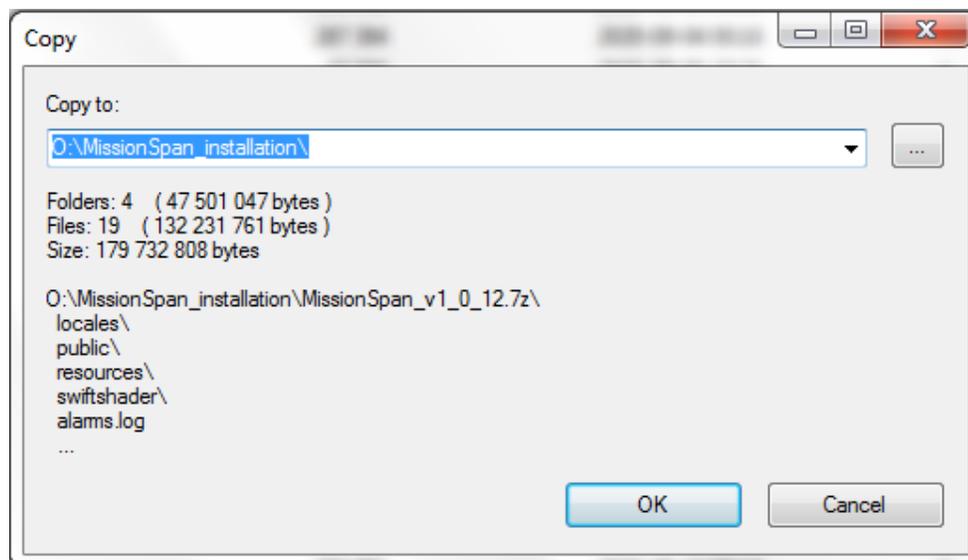


Figure 2-3 Extracting the Installation Zip File Contents

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3. Following extraction, the contents of the destination folder should now look like **Figure 2-4**.

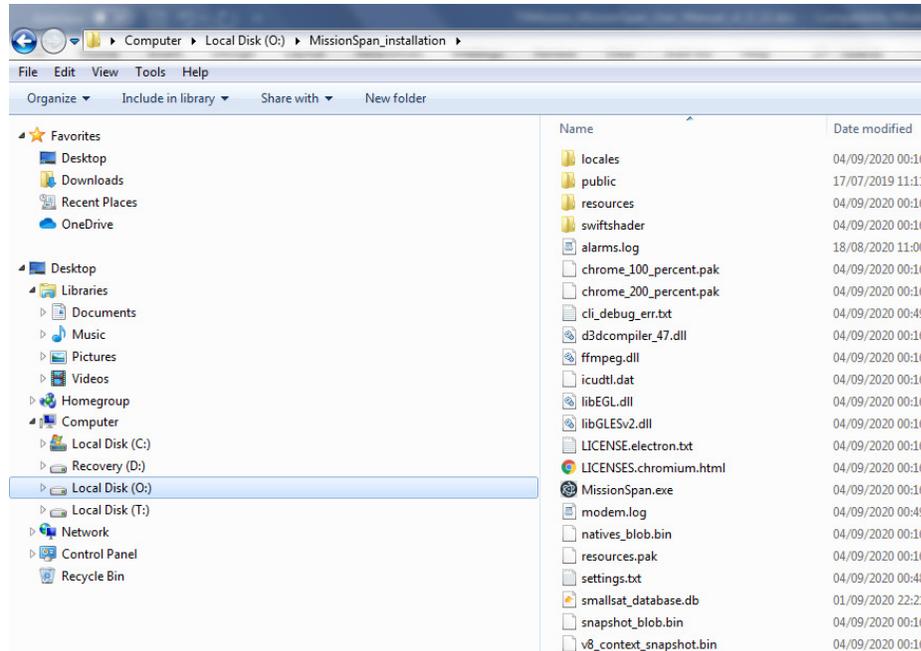


Figure 2-4 Installation Folder Contents

4. Right clicking on the *MissionSpan.exe* file brings up a context menu as shown in **Figure 2-5** that allows a desktop shortcut to be created and allows MissionSpan to be accessed directly from the Windows Start Menu or Taskbar, if desired.

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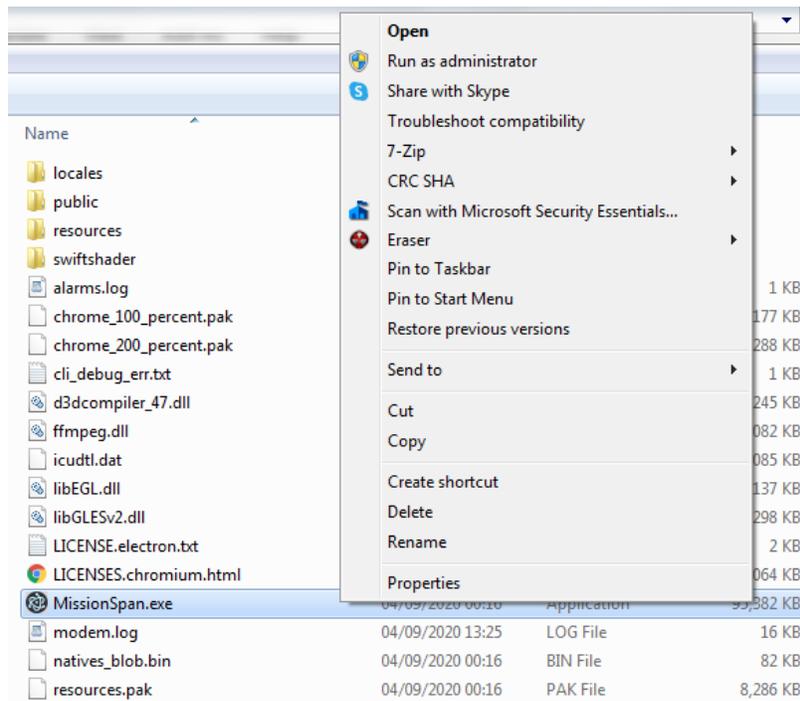


Figure 2-5 Creating Desktop Shortcut to Application

5. Multiple instances of MissionSpan can run concurrently on the same or different computers. The single-user version of MissionSpan installs a local configuration database on the computer. The multi-user version allows the database to be located on a shared server drive, ensuring that all changes made to the network configuration are propagated to all operators in real time.
6. Double click on the *MissionSpan.exe* file to start the application. The login procedure is described in the next section. Note that a modem simulator is provided as a separate installation file and can be used with MissionSpan to simulate any number of modems – see **Chapter 4 Appendix**.

3 User Guide

3.1 Starting the Application

Double click on the *MissionSpan.exe* file in the installation folder to start the application. This will bring up a login screen as shown in **Figure 3-1**.



Figure 3-1 MissionSpan™ Login Screen

The default username and password are *admin* and *txmission*, respectively.



It is strongly recommended that to ensure security, the default admin password is changed immediately on first logging in.

The *admin* user cannot be deleted. Other user login names can be added as required.

When starting the application for the first time, Windows will display a warning as shown in **Figure 3-2**. Uncheck both boxes and select *Cancel*, as MissionSpan does not need any special permissions in relation to Windows Firewall.

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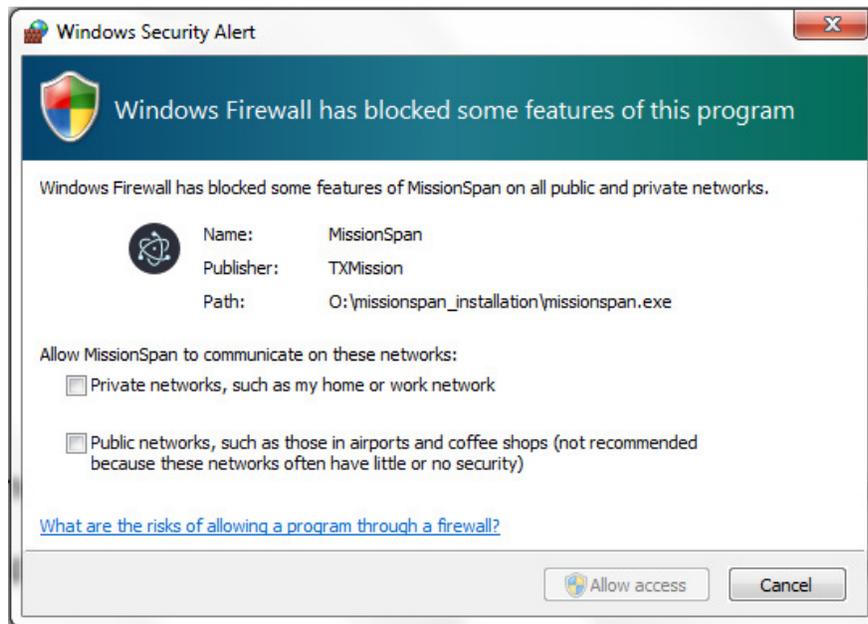


Figure 3-2 Firewall Warning Screen

Following successful login, the screen shown in **Figure 3-3** will be displayed. This shows an example network held in MissionSpan's database, which can be deleted (as explained later) if it is not required.

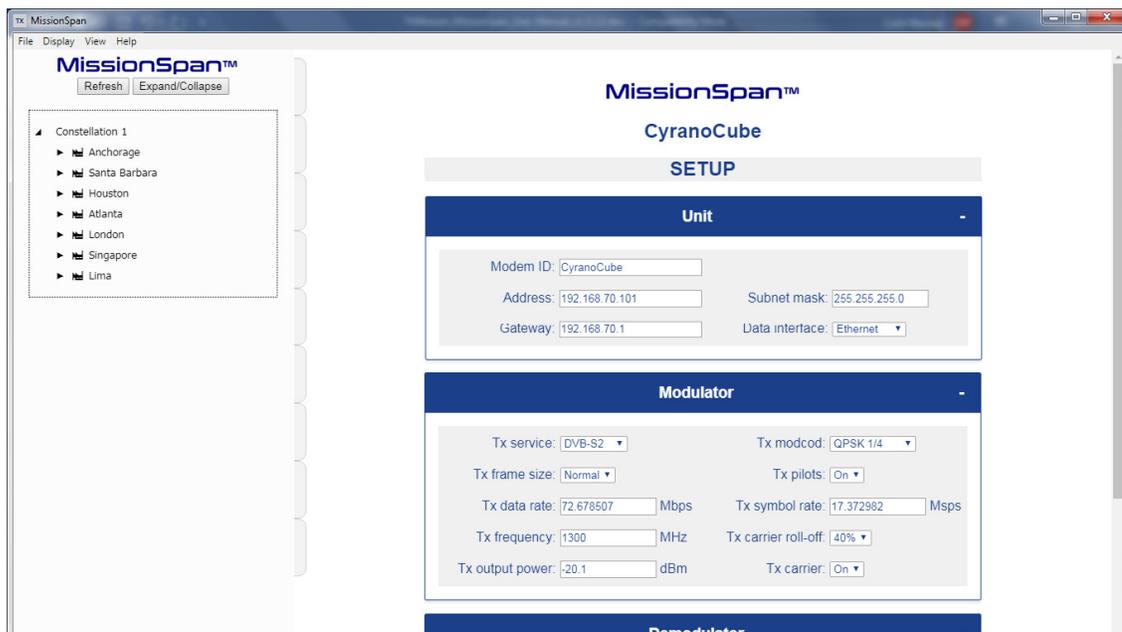


Figure 3-3 Main Application Screen

3.2 User Interface Layout

MissionSpan's user interface comprises several elements as described in the following sections.

3.2.1 Navigation Tree

The navigation tree (**Figure 3-4**) is located on the left-hand side of the screen and is used to navigate to sites and devices within the currently selected network. The currently selected site or device is indicated by being highlighted.

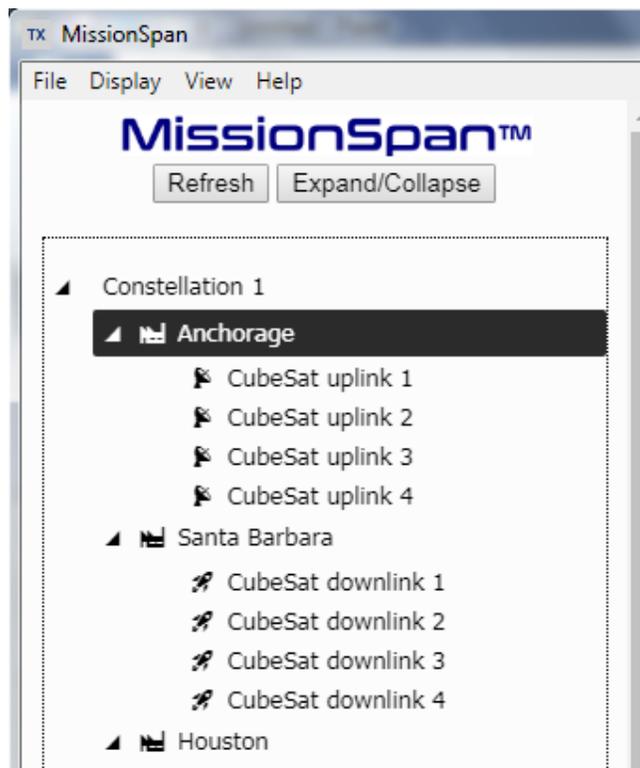


Figure 3-4 Navigation Tree

Networks comprise one or more sites and sites contain one or more devices. Devices typically represent TXMission modems but could potentially be any network device that supports an embedded web server. Sites are usually physical locations such as ground stations, equipment racks, satellites or airborne vehicles where the network devices are located. However, a network could be structured in other ways, for example, as sets of devices that provide specific network services.

Nodes on the tree can be expanded or collapsed as required by clicking on the node. For larger networks, a scroll bar will appear on the right-hand side of the navigation area to allow access to network nodes that are not in the visible area.

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The navigation tree therefore provides a convenient way of accessing and managing all devices in the network.

3.2.2 Display Area

The right-hand side of the screen is a display area that provides the functionality described in the following sections.

3.2.2.1 Local Menus

The display area is used to display menus that allow the operator to manage local network configuration (via MissionSpan's internal database). This mode of operation is referred to as *Local* mode because it does not directly interact with, or change any settings for, any network device. Essentially it operates as an off-line mode where the operator defines and maintains settings for networks, sites, devices, users and modem configurations. Local mode can be used to create and maintain network information for any number of networks (such as satellite constellations or fleets of aircraft).

Local mode menus (**Figure 3-5**) are displayed in a silver colour scheme and show the MissionSpan logo at the top of the display area. The different sections of each menu can be collapsed or expanded using the -/+ icon located at the top right of each section header title.



Figure 3-5 Local Menu System

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As can be seen, a fly-out side navigation menu (**Figure 3-6**) is located on the left-hand side of the display area.

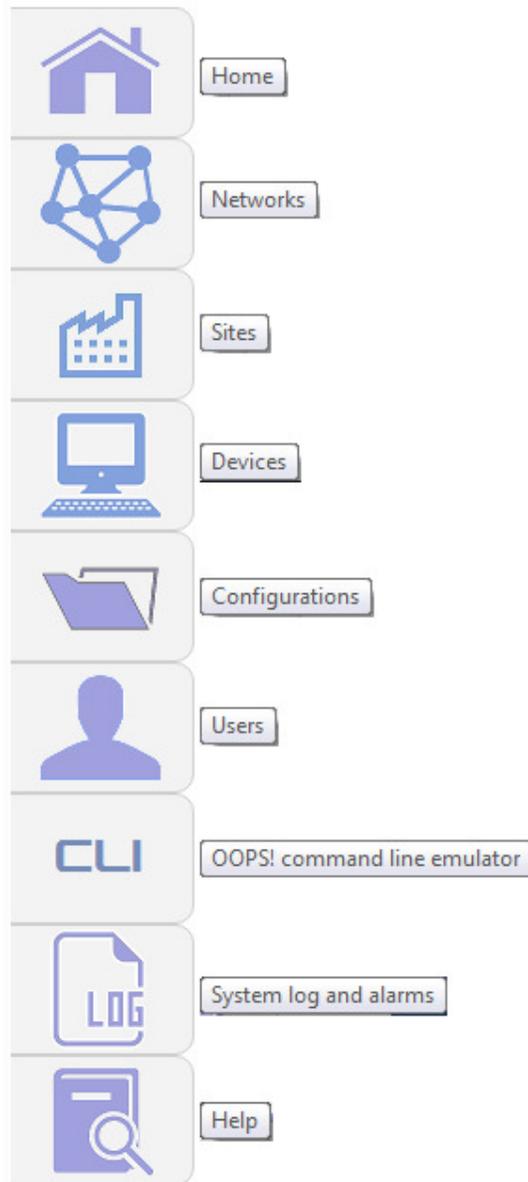


Figure 3-6 Local Mode Fly-out Side Navigation Menu

The fly-out menu provides options for:

- Modem configuration (*Home* menu)
- Network configuration
- Site configuration

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- Device configuration
- User configuration
- Command line interface
- Local system log display
- A Help menu (provides access to this manual)

The local menus are described in detail in the relevant parts of this manual that deal with the above functions.

As mentioned, the database can hold all configurations for all modems. The MissionSpan database, in whole or in part, is transferrable to the modems in the network, allowing all the configurations to be maintained centrally and then distributed throughout the network whenever required. A typical scenario is that each modem will store several alternate configurations (comprising transmission frequencies, data rates, waveforms, etc.), representing different network services, which can be switched on demand.

3.2.2.2 Remote Menus

When the operator clicks on a device in the navigation tree, the display area is used to display the device's built-in web server, as if it were being accessed from a browser. This is referred to as *Network* display mode. At this point, the operator can monitor and control the device using a set of web pages and menus provided by the device itself, which replace the local menu system.

Remote menus (**Figure 3-7**) are displayed in an amber colour scheme and display the TXMission logo at the top of the display area. Remote menus contain a fly-out side navigation menu that has some commonality with MissionSpan's fly-out menu, but which also has features that are unique to the modem web server. The commonality of user interface features and style between MissionSpan and the modem web server means that operators who are familiar with either can easily learn to use the other.

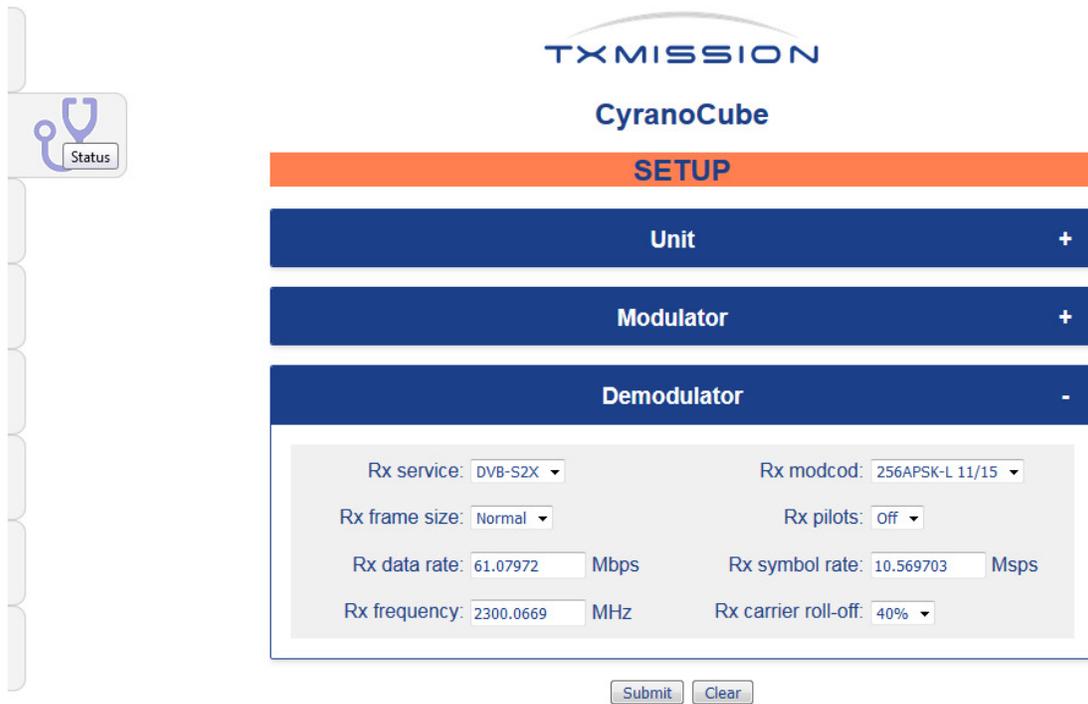


Figure 3-7 Remote (Modem) Menu System

The modem web server is documented in a separate user manual. However, as mentioned, there is a significant degree of overlap in relation to the basic modem configuration features available in MissionSpan’s *Local* mode, which are described later in this manual.



To switch back to Local mode, the operator selects Local from the application Win menu (described later).

3.2.2.3 Command Line Interface

When in *Local* mode, there is a menu option that provides access to a command line terminal emulator (**Figure 3-8**). The terminal implements TXMission’s OOPS! command line protocol. This is another way of managing network devices and of defining modem configurations in MissionSpan’s local database. The operator can choose whether to send commands to update the local database (to create or edit modem configurations) or to any network device (which will action and update its own database when it receives the commands).

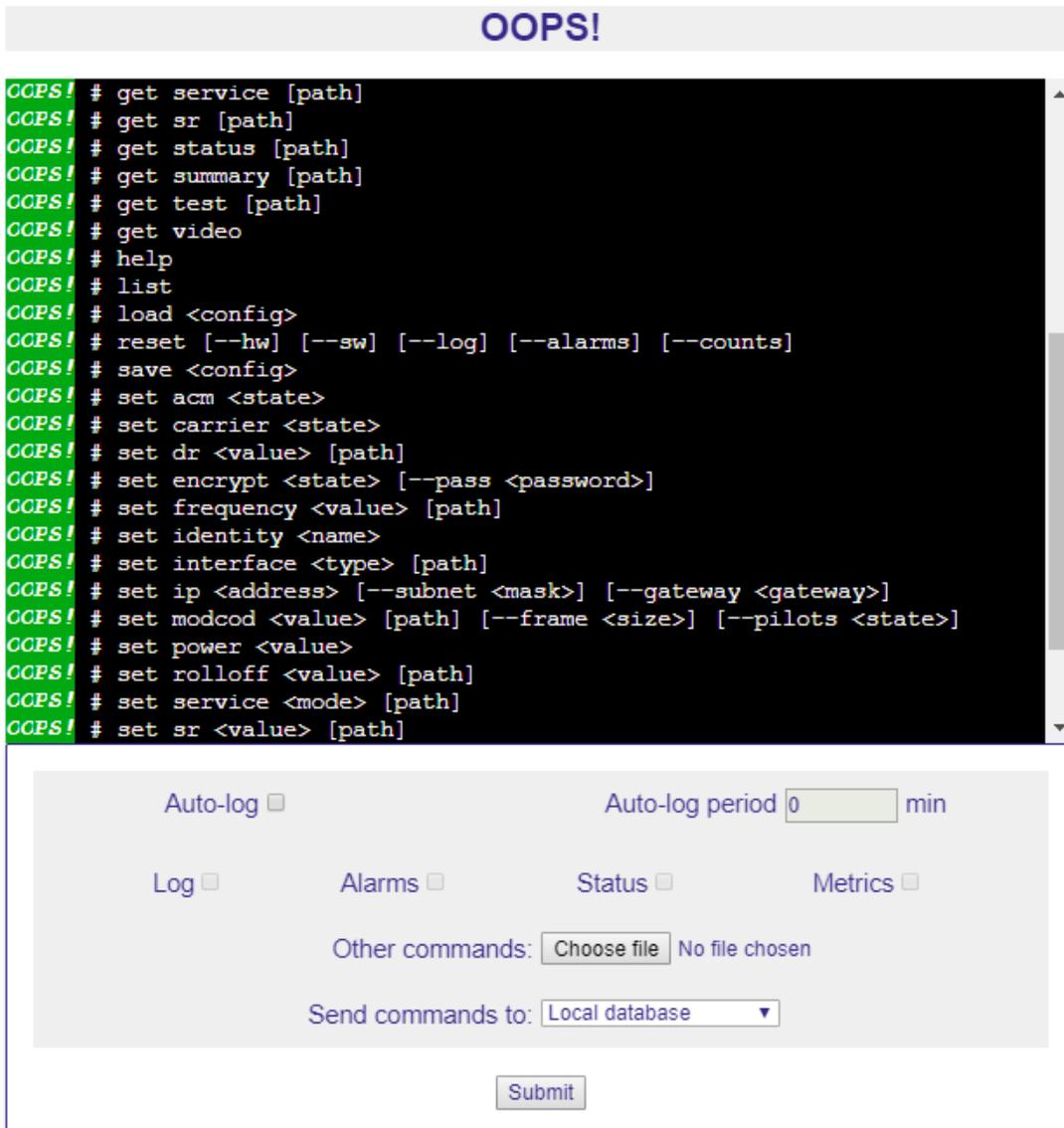


Figure 3-8 OOPS! Command Line Terminal Emulator

The command line interface (CLI) is distinguished by the fact that it can operate in both local (*Local*) and remote (*Network*) modes, targeting either the local database or a remote modem.

3.2.3 Application Menus

The *Application Menus* are displayed at the top left of the main screen as shown in **Figure 3-8**. As the name suggests, these give access to application-level functions such as switching between modes of operation or exiting the application. These menu options are described later in the document in the context within which they are normally used.



Figure 3-8 Application Menu System

3.3 Defining a New Network

MissionSpan organizes communications resources into networks, sites and devices. Sites represent meaningful parts of the network such as locations, racks of equipment or types of service. Devices are typically TXMission modems but can be any network device that supports an embedded web server as its user interface.

This section describes how to set up a new network (using the *Networks*, *Sites* and *Devices* menus shown in **Figure 3-6**).

An example of sites and modems in a network is shown in **Figure 3-9**. Sites are depicted by the 🏭 (factory) icon. Ground station modems are indicated by the 📡 icon and onboard modems by the 🚀 icon. Other types of devices are shown using the 🖥️ icon.

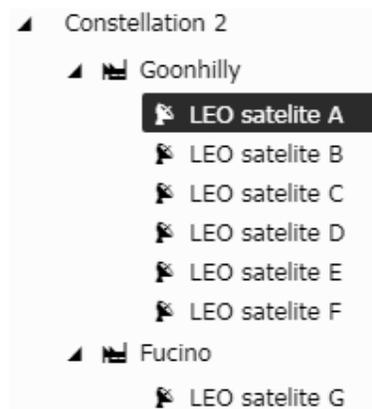


Figure 3-9 Network Navigation Tree (showing Sites and Modems)

3.3.1 Adding a Network using the Networks Menu

While in *Local* mode, select the *Networks* option from the fly-out menu in the display area. This will display the *Networks* menu shown in **Figure 3-10**. Note that the title of this screen indicates that *Constellation 2* is the currently selected network, meaning that *Constellation 2* will be displayed in the navigation tree.

MissionSpan™

Constellation 2

The screenshot shows two distinct sections of the user interface. The top section is titled "NETWORKS" in a light grey bar. Below it is a dark blue header labeled "Load/Delete". Underneath, there is a light grey box containing the text "Network name:" followed by a dropdown menu currently showing "Constellation 1". Below this box are two buttons: "Load" and "Delete". The bottom section is a dark blue header labeled "Add". Below it is a light grey box containing the text "Network name:" followed by an empty text input field. Below this box is a single button labeled "Create".

Figure 3-10 Networks Menu

To create a new network, just enter a name in the *Add* section and click the *Create* button. The new network will now appear in the list of networks shown in the *Network name* dropdown box of the *Load/Delete* section, although at this stage the network has no contents. For example, after adding and loading *New network*, the *Networks* screen should look like **Figure 3-11**.

The screenshot shows a web browser window titled "MissionSpan". On the left, there is a sidebar with a "New network" button. The main content area displays the "MissionSpan™" logo and the text "New network". Below this, there is a "NETWORKS" section with a "Load/Delete" header. Underneath, there is a "Network name:" dropdown menu. The dropdown is open, showing a list of options: "Constellation 1", "Constellation 2", "Constellation 3", "Constellation 4", and "New network". The "New network" option is highlighted in blue. Below the dropdown is a "Load" button.

Figure 3-11 Networks Screen (after adding New Network)

The new network can be loaded into the navigation tree at any stage by selecting it from the list of networks and clicking the *Load* button. At this point we want to add sites and modems to the network as described in the following sections.

3.3.2 Adding Sites to a Network using the Sites Menu

While in *Local* mode, select the *Sites* menu from the fly-out menu in the display area. This will display the screen shown in **Figure 3-12**.

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New network

SITES

Edit -

Site to edit: Anchorage ▾

New name:

New network: Constellation 1 ▾

Change Cancel

Add -

Site name:

Network: Constellation 1 ▾

Create Cancel

Delete -

Site name: Anchorage ▾

Delete

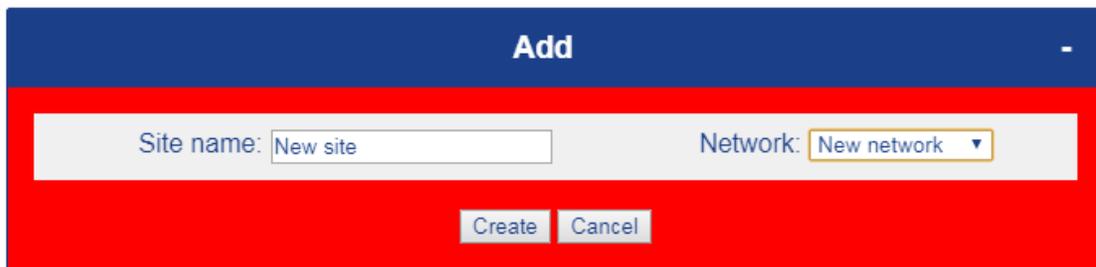
Figure 3-12 Sites Menu

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To add a site, enter the new site name in the *Add* section and, using the dropdown control, select the network that the site is to be associated with. (Sites can only be associated with one network.) Then select the *Create* button. Repeat this process for each new site. Note that sites will not appear in a network until they have at least one device associated with them.

A site can be deleted if necessary, using the *Delete* control.

Note that when the new site name is entered into the Add section, the background colour for this section will change to red (**Figure 3-13**). This is a common feature of data entry on all screens and acts as a reminder to submit the request using the appropriate button (*Create* or *Cancel* in this case).



The screenshot shows a web form titled "Add" with a blue header bar. The main content area has a red background. There are two input fields: "Site name:" with the text "New site" and "Network:" with a dropdown menu showing "New network". Below the fields are two buttons: "Create" and "Cancel".

Figure 3-13 Red indicates data has changed and form needs to be submitted

Following entry of a new site, the *Sites* screen will now show the additional sites (**Figure 3-14**).

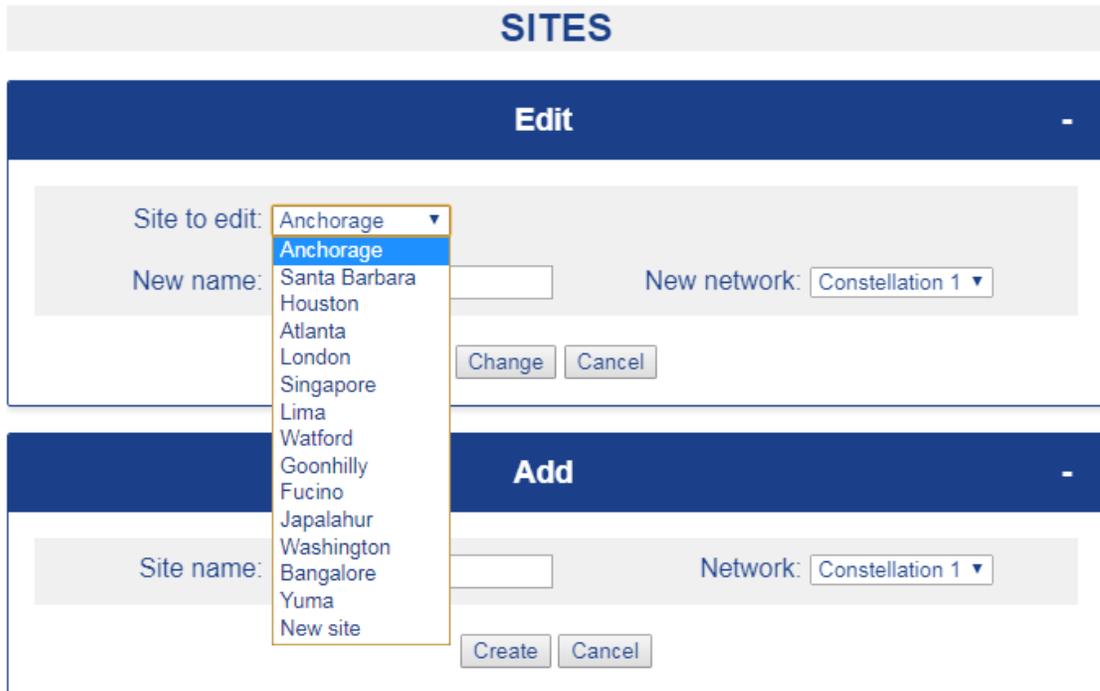


Figure 3-14 Sites Screen (after adding New Site)

3.3.3 Adding Devices to a Network using the Devices Menu

While in *Local* mode, select the *Devices* menu from the fly-out menu in the display area. This will display the screen shown in **Figure 3-15**.

New network

DEVICES

Edit -

Device to edit:

New name: New address:

New site: New user:

Display icon: Ground modem Onboard modem Other

Add -

Device name: Address:

Site: User:

Display icon: Ground modem Onboard modem Other

Delete -

Device name:

Figure 3-12 Devices Menu

The process for adding modems is as follows:

- Add the new modem name in the *Add* section.
- Enter an IP address in dotted decimal notation (e.g. 192.168.0.1).
- Assign the modem to a site using the *Site* dropdown box.

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- Select a username to be used to log when logging into the modem. (The password will be provided automatically from MissionSpan's database.)
- Select a display icon that represents the type of device. This is used for display purposes only to indicate to the operator the device type being accessed.
- Click the *Create* button to store the data in the database.
- Repeat the process for each modem or device.

Devices can only be associated with one site.

A device can be deleted if necessary, using the *Delete* control.

3.4 Using and Editing Networks

3.4.1 Loading a Network

Operators may have to work with several networks at the same time. Only one network is currently presented to the operator at any time. Consequently, the operator may need to load different networks as circumstances demand.

To do this, while in *Local* mode, select the *Networks* option from the fly-out menu in the display area. This will display the *Networks* screen shown in **Figure 3-13**. Select the required network from the dropdown box and select *OK* from the confirmation dialog, at which point the network will be loaded into the navigation tree.

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New network

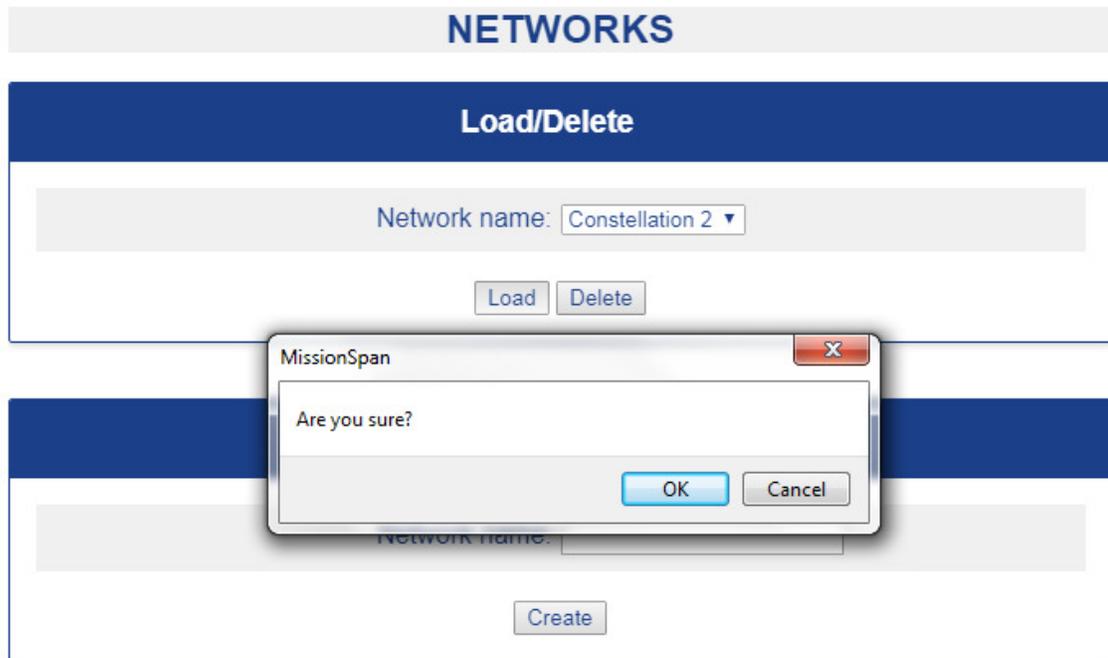


Figure 3-13 Networks Screen (loading a network)

3.4.2 Editing a Network

Once a network has been created, it may be necessary from time to time to edit the existing network structure to reflect changes made to equipment and services. See the following sections for instructions on editing sites and devices.

While in *Local* mode, select the *Networks* option from the fly-out menu in the display area. This will display the *Networks* menu shown in **Figure 3-14**. Although a network contains sites and devices, the network itself is defined only by its name. The network name cannot be edited and therefore the only option available is to delete the network using the Delete control shown in **Figure 3-14**.

MissionSpan™

New network

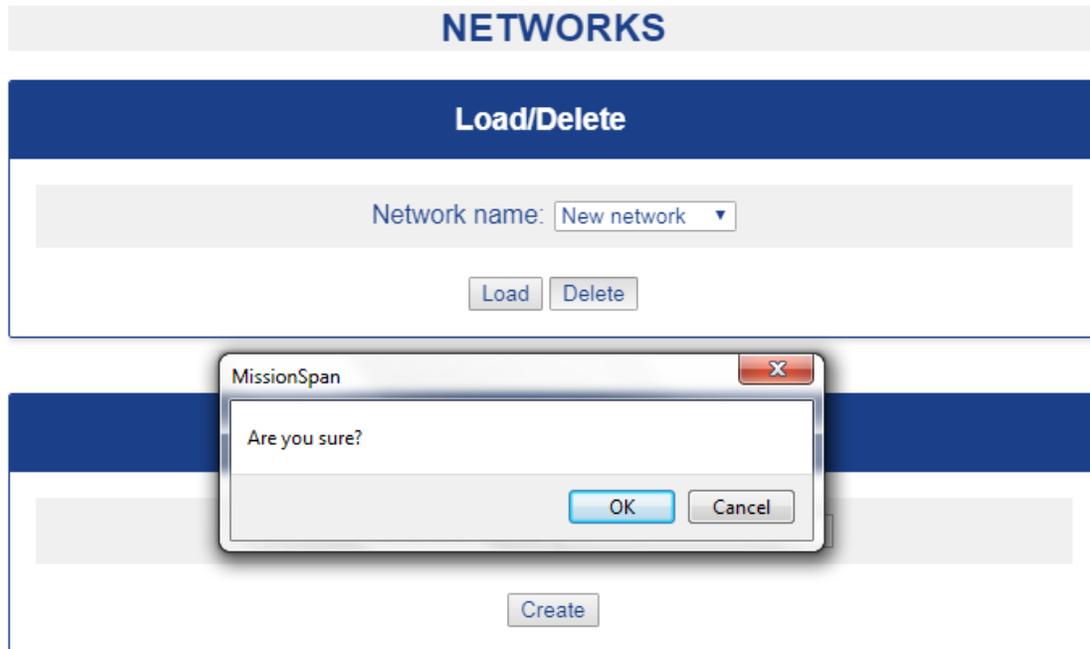


Figure 3-14 Networks Screen (deleting a network)

Select *OK* from the confirmation dialog to delete the network. Deleting a network does not delete its sites or devices. Following deletion of a network, its associated sites and devices can either be reallocated to other networks, left unassigned or deleted.

3.4.3 Editing Sites

While in *Local* mode, select the *Sites* emnu from the fly-out menu in the display area. This will display the screen shown in **Figure 3-15**, which shows a site being moved to be part of another network. The name of the site can also be changed. Selecting the *Change* button will cause the changes to be stored in the database.

The *Delete* control can be used to delete a site.

Constellation 1

The screenshot displays the 'SITES' interface for 'Constellation 1'. It features three main sections: 'Edit', 'Add', and 'Delete'. The 'Edit' section is highlighted with a red border and contains a dropdown menu for 'Site to edit' (set to 'Anchorage'), a text input for 'New name' (containing 'Anchorage'), and another dropdown for 'New network' (set to 'Constellation 3'). Below these are 'Change' and 'Cancel' buttons. The 'Add' section is a simple blue header with a plus sign. The 'Delete' section contains a dropdown for 'Site name' (set to 'Anchorage') and a 'Delete' button.

Figure 3-15 Sites Screen (editing a site)

3.4.4 Editing Devices

While in *Local* mode, select the *Devices* menu from the fly-out menu in the display area. This will display the screen shown in **Figure 3-16**, which shows a device being moved to another site. The name of the device can also be changed. Selecting the *Change* button will cause the changes to be stored in the database.

Devices can only be associated with one site. The *Delete* control can be used to delete a device.

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Constellation 1

DEVICES

Edit -

Device to edit:

New name: New address:

New site: New user:

Display icon: Ground modem Onboard modem Other

Add +

Delete -

Device name:

Figure 3-16 Devices Screen (editing a device)

3.5 Local Menus

Local menus are available when MissionSpan is in *Local* mode (i.e., not displaying the user interface from any network device). The local menus are accessible from a fly-out side navigation menu (**Figure 3-17**) located in the right-hand side display area.

MissionSpan's *Networks*, *Sites* and *Devices* local menus are described in Sections 3.3 and 3.4, which takes the reader through the process of creating and maintaining communications networks. This section describes the remaining local menus (as shown in red in **Figure 3-17**).

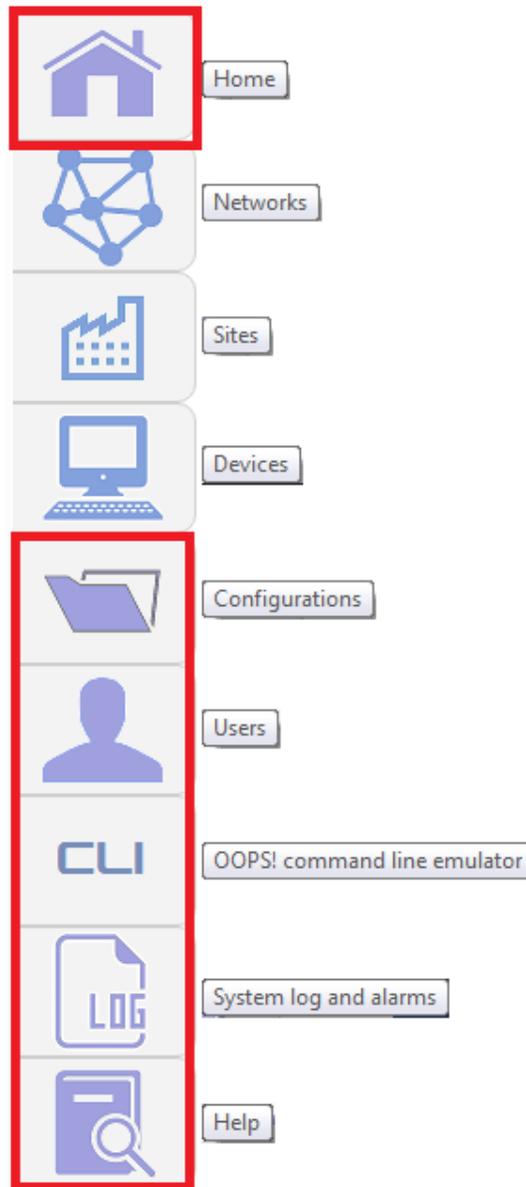


Figure 3-17 Local Side Navigation Menu

3.5.1 Modem Configuration (Home) Menu

A key function of MissionSpan is giving operators the ability to create modem configurations that are ultimately transferred from MissionSpan to the modems themselves either pre-deployment or after they become operational. The modems have this same capability for creating configurations and can store any number of configurations but there are two advantages to managing modem configurations using MissionSpan:

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- To create or edit a configuration using a modem, the modem itself needs to be available, online and needs to support a compatible feature set for the configuration being created. By contrast, MissionSpan can be used to create and modify configurations at any time and does not require any modems to be available.
- MissionSpan can act as a central repository for modem configurations. Creating lots of different configurations on the modems themselves is a potentially error prone process. By contrast, basic templates can be created in MissionSpan and new configurations can then be cloned from these with just a few key parameters being changed (such as transmission frequencies) as required. For larger constellations this is highly efficient.

Because of its importance, and to create commality with the modem's web user interface, the modem configuration menu is called the *Home* menu (**Figure 3-18**).

Note that in addition to the standard side navigation menu, this web page provides a top navigation menu to allow configuration of advanced modem features such as traffic shaping. The advanced menus are described in the sections following this one.

CyranoCube

SETUP

Unit

Modem ID:

Address:

Subnet mask:

Gateway:

Data interface:

Modulator

Tx service:

Tx modcod:

Tx frame size:

Tx pilots:

Tx data rate: Mbps

Tx symbol rate: Msps

Tx frequency: MHz

Tx carrier roll-off:

Tx output power: dBm

Tx carrier:

Demodulator

Rx service:

Rx modcod:

Rx frame size:

Rx pilots:

Rx data rate: Mbps

Rx symbol rate: Msps

Rx frequency: MHz

Rx carrier roll-off:

Figure 3-18 Modem Configuration (Home) Screen

3.5.1.1 Unit Menu Options

The *Unit* menu allows entry of the following:

- **Modem ID**

The *Modem ID* is a meaningful name allocated to the modem. Its location or the service it provides is often used for this purpose. The name format supports the space key and all visible keyboard characters.

Note that this is not the same as the name of the configuration under which the information is stored in MissionSpan's database.

- **Address**

This is the IP address of the modem and is entered in dotted decimal notation (e.g. 10.1.0.1).

Onboard modems support a single Ethernet port whereas ground modems support two. In the case of onboard modems, link traffic and monitor and control use the same address. For ground modems, the address is associated with the monitor and control port (referred to as the M&C or TT&C port) and is used when the operator wants to access the modem's web server or command line function. The ground modem traffic port is not allocated an IP address but nevertheless functions independently of the M&C port since traffic packets are simply bridged over the port as required.

Note that TXMission modems currently support only an Ethernet bridging function. Even when routing is used elsewhere in the network, the satellite link can always be implemented as a bridge.

When Ethernet is used with DVB-S2/X, user traffic is encapsulated using the Generic Stream Encapsulation (GSE) protocol (ETSI TS 102 606-1), which provides a way of carrying packet-oriented traffic inside DVB-S2/X satellite frames.

Care should be taken not to lose access to a modem by changing its IP address to one that is not compatible with the wider control network.

- **Subnet Mask**

The subnet mask of the modem is entered in dotted decimal notation (e.g. 10.1.0.1).

- **Gateway**

The gateway of the modem provides access to the wider network beyond the immediate satellite network (such as the internet) and is entered in dotted decimal notation (e.g. 10.1.0.1).

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- **Data Interface**

The data interface is the physical interface used to route user traffic in and out of the modem.

The following interfaces are selectable:

- *Ethernet*
- *LVDS*
- *RS485*

The following interfaces are physically available but currently reserved:

- *SDI/ASI*
- *USB*
- *UART*
- *CAN*
- *I2C*
- *SPI*
- *SpaceWire*

Even when a non-Ethernet interface is used then the modem's Ethernet port remains accessible for monitor and control purposes.

3.5.1.2 Modulator Menu Options

The *Modulator* menu allows entry of the following:

- **Tx service**

The *Tx service* can be set to the following:

- *Off*: this switches the transmit service off.
- *DVB-S2*: this switches the transmit service to DVB-S2 operation (EN 302 307-1).
- *DVB-S2X*: this switches the transmit service to DVB-S2X operation (EN 302 307-2).
- *CCSDS DVB-S2*: this switches the transmit service to CCSDS over DVB-S2 operation (CCSDS 131.3-B-1).
- *CCSDS DVB-S2X*: this switches the transmit service to CCSDS over DVB-S2X operation (proprietary extension to CCSDS 131.3-B-1).

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- *CCSDS Viterbi*: this switches the transmit service to CCSDS operation (CCSDS 131.0-B-1) using Viterbi only.
- *CCSD Viterbi-RS*: this switches the transmit service to CCSDS operation (CCSDS 131.0-B-1) using both Viterbi and Reed-Solomon encoding.

- **Tx modcod**

A modcod is the combination of a modulation and Forward Error Correction (FEC) rate. The following transmit modcods are supported:

- DVB-S2 Normal frame:

QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
8PSK 3/5, 2/3, 3/4, 5/6, 8/9, 9/10
16APSK 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
32APSK 3/4, 4/5, 5/6, 8/9, 9/10

- DVB-S2 Short frame:

QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9
8PSK 3/5, 2/3, 3/4, 5/6, 8/9
16APSK 2/3, 3/4, 4/5, 5/6, 8/9
32APSK 3/4, 4/5, 5/6, 8/9

- DVB-S2X Normal frame:

QPSK 13/45, 9/20, 11/20
8PSK 23/36, 25/36, 13/18
8APSK-L 5/9, 26/45
16APSK 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90
16APSK-L 5/9, 8/15, 1/2, 3/5, 2/3
32APSK 32/45, 11/15, 7/9
32APSK-L 2/3
64APSK 11/15, 7/9, 4/5, 5/6
64APSK-L 32/45
128APSK 3/4, 7/9
256APSK 32/45, 3/4
256APSK-L 29/45, 2/3, 31/45, 11/15

- DVB-S2X Short frame:

QPSK 11/45, 4/15, 14/45, 7/15, 8/15, 32/45
8PSK 7/15, 8/15, 26/45, 32/45
16APSK 7/15, 8/15, 26/45, 3/5, 32/45
32APSK 2/3, 32/45

- CCSDS Viterbi-RS:

Viterbi: BPSK, QPSK & OQPSK 1/2, 2/3, 3/4, 5/6, 7/8
Reed-Solomon:
Symbols per codeword: 255
Error correction values: 8 & 16

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*Codes include (255, 233) & (255, 239) plus shortened codeblocks
Interleaver depth: 1, 2, 3, 4, 5 & 8*

- **Tx frame size**

This is used only in DVB-S2/S2X modes of operation and can be set to:

- *Normal*

Normal operation uses a satellite frame size of 64,800 bits. This allows the error correction to work more efficiently and therefore has better Es/No performance than the equivalent modcod using the short frame size.

A downside is that latency through the encoder/decoder is four times that of short frames. Latency halves as data rate doubles therefore for high data rate links, or latency insensitive traffic, the use of normal frames is recommended.

- *Short*

Short operation uses a satellite frame size of 16,200 bits.

- **Tx pilots**

Pilots are used only in DVB-S2/S2X modes of operation and can be set *On* or *Off*.

Pilots are a signal that is added to the transmitted carrier to make it easier for the receiver to lock onto the carrier. Pilots are typically used when there is a poor signal at the receiver. The receiver can usually stay locked onto a carrier containing pilot tones lower down into the noise.

The downside of using pilots is that they take up around 2.4% of the carrier bandwidth. When comparing the spectral efficiency versus Es/No of carriers using pilots they generally lie on the same straight line as carriers that are not using pilots, therefore the choice whether to use them will come down to practical considerations such as the satellite link budget calculation or the need to overcome interference on a link caused by the prevailing conditions.

- **Tx data rate**

Transmit data rate and symbol rate are interlinked. If the operator enters a non-zero symbol rate then the data rate will be calculated automatically using the current settings (modcod, frame size, etc.).

If a data rate is entered then the symbol rate will be automatically calculated.

Minimum and maximum data rates are determined by the specific model of modem and vary with the modcod being used (since the choice of modcod changes the symbol rate). Typically, data rates of up to 1Gbps are supported subject to the choice of modcod.

Data rates are entered in Mbps with up to six figures after the decimal point (e.g. 500.123456 Mbps).

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- **Tx symbol rate**

As discussed above, symbol rate and data rate are interlinked and the symbol rate will be automatically set from the data rate unless it is entered by the operator.

Minimum and maximum symbol rates are determined by the specific model of modem and the carrier roll-off factor being used. Typically, an occupied bandwidth of 125MHz is supported, which equates to a maximum of 119Msps when 5% roll-off is used.

Symbol rates are entered in Msps with up to six figures after the decimal point (e.g., 100.123456 Msps).

- **Tx frequency**

Minimum and maximum frequencies are determined by the specific model of modem. Typically, frequencies between 75MHz up to 6GHz are supported.

Frequencies are entered in MHz with up to six figures after the decimal point (e.g. 1220.123456 MHz).

Note that in some older models of modems, there is a single LO synthesizer shared between transmit and receive and consequently the transmit and receive centre frequencies must be the same (carriers can still be transmitted and received on different frequencies but this then becomes a function of the off-board frequency conversion).

Further up/down frequency conversion may optionally be performed externally to the modem (e.g to and from X-band) in which case the modem provides an intermediate frequency to the external equipment and must receive a carrier from the equipment at a suitable frequency.

Care should be taken not to lose access to a modem by changing its frequency to one that does not match the control network. The use of pre-defined configurations is recommended in this regard, as it eliminates the potential for mistakes when manually entering information.

- **Tx carrier roll-off**

The carrier roll-off can be set to the following values:

- 5%
- 10%
- 15%
- 20%
- 25%
- 35%
- 40%

Use of a lower roll-off will result in a lower occupied bandwidth for the carrier. However, the peak-to-average-power ratio (crest factor) of the carrier increases

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for lower values, meaning that a higher back-off is required for the transmit amplifier in order not to overdrive it and distort the carrier.

- **Tx output power**

The modem outputs a very small signal, around a milliwatt or less. This needs to be fed into a power amplifier for onward transmission. (TXMission provides a variety of RF solutions covering offboard frequency conversion, power amplification, LNAs and bandpass filters – contact us for details.)

Minimum and maximum power levels are determined by the specific model of modem but are typically in the range of -40dBm to -5dBm (or 0dBm).

The power level is entered as a negative number in dBm with one figure after the decimal point (e.g. -15.7 dBm).

- **Tx carrier**

This control allows the transmit carrier to be switched *Off* or *On*.

3.5.1.3 Demodulator Menu Options

The *Demodulator* menu allows entry of the following:

- **Rx service**

The *Rx service* can be set to the following:

- *Off*: this switches the receive service off.
- *DVB-S2*: this switches the receive service to DVB-S2 operation (EN 302 307-1).
- *DVB-S2X*: this switches the receive service to DVB-S2X operation (EN 302 307-2).
- *CCSDS DVB-S2*: this switches the receive service to CCSDS over DVB-S2 operation (CCSDS 131.3-B-1).
- *CCSDS DVB-S2X*: this switches the receive service to CCSDS over DVB-S2X operation (proprietary extension to CCSDS 131.3-B-1).
- *CCSDS Viterbi*: this switches the receive service to CCSDS operation (CCSDS 131.0-B-1) using Viterbi only.
- *CCSD Viterbi-RS*: this switches the receive service to CCSDS operation (CCSDS 131.0-B-1) using both Viterbi and Reed-Solomon encoding.

- **Rx modcod**

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A modcod is the combination of a modulation and Forward Error Correction (FEC) rate. The following receive modcods are supported:

- DVB-S2 Normal frame:

QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
8PSK 3/5, 2/3, 3/4, 5/6, 8/9, 9/10
16APSK 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
32APSK 3/4, 4/5, 5/6, 8/9, 9/10

- DVB-S2 Short frame:

QPSK 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9
8PSK 3/5, 2/3, 3/4, 5/6, 8/9
16APSK 2/3, 3/4, 4/5, 5/6, 8/9
32APSK 3/4, 4/5, 5/6, 8/9

- DVB-S2X Normal frame:

QPSK 13/45, 9/20, 11/20
8PSK 23/36, 25/36, 13/18
8APSK-L 5/9, 26/45
16APSK 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90
16APSK-L 5/9, 8/15, 1/2, 3/5, 2/3
32APSK 32/45, 11/15, 7/9
32APSK-L 2/3
64APSK 11/15, 7/9, 4/5, 5/6
64APSK-L 32/45
128APSK 3/4, 7/9
256APSK 32/45, 3/4
256APSK-L 29/45, 2/3, 31/45, 11/15

- DVB-S2X Short frame:

QPSK 11/45, 4/15, 14/45, 7/15, 8/15, 32/45
8PSK 7/15, 8/15, 26/45, 32/45
16APSK 7/15, 8/15, 26/45, 3/5, 32/45
32APSK 2/3, 32/45

- CCSDS Viterbi-RS:

Viterbi: BPSK, QPSK & OQPSK 1/2, 2/3, 3/4, 5/6, 7/8

Reed-Solomon:

Symbols per codeword: 255

Error correction values: 8 & 16

Codes include (255, 233) & (255, 239) plus shortened codeblocks

Interleaver depth: 1, 2, 3, 4, 5 & 8

- **Rx frame size**

This is used only in DVB-S2/S2X modes of operation and can be set to:

- *Normal*

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Normal operation uses a satellite frame size of 64,800 bits. This allows the error correction to work more efficiently and therefore has better Es/No performance than the equivalent modcod using the short frame size.

A downside is that latency through the encoder/decoder is four times that of short frames. Latency halves as data rate doubles therefore for high data rate links, or latency insensitive traffic, the use of normal frames is recommended.

- *Short*

Short operation uses a satellite frame size of 16,200 bits.

- **Rx pilots**

Pilots are used only in DVB-S2/S2X modes of operation and can be set *On* or *Off*.

Pilots are a signal that is added to the transmitted carrier to make it easier for the receiver to lock onto the carrier. Pilots are typically used when there is a poor signal at the receiver. The receiver can usually stay locked onto a carrier containing pilot tones lower down into the noise.

The downside of using pilots is that they take up around 2.4% of the carrier bandwidth. When comparing the spectral efficiency versus Es/No of carriers using pilots they generally lie on the same straight line as carriers that are not using pilots, therefore the choice whether to use them will come down to practical considerations such as the satellite link budget calculation or the need to overcome interference on a link caused by the prevailing conditions.

- **Rx data rate**

Receive data rate and symbol rate are interlinked. If the operator enters a non-zero symbol rate then the data rate will be calculated automatically using the current settings (modcod, frame size, etc.).

If a data rate is entered then the symbol rate will be automatically calculated.

Minimum and maximum data rates are determined by the specific model of modem and vary with the modcod being used (since the choice of modcod changes the symbol rate). Typically, data rates of up to 1Gbps are supported subject to the choice of modcod.

Data rates are entered in Mbps with up to six figures after the decimal point (e.g. 500.123456 Mbps).

- **Rx symbol rate**

As discussed above, symbol rate and data rate are interlinked and the symbol rate will be automatically set from the data rate unless it is entered by the operator.

Minimum and maximum symbol rates are determined by the specific model of modem and the carrier roll-off factor being used. Typically, an occupied bandwidth

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of 125MHz is supported, which equates to a maximum of 119MSPS when 5% roll-off is used.

Symbol rates are entered in MSPS with up to six figures after the decimal point (e.g. 100.123456 MSPS).

- **Rx frequency**

Minimum and maximum frequencies are determined by the specific model of modem. Typically, frequencies between 75MHz up to 6GHz are supported.

Frequencies are entered in MHz with up to six figures after the decimal point (e.g. 1220.123456 MHz).

Note that in some older models of modems, there is a single LO synthesizer shared between transmit and receive and consequently the transmit and receive centre frequencies must be the same (carriers can still be transmitted and received on different frequencies but this then becomes a function of the off-board frequency conversion).

Further up/down frequency conversion may optionally be performed externally to the modem (e.g. to and from X-band) in which case the modem provides an intermediate frequency to the external equipment and must receive a carrier from the equipment at a suitable frequency.

Care should be taken not to lose access to a modem by changing its frequency to one that does not match the control network. The use of pre-defined configurations is recommended in this regard, as it eliminates the potential for mistakes when manually entering information.

- **Rx carrier roll-off**

The carrier roll-off can be set to the following values:

- 5%
- 10%
- 15%
- 20%
- 25%
- 35%
- 40%

Use of a lower roll-off will result in a lower occupied bandwidth for the carrier. However, the peak-to-average-power ratio (crest factor) of the carrier increases for lower values, meaning that a higher back-off is required for the transmit amplifier in order not to overdrive it and distort the carrier.

3.5.2 Modem Configuration Traffic Shaper Menu

The *Traffic Shaper* menu (**Figure 3-19**) allows the allocation of bandwidth between competing TCP/IP traffic streams that have been classified using DiffServ DSCP markings.

TXMission satellite modem

QUALITY OF SERVICE

DiffServ

DSCP Class	CIR	BIR	Priority
CS0	6 %	40 %	3 ▾
CS1	1 %	25 %	0 ▾
CS2	3 %	100 %	0 ▾
CS3	4 %	100 %	0 ▾
CS4	5 %	100 %	0 ▾
CS5	6 %	100 %	0 ▾
CS6	7 %	100 %	0 ▾
CS7	1 %	100 %	0 ▾
AF11	1 %	100 %	0 ▾
AF12	0 %	100 %	0 ▾
AF13	1 %	100 %	0 ▾
AF21	8 %	100 %	1 ▾
AF22	7 %	100 %	0 ▾
AF23	6 %	100 %	1 ▾
AF31	5 %	100 %	0 ▾
AF32	4 %	100 %	0 ▾
AF33	3 %	100 %	0 ▾
AF41	2 %	100 %	6 ▾
AF42	1 %	100 %	3 ▾
AF43	2.25 %	100 %	0 ▾
EF	3 %	100 %	5 ▾
LE	4 %	100 %	0 ▾
Default	1 %	100 %	7 ▾

Figure 3-19 Modem Configuration Traffic Shaper Menu

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The traffic shaping function manages TCP/IP packets within the modulator and provides a guaranteed quality of service for defined IP data streams. The implementation supports Layer 3 classification using the 6-bit Differentiated Services Code Point (DSCP) value in the 8-bit Differentiated Services (DS) field in the IP header.

Traffic shaping allows the quality-of-service mechanism used on terrestrial services to be extended over (pseudo) satellite to create fully provisioned end-to-end services. It supports the implementation and monitoring (through a comprehensive set of per stream packet metrics) of customer service level agreements.

Being packet based, IP naturally supports multiplexing of different data streams. These streams often have different inherent priority levels and competing demands for bandwidth. Traffic shaping controls access to bandwidth for each stream and the relative priority levels of different streams (which affects packet delay and jitter).

The interface controls and concepts that are supported are as follows.

Guaranteed Bandwidth

The *Committed Information Rate* (CIR) is the guaranteed bandwidth, as a percentage of the overall bandwidth, that will be allocated to the specified data stream. Percentages, rather than absolute values, are used because the values remain valid even when the transmit data rate changes dynamically (for example, when ACM is active).

The sum of all CIRs for all classified data streams cannot exceed 100% (which equates to the transmit data rate of the modulator).

Note that a CIR of 0 causes the classification rule to be disabled. Consequently, a stream must be guaranteed bandwidth before shaping of the stream occurs. Traffic shaping can be switched off by setting all CIRs to zero. (To switch quickly between overall traffic shaping being on or off, two modem configurations should be created – one with the required traffic shaping settings and the other with all CIRs set to zero. The desired configuration can then be loaded as required.)

Maximum Bandwidth

If excess bandwidth becomes available (i.e., one or more streams do not require their allocated bandwidth) or some of the overall bandwidth has not been allocated to specific streams, then it can be allocated in a controlled manner between competing streams.

This setting is called the *Burst Information Rate* (BIR), also specified as a percentage. It defines the maximum amount of bandwidth, beyond the guaranteed bandwidth, that a stream can be allocated, should spare bandwidth become available. Each BIR must be less than or equal to 100%.

Priority

Once all guaranteed bandwidths have been met then excess bandwidth may become available. If several streams have BIRs set, then it means that they are all potentially competing for the same excess bandwidth. The allocation of bandwidth in these circumstances is determined by the stream *Priority* setting.

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In this situation, the allocation of the spare bandwidth between competing schemes will be done based on the priority level allocated to each stream. If a stream has a higher priority than another then its full BIR will be met before any excess bandwidth is allocated to the lower priority stream.

The priority setting also controls latency and jitter. If there are packets in different priority queues for transmission then the packets will be sent based on their priority, with the packets from the highest priority queue being sent first.

Priority values range from zero to seven, with zero being the highest priority (note that this is the opposite order of prioritization to IEEE 802.1p priority tagging where seven is the highest priority).

Default Class

A default data stream exists for any packets that are not explicitly part of a classified data stream. Normally, the default class should be assigned the lowest available priority, namely, seven, and have its BIR value set to 100%. However, these settings are not compulsory.

Each incoming packet is assigned to the first class for which a match is found. If no match is found, then the packet is assigned to the default class.

DiffServ DSCP Class

The DSCP classes that are supported are CS0, CS1, CS2, CS3, CS4, CS5, CS6, CS7, AF11, AF12, AF13, AF21, AF22, AF23, AF31, AF32, AF33, AF41, AF42, AF43, EF and LE.

When traffic shaping is enabled, each packet passed to the modem that has one of these values will be recognised and processed by the traffic shaper and all other packets will be processed as part of the default class.

Traffic Shaper Metrics

The traffic shaper stores the following metrics, which can be accessed through the web user interface status screens and the OOPS! command line protocol:

- **Number of packets transmitted for each DSCP stream**
- **Number of bytes transmitted for each DSCP stream**
- **Number of packets dropped for each DSCP stream**
- **Number of packets over the limit for each DSCP stream (command line only)**
- **Total number of packets transmitted for all streams**
- **Total number of bytes transmitted for all streams**
- **Total number of packets dropped for all streams**

3.5.3 Modem Configuration Advanced Menu

The *Advanced* menu (**Figure 3-20**) supports configuration of ACM, encryption and power saving features. It also supports modem software upgrades and allows the modem to be reset.

Modem Traffic Shaper Advanced

Downlink A

ADVANCED

Advanced Features

ACM: Power saving:

AES encryption: Passphrase:

Software Upgrade

No file chosen

System Reset

Figure 3-20 Modem Configuration Advanced Menu

3.5.3.1 Advanced Features Menu Options

The *Advanced Features* menu (**Figure 3-20**) supports the following:

- **ACM**

ACM can be set to the following:

- *Off*: this switches ACM off.
- *On*: this switches ACM on.

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When off, the modem operates in DVB-S2/S2X CCM mode. ACM and CCM modes of operation are explained in the DVB-S2/S2X standards (EN 302 307-1 and EN 302 307-2). When ACM is on, the transmit modcod is selected based on the Es/No value reported by the receiver, assuming a feedback channel is available between the receiver and transmitter. ACM cannot be used if this feedback channel does not exist, as there is nothing to base the choice of modcod on. ACM should be switched on in both the transmitter and receiver. The ACM feedback mechanism is proprietary; the message format is available on request.

- **Power saving**

Power saving can be set to the following:

- *Off*: this switches power saving off.
- *On*: this switches power saving on. When on, the modem attempts to limit prime power consumption to the minimum using various techniques, such as reducing the number of processor cores that are enabled. These may have a marginal, but measurable, impact on efficiency and performance of the modem. This trade-off may be deemed acceptable in situations where minimizing power consumption is critical, or for periods where normal operation is suspended, or throughput performance requirements are reduced.

- **AES encryption**

AES encryption can be set to the following:

- *Off*: this switches AES-256 encryption off.
- *On*: this switches AES-256 encryption on.

Encryption is an export-controlled feature and must be ordered at the time of the original purchase of the modem, as it cannot be provided as a software upgrade later.

When encryption is on, all TCP/IP traffic is securely encrypted in a VPN tunnel between the modems. Encryption adds an overhead of around 3% compared to when encryption is disabled.

- **Passphrase**

The passphrase is used to generate an encryption key. The passphrase must be the same on both modems that are exchanging TCP/IP data.

If the passphrase is changed while encryption is enabled, then encryption must be switched off and on again for the new passphrase to be actively used.

The passphrase can consist of any characters other than spaces. It is recommended that a passphrase of at least 15 characters in length is used and that it is changed from its default value.

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Caution should be taken when enabling and disabling encryption, and when changing the encryption key, to make sure that communications with the other modem are not lost due to incompatible settings between the two modems.

3.5.3.2 Software Upgrade Menu Options

The *Software Upgrade* menu (**Figure 3-20**) allows the modem software to be upgraded or downgraded.

Note that when MissionSpan is being used in *Local* mode, the software upgrade process is not supported, as MissionSpan is not actively communicating with any modem. The upgrade process must be initiated when connected to the desired modem in *Network* mode. (The upgrade feature has been retained in MissionSpan's local menus only as a result of underlying code commonality between MissionSpan and the modem web server.)

The following description of the upgrade process assumes MissionSpan is in *Network* mode and is actively connected to the desired modem.

If the modem is onboard, as opposed to on the ground, then the upgrade will take place over the air.

The software upgrade process will interrupt normal modem operation and should therefore be carried out either pre-deployment or during an operational maintenance window.

The length of time taken for the upgrade depends on the time it takes to transfer the software file to the modem. Software files are generally between 100MB and 130MB in size. For over-the-air upgrades at low bit rates, the time taken to transfer the file can be substantial. However, the upgrade process itself does not interfere with the normal operation of the modem until the transfer is complete.

The procedure for upgrading the modem software is as follows:

- Browse to the software upgrade file using the *Choose file* button. (The software is provided as a compressed file and the filename will end with *.tar.gz*.) The chosen filename should now be displayed as in **Figure 3-21**.

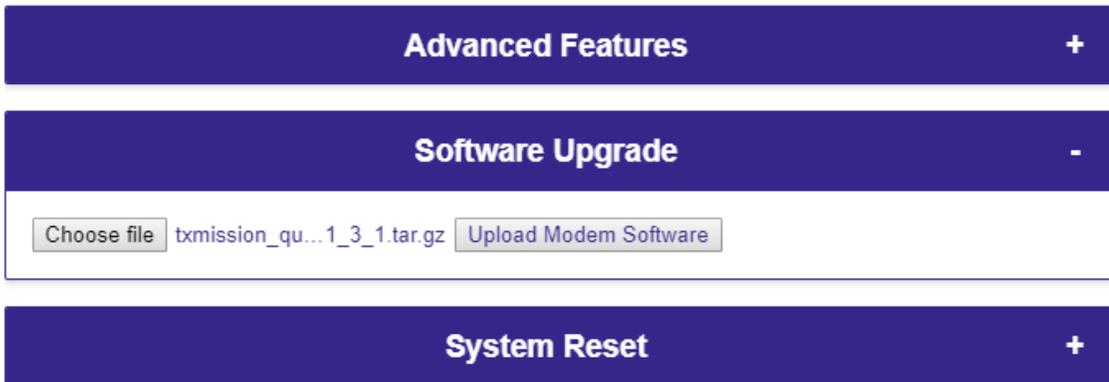


Figure 3-21 Modem Configuration Software Upgrade (file selection)

- Click the *Upload Modem Software* button. During the file transfer process, the status of the transfer will be displayed, as shown in **Figure 3-22**.

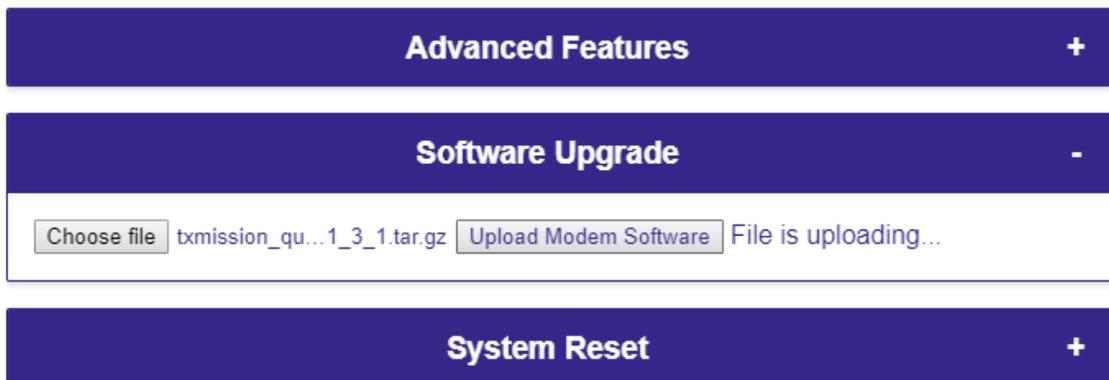


Figure 3-22 Modem Configuration Software Upgrade (file upload in progress)

- When the transfer is completed successfully, this will be reflected in the status message (**Figure 3-23**).

As soon as the file upload completes, the modem will initiate the upgrade of the software and move the new software from its temporary location used for the file transfer to permanent storage in non-volatile memory. The modem will then reset automatically to load and run the new software version.

The user interface should refresh automatically once the modem has completed powering up. The process will take around a minute from when the reset is initiated.

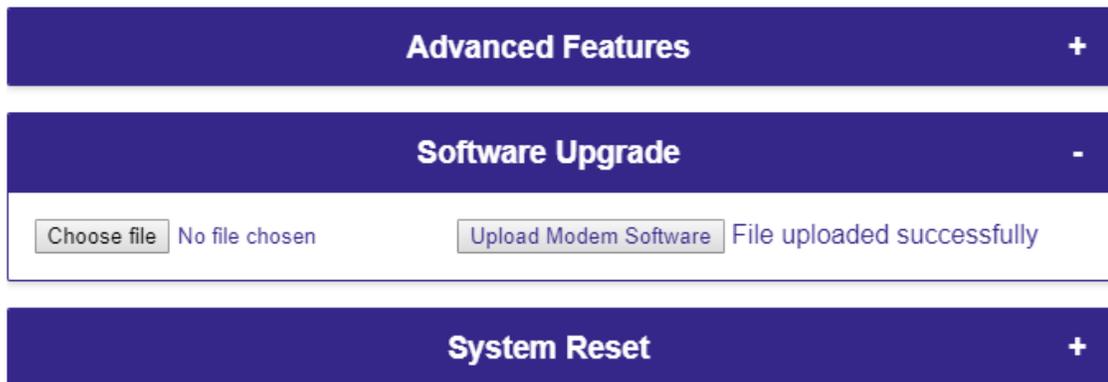


Figure 3-23 Modem Configuration Software Upgrade (file uploaded successfully)

- If an error occurs during the file transfer, then the status will be displayed as shown in **Figure 3-24**. The file transfer should be repeated until it completes successfully. Modem operation will continue normally until the file is transferred successfully.

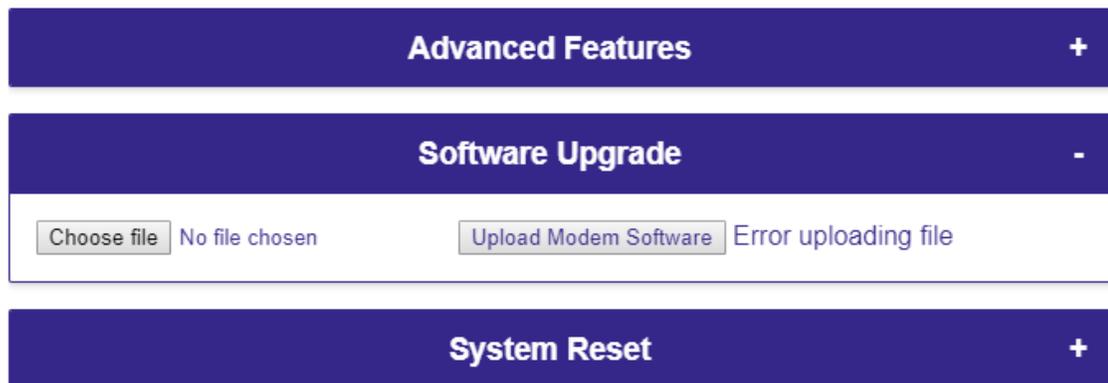


Figure 3-24 Modem Configuration Software Upgrade (file upload error)

3.5.3.3 System Reset Menu Options

The *System Reset* menu (**Figure 3-20**) supports the following:

- **Soft Reset**

A soft reset reboots the operating system and restarts the modem application.

- **Hard Reset**

A hard reset restarts the modem by applying a reset signal, which causes it to go through a similar sequence of operations to what occurs when it powers up.

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3.5.4 Networks Menu

The *Networks* menu is described in Sections 3.3 and 3.4 (setting up and using networks).

3.5.5 Sites Menu

The *Sites* menu is described in Sections 3.3 and 3.4 (setting up and using networks).

3.5.6 Devices Menu

The *Devices* menu is described in Sections 3.3 and 3.4 (setting up and using networks).

3.5.7 Configurations Menu

The *Configurations* menu (**Figure 3-25**) is used to store, load and delete modem configurations.

Modem configurations are managed independently of other network resources, such as sites and devices and are held in a separate table within the application database. Modem configurations are therefore available to be used with all devices in the network.

The easiest way of transferring modem configurations around the network is to FTP the MissionSpan database to each modem manually (contact us for details). (In future, this feature will be supported within MissionSpan.)

CubeSat CyranoZeta: Orbital Configuration 1

CONFIGURATIONS

Load/Delete

Configuration name:

Create

Configuration name:

Figure 3-25 Configurations Menu

To load a configuration, select it from the dropdown box and click on the *Load* button. The configuration can now be viewed and edited using the *Modem Configuration (Home)* menu.

*When a configuration is loaded, it is copied from the database to the **current** configuration. The title of each configuration screen will show the Modem ID from the **current** configuration and the original configuration name (in the case of **Figure 3-25**, these are CubeSat CyranoZeta and Orbital Configuration 1, respectively).*



*When the modem is power cycled, it is the **current** configuration that is loaded. Changes to configurations can only be made through the **current** configuration. The operator will therefore typically load a configuration, edit it as the **current** configuration and then store the **current** configuration as a named configuration (either as the original configuration name or to a configuration with a new name).*

*Changes made to the **current** configuration are stored immediately into the database as they are made. However, if another configuration were to be loaded without saving any changes to the **current** configuration beforehand, then the changes would be lost since the **current** configuration is overwritten at this point.*

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Note that *Factory configuration* is a special configuration. By loading the factory configuration, the operator can create a new configuration starting from the factory default settings.

To delete a configuration, select it from the dropdown box and click on the *Delete* button. Click *OK* on the resulting dialog to confirm the deletion. The factory configuration cannot be deleted.

To save a new configuration, or overwrite an existing configuration, enter the configuration name in the *Create* section and click the *Create* button.

3.5.8 Users Menu

The *Users* menu (**Figure 3-26**) is used to add, delete and edit user details and can also be used to log out of the application.

Details entered for users can be applied equally to access MissionSpan and/or network devices such as modems.

The default MissionSpan user is *admin* (default password *txmission*). There are no limits on the number of users that can be added.

Currently, MissionSpan does not support different levels of administration rights and all users have equal access and permissions.

All passwords are stored in encrypted form in the database.

USERS	
Logout -	
Current user: <input type="text" value="colin"/>	
<input type="button" value="Logout"/>	
Change Password -	
Current password: <input type="text"/>	
New password: <input type="text"/>	
Confirm new password: <input type="text"/>	
<input type="button" value="Change"/> <input type="button" value="Cancel"/>	
Add -	
New user name: <input type="text"/>	
Password: <input type="text"/>	
Confirm password: <input type="text"/>	
<input type="button" value="Add"/> <input type="button" value="Cancel"/>	
Delete -	
User name: <input type="text" value="admin"/>	
<input type="button" value="Delete"/>	

Figure 3-26 Users Menu

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The name of the current user is shown in the *Logout* section. Clicking on the *Logout* button logs the current user out and displays the login screen.

The current user's password can be changed in the *Change Password* section by entering the current password and new password and confirming the new password before clicking on the *Change* button. Passwords must be at least eight characters long.

A new user can be added in the *Add* section by entering a user name, password and confirming the password before clicking on the *Add* button. There are no restrictions on the types or number of characters that can be part of a user's name. Passwords must be at least eight characters long.

A user can be deleted by selecting the user's name from the dropdown box in the *Delete* section before clicking on the *Delete* button.

There are no facilities for resetting forgotten passwords. It is recommended that MissionSpan's database (*smallsat_database.db* stored in the root installation folder) is backed up regularly. By backing up the database, it may be possible to revert to logging in using an older username or password. Another technique is to reinstall MissionSpan on a different computer and then directly copy the *User* table of its database to the current MissionSpan database and then log in using the default *admin* username and password.

3.5.9 Command Line Interface (CLI) Menu

The *CLI* menu (**Figure 3-27**) provides a command line terminal emulator.

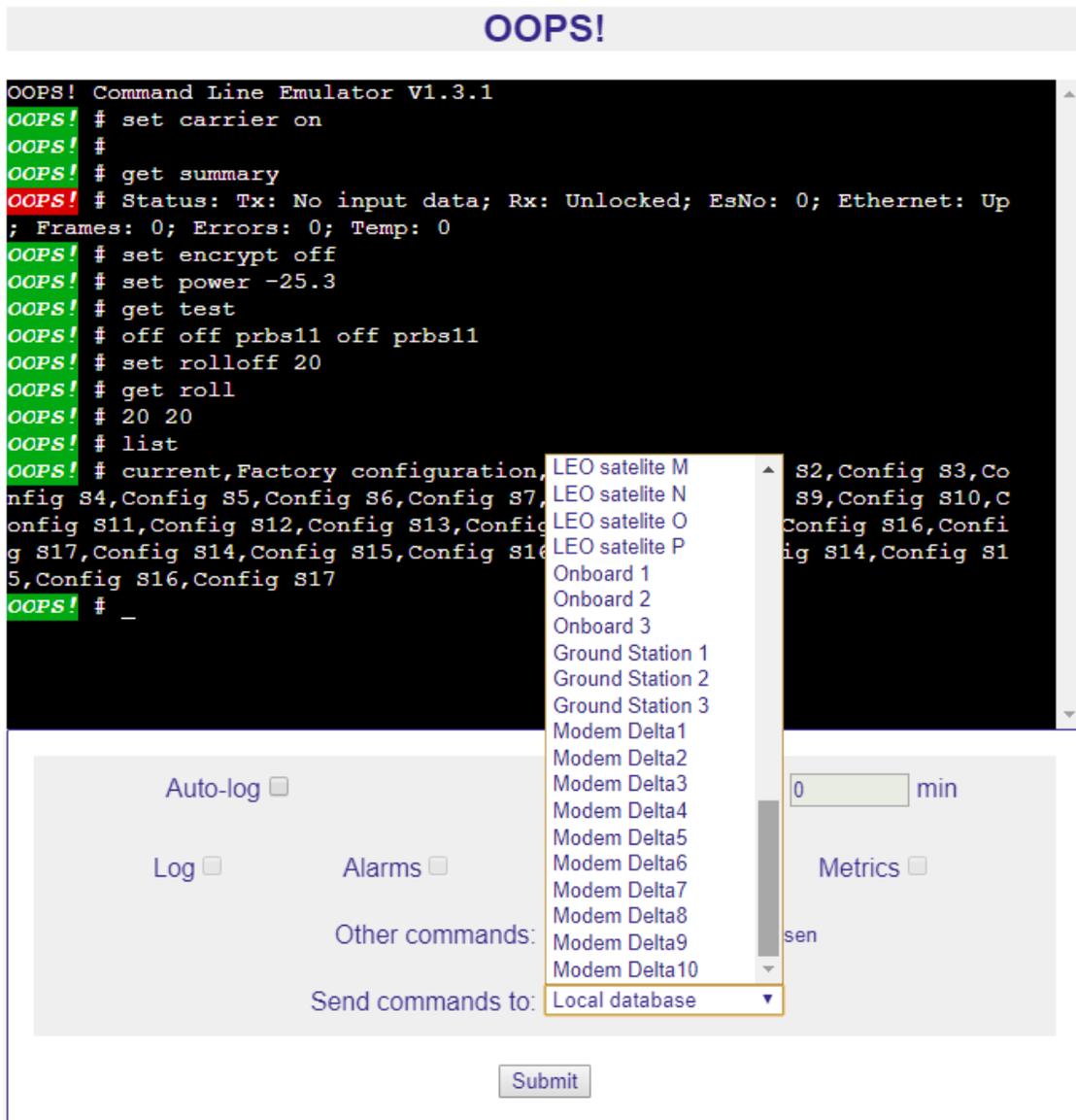


Figure 3-27 Command Line Interface (CLI) Menu

3.5.9.1 General Command Line Operation

The CLI interface implements TXMission’s OOPS! command line protocol and provides an alternate way of managing network devices. OOPS! is documented in *Interface Control Document Part 1: One and Only Protocol for Smallsats! (OOPS!)*, which can be viewed via MissionSpan’s *Help* menus and is also available on TXMission’s website.

The CLI can also be used to define modem configurations in MissionSpan’s local database. When used in a local mode, each command that is issued updates the *current* configuration in the database. OOPS! supports the ability to store the *current* configuration to a named configuration in the database, or this can be done using the local *Configurations* menu once all the OOPS! commands have been issued. Essentially, the operation of MissionSpan’s *Modem Configuration (Home)* menu, the modem’s own

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web server and the command line interface are all completely interchangeable. For example, if a local command is issued, any configuration change will appear on the *Home* screen.

The operator can choose whether to send commands to update the local database (to create or edit modem configurations) or to any network device (which will action and update its own database when it receives the commands). To do this, select the network device to be controlled from the dropdown box (**Figure 3-27**) and click the *Submit* button.

The terminal emulator provides first-level command validation. It will display an error message in red if a command has an invalid format (**Figure 3-28**). A second level of validation occurs when commands are sent to the actual network devices, which check, for example, that parameters such as data rates are within the operating limits of the device. When a command has been successfully executed then the display shows a start-of-line prompt in green.

For users wishing to implement their own network control system, TXMission provides sample code on request that can act as a template for the client-side application. This includes a terminal emulator, command parser (which checks for correct command format and reports errors) and a sockets module for encapsulating/decapsulating and sending/receiving messages.

```
OOPS! #
OOPS! #
OOPS! # set modcod qpsk-1/4 tx --frame normal --pilots on
OOPS! #
OOPS! # set modcod qpsk-1/4 rx --frame normal --pilots of
OOPS! # Error: argument: p, entered: "of", options: "off", "on"
OOPS! #
OOPS! # set mdcod qpsk-1/4 rx --frame normal --pilots off
OOPS! # Error: command not recognised
OOPS! #
OOPS! # get carrier status
OOPS! # Error: too many arguments have been supplied
OOPS! #
OOPS! # get carrier
OOPS! # on
OOPS! #
OOPS! # set car off
OOPS! #
OOPS! # get service
OOPS! # dvbs2 dvbs2x
OOPS! #
OOPS! # get modcod
OOPS! # qpsk-1/4 qpsk-13/45 normal normal on off
OOPS! #
```

Figure 3-28 Command Line Interface (CLI) Menu (showing error messages)

3.5.9.2 Datalogging Operation

When auto-logging is switched on (**Figure 3-29**), the following commands and responses are logged to a file on the computer running MissionSpan:

- Commands (and their responses) entered manually by the operator.
- Optional pre-selected commands (and responses), namely, fetching the modem log, the alarms log, the modem status and modem metrics.
- Any other OOPS! commands (and responses) that have been specified by the operator in a custom file.

The screenshot shows a web-based configuration interface for datalogging. It features several controls: a checked checkbox for 'Auto-log', an input field for 'Auto-log period' set to '5' with 'min' as a unit; four checked checkboxes for 'Log', 'Alarms', 'Status', and 'Metrics'; a section for 'Other commands' with a 'Choose file' button and the text 'commands.txt'; a 'Send commands to:' dropdown menu currently set to 'Onboard 1'; and a 'Submit' button at the bottom.

Figure 3-29 Command Line Interface (CLI) Menu (showing datalogging controls)

The following points should be noted:

- A new log file is created in the root MissionSpan folder every time MissionSpan starts. Filenames have the format *oops_XXXXXXXX.log* where *XXXXXXXX* represents random hexadecimal characters, for example, *oops_15cbda94.log*.
- All commands and responses are logged to the same file. The use of the *get id* or *get ip* commands are recommended for distinguishing different sources of data in the log files.
- A timestamp is added to each log entry by MissionSpan using the current time and date of the host computer. Responses from the modems are not timestamped by the modem except the modem system log and the modem alarms log, every entry of which is timestamped by the modem. It is advisable to synchronise the time and date of all devices in the network (the command *set time* can be used for this purpose).
- There is no requirement to auto-log any of the predefined options (log, alarms, status and metrics). These can all be switched off, in which case log entries will consist of what is entered manually or loaded from an operator-selected file of commands to be executed.

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- To execute commands from a file, the commands should be entered one per line, for example, a file called *commands.txt* might contain the following:

```
get id
get carrier
get service
get status
```

- The command file should be selected **only after** auto-logging has been switched on. If the command filename is not visible (**Figure 3-29**) then it is not being used!
- OOPS! commands include the ability to load predefined configurations. This means that modem services can easily be automatically changed at predefined periodic intervals.
- The minimum period between auto-commands is one minute and the maximum is 24 hours (1440 minutes).
- Auto-logging is active only when the MissionSpan CLI interface is visible. A second instance of MissionSpan should therefore be launched in order to attend to other monitor and control tasks while logging is active.
- The log file is not locked and can be accessed while logging is active. (It may be useful to run a script in the background to make a copy of the log at regular intervals for backup purposes.)
- Commands and their responses are not necessarily interleaved in the log. The requests and responses are asynchronous, and all the automated commands will usually be sent before any responses are received. For manually entered commands, a response will usually be received before the operator has time to enter another command. However, the order in which responses are received will follow the same order as the commands. To support post-processing therefore, markers are added to the MissionSpan log file as follows:
 - A start-of-command string *<SOC>* is added on a separate line prior to each command.
 - A start-of-response string *<SOR>* is added on a separate line prior to each response.
- Log files are stored in UTF-8 format, which is the same as normal text files.
- Auto-logged commands and responses will appear in the CLI window as well as being logged to file. This does not prevent the terminal window being used for manual commands while auto-logging is active.
- Logging from any network device is supported at any time – it is not necessary for the device to be part of the current network constellation that is being actively used in MissionSpan.
- A small excerpt from a log file is shown below as an example of the log file format:

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<SOC>

Sun, 06 Dec 2020 17:01:20 GMT: get dr

<SOC>

Sun, 06 Dec 2020 17:01:20 GMT: get ser

<SOC>

Sun, 06 Dec 2020 17:01:20 GMT: get car

<SOC>

Sun, 06 Dec 2020 17:01:20 GMT: get id

<SOC>

Sun, 06 Dec 2020 17:01:20 GMT:

<SOR>

Sun, 06 Dec 2020 17:01:20 GMT: 50 75

<SOR>

Sun, 06 Dec 2020 17:01:20 GMT: on

<SOR>

Sun, 06 Dec 2020 17:01:20 GMT: dvbs2 dvbs2

<SOR>

Sun, 06 Dec 2020 17:01:20 GMT: TXMission satellite modem

<SOR>

Sun, 06 Dec 2020 17:01:20 GMT: Error: command not recognised

3.5.10 System Log

The *Log* screen (**Figure 3-30**) provides access to MissionSpan's log. Generally, this shows local activity including operator logins, logouts, screen and database accesses and any errors that occur.

When MissionSpan is used to access network modems then these have their own logging systems and while their logs can be displayed in MissionSpan, they are stored only on the modems.

MissionSpan™

CubeSat CyranoZeta

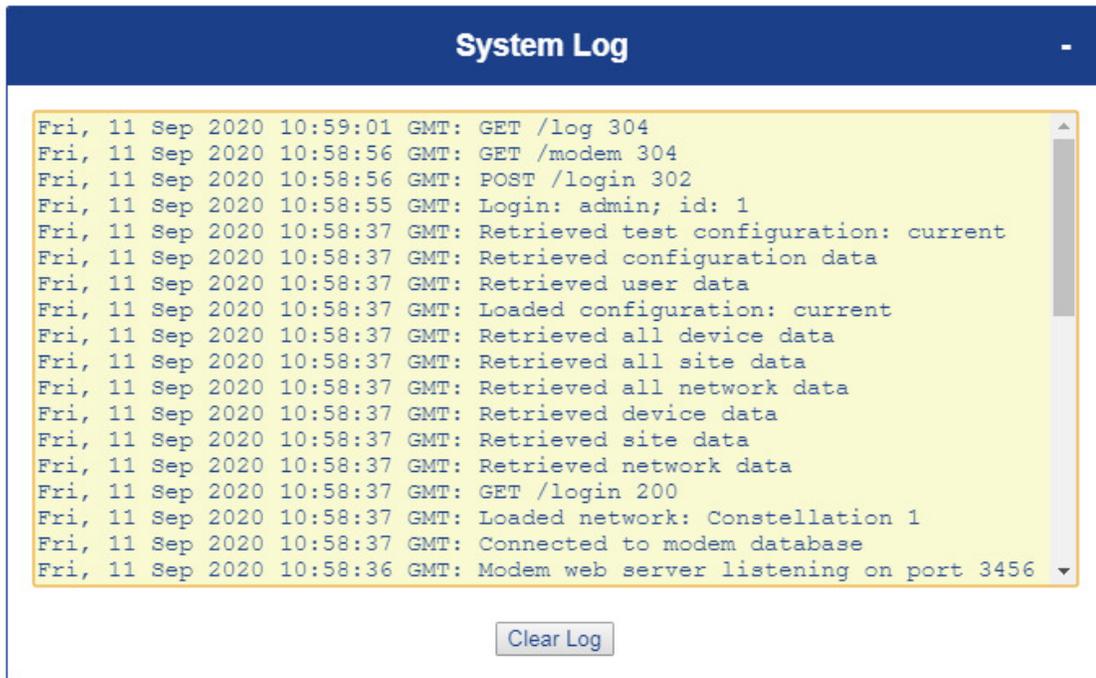


Figure 3-30 System Log

3.5.11 Help Menu

The *Help* menu is currently reserved for future use. Help is available through the application-level *Help* menu described in the next section.

3.6 Application Menus

MissionSpan's main menus are shown in **Figure 3-31** through **3-35**.

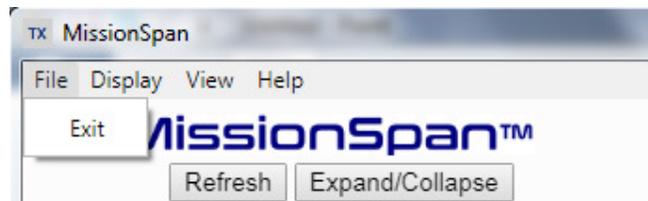


Figure 3-31 Application File Menu

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Figure 3-32 Application Display Menu

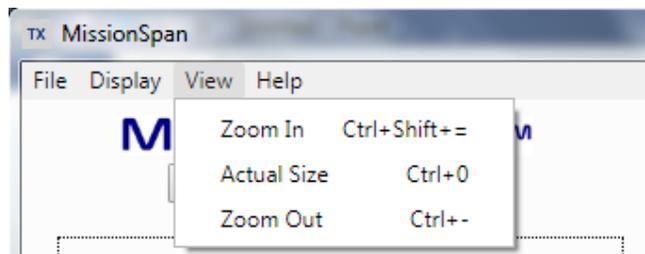


Figure 3-33 Application View Menu

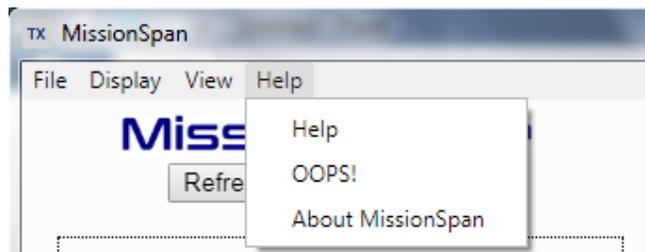


Figure 3-34 Application Help Menu



Figure 3-35 Navigation Menu

These provide the options described in the following sections.

3.6.1 File Menu Exit Option

Selection of the *File* menu *Exit* option causes the current instance of the MissionSpan application to close. This has no effect on the operation of any of the networks.

Follow the instructions earlier in this manual to restart the application and log in.

3.6.2 Display Menu Network Option

Selection of the *Display* menu *Network* option causes MissionSpan to switch out of *Local* mode and to show the user interface for the last network device that was previously selected, in the display area (**Figure 3-36**).

In *Network* mode, the operator is connected directly to the devices in the network and can control and monitor them using their built-in user interfaces, which appear to the right of the navigation tree. Selection of *Network* mode is automatic when the operator selects a device from the navigation tree. Different menu colour schemes are used for *Local* and *Network* mode, namely, silver for local mode and amber for network mode.

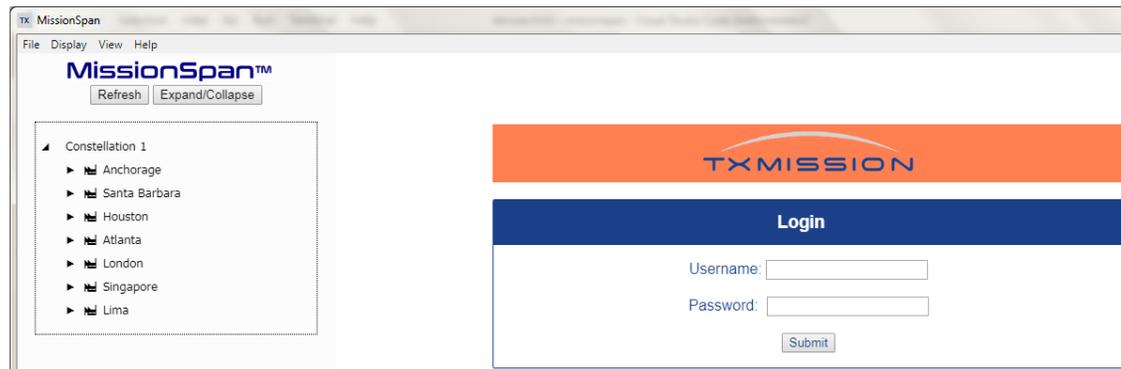


Figure 3-36 Network Mode (showing access to remote devices)

3.6.3 Display Menu Local Option

Selection of the *Display* menu *Local* option causes MissionSpan to switch out of *Network* mode and to show MissionSpan's local menu system in the display area.

Different menu colour schemes are used for *Local* and *Network* mode, namely, silver for local mode and amber for network mode.

3.6.4 View Menu

The *View* menu provides zoom (in, out and reset) functions for the right-hand side display area. These may be useful in adjusting the MissionSpan application for optimal viewing when using different monitors and screen resolutions.

3.6.5 Help Menu Help Option

Selection of the *Help* menu *Help* option causes MissionSpan to display this user manual.

3.6.6 Help Menu About Option

Selection of the *Help* menu *About* option causes MissionSpan to display version information for the application (**Figure 3-37**).

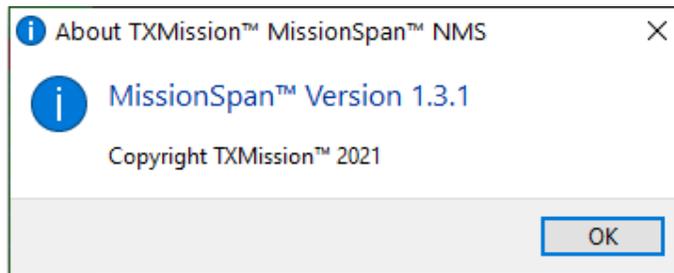


Figure 3-37 Application About Box

3.6.7 Navigation Menu Refresh Option

Selection of the *Navigation* menu *Refresh* option causes the navigation tree to be refreshed.

If the operator changes any aspect of the network definition then the navigation tree will be refreshed automatically. However, in a multi-operator scenario, the network tree will not automatically update if another operator changes the network, assuming there is a centrally located database that is being shared by all operators.

3.6.8 Navigation Menu Expand/Collapse Option

Selection of the *Navigation* menu *Expand/Collapse* option causes all the nodes in the navigation tree to either expand (showing all devices for all sites) or collapse (showing just the sites that are part of the network).

4 Appendix: Modem Simulator

Although MissionSpan is primarily designed to be used with TXMission satellite modems, it can be useful to use it with a TXMission modem simulator. For example, simulators can be used to check the operation of newly created modem configurations prior to their deployment in a live network. The use of modem simulators is also useful when becoming familiar with MissionSpan and training operators. The modem simulator is provided free of charge as a separate installation file to all MissionSpan users.

The modem simulator can run on the same computer as MissionSpan and/or any number of other computers. The modem simulator comprises TXMission's modem web server combined with logic that simulates modem operation, such as the output of status information.

4.1 Installing the Modem Simulator

The modem simulator is a web server that runs on Windows, Linux and other computers that support a **node.js** environment. Node.js is a framework for running JavaScript applications. The modem simulator installation zip file includes node.js for 64-bit Windows environments. Versions of node.js for other environments can be downloaded from <https://nodejs.org/en/download/>.



The modem simulator, as shipped, is dependent on a specific version of node.js being installed. Please install the version of node.js included in the installation zip file. If you already have a later version of node.js installed then you will have to uninstall it and install the version provided by TXMission. Some node.js modules have been cross-compiled for an Intel processor environment – please contact us if you intend installing the modem simulator onto a computer that has a non-Intel processor.

A Windows computer should meet the following specification as a minimum (when used with other operating systems, the computer should provide equivalent resources):

5. Microsoft Windows 10 (recommended but not essential)
6. Intel i5 processor (recommended but not essential)
7. 8GB memory
8. 100MB of free disk space



*The modem simulator is provided as a compressed 7-Zip file (**Figure 4-1**). 7-Zip is an archiving tool that can be downloaded freely from the internet. WinZip can also be used. Ensure that 7-Zip or a compatible archive tool is available before proceeding.*

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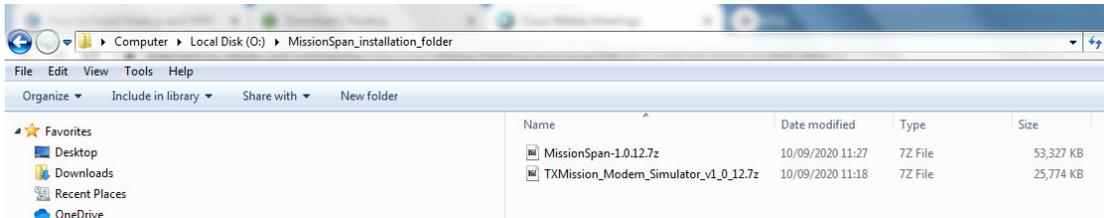


Figure 4-1 Modem Simulator Installation Zip File

The installation process for the application is as follows:

1. Navigate to the destination folder where the modem simulator is to be installed and open the archive TXMission_Modem_Simulator_vx_x_x.7z (you may need to right-click on the file and select 'Open' or 'Open archive'). The archive tool will display the contents of the zip file (see **Figure 4-2**).

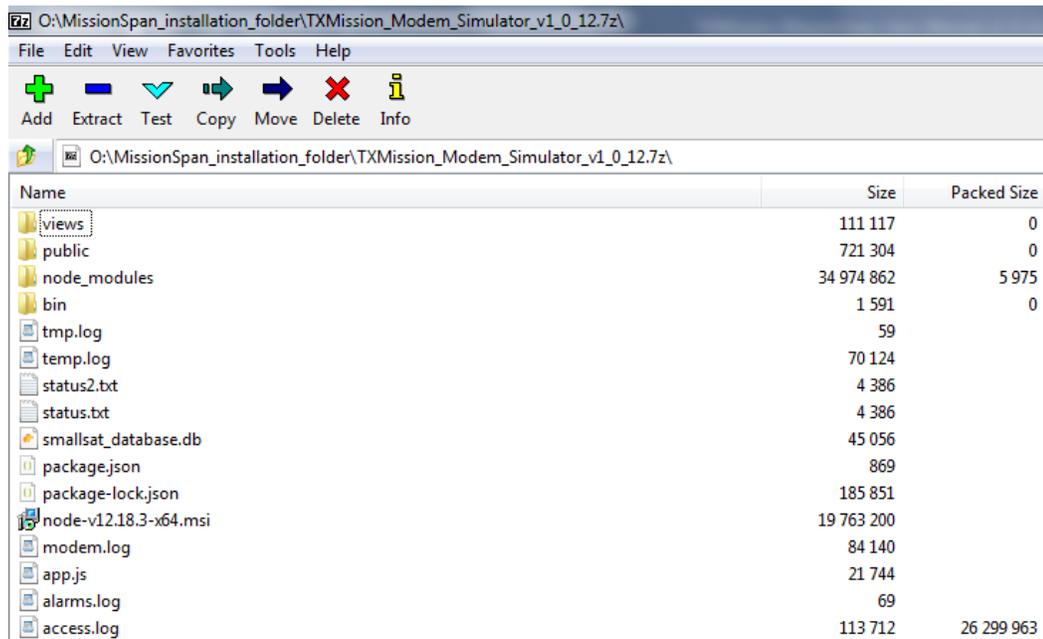


Figure 4-2 Modem Simulator Installation Zip File Contents

2. Select the *Extract* button in order to extract all files and choose the destination folder as shown in **Figure 4-3**.

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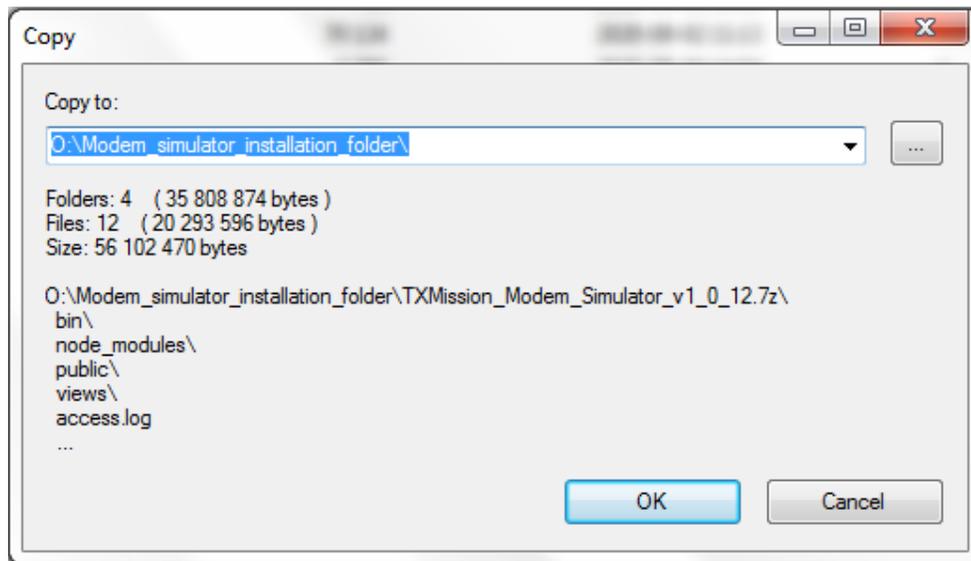


Figure 4-3 Extracting the Installation Zip File Contents

3. Following extraction, the contents of the destination folder should now look like **Figure 4-4**.

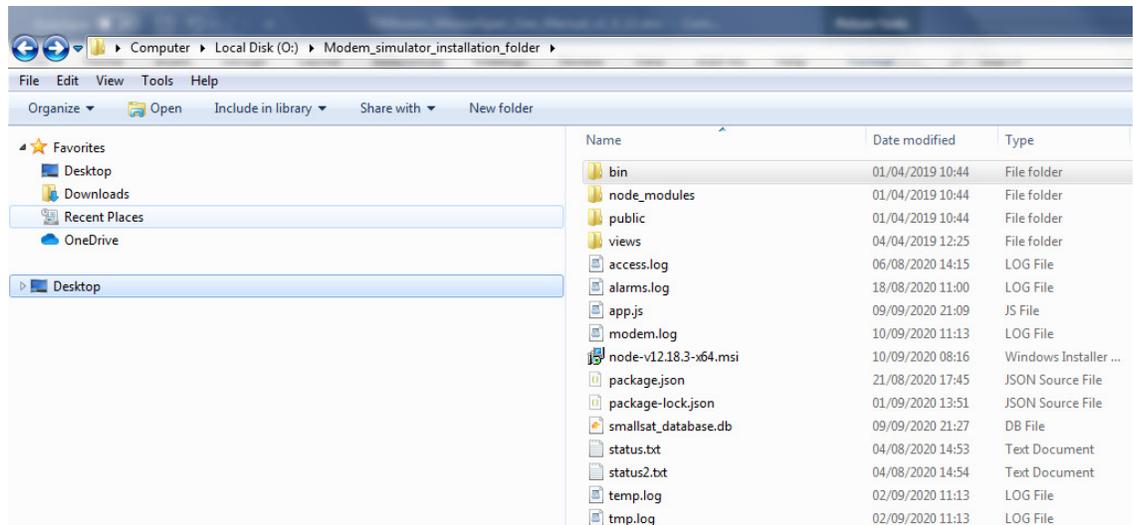


Figure 4-4 Installation Folder Contents

4. Before the modem simulator can be run, it is necessary to install the node.js runtime environment. Double click on the *node-vx.x.x-x64.msi* file to start the installation.
5. Click *Next* on the node.js setup wizard Welcome screen.
6. Review and accept the license agreement before clicking *Next*.

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7. The installer will prompt for a installation location. When this has been selected click on *Next*.
8. The wizard will let you select components to include or remove from the installation. Accept the defaults by clicking *Next*.
9. Finally, click the *Install* button to run the installer and when it finishes, click *Finish*.

4.2 Runing the Modem Simulator

To run the modem simulator following installation, do the following.

1. Start a Windows command prompt by entering *command prompt* into Windows Start Menu search box and then select the *Command Prompt* application, right click and select *Run as administrator* (**Figure 4-5**).

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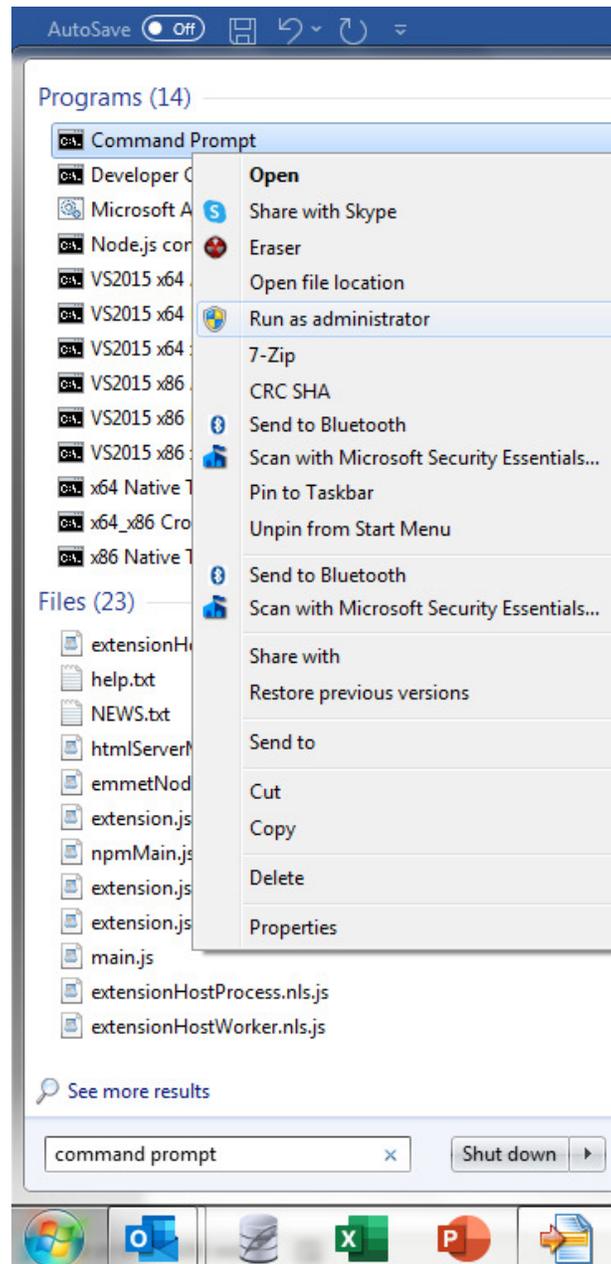


Figure 4-5 Starting a Command Prompt Window

2. Change to the installation folder by entering `cd install_folder` where *install_folder* is the pathname of your modem simulator installation folder.
3. Then enter `node bin\www` to start the modem simulator (**Figure 4-6**). Note that a firewall warning screen like that of **Figure 3-2** will be displayed – allow the modem simulator to communicate over at least the local network. Various messages will then be displayed, as shown, in the console window (**Figure 4-6**) as it starts up.

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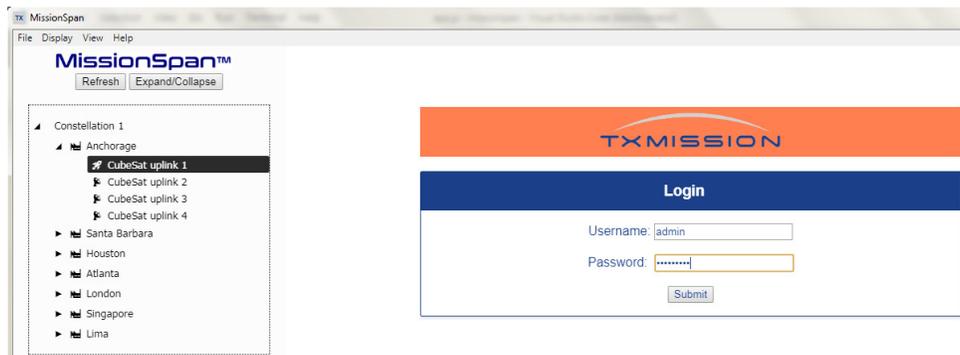


Figure 4-8 Accessing local version of Modem Simulator from MissionSpan

- To access the modem simulator on a different computer from MissionSpan then change the device's IP address within MissionSpan accordingly (as described earlier in this manual). An example is shown in **Figure 4-9**. Note that it may be necessary to provide access through any firewalls on both computers (the modem simulator web server runs on port 3000 and an OOPS! command handler listens for commands on port 5555).

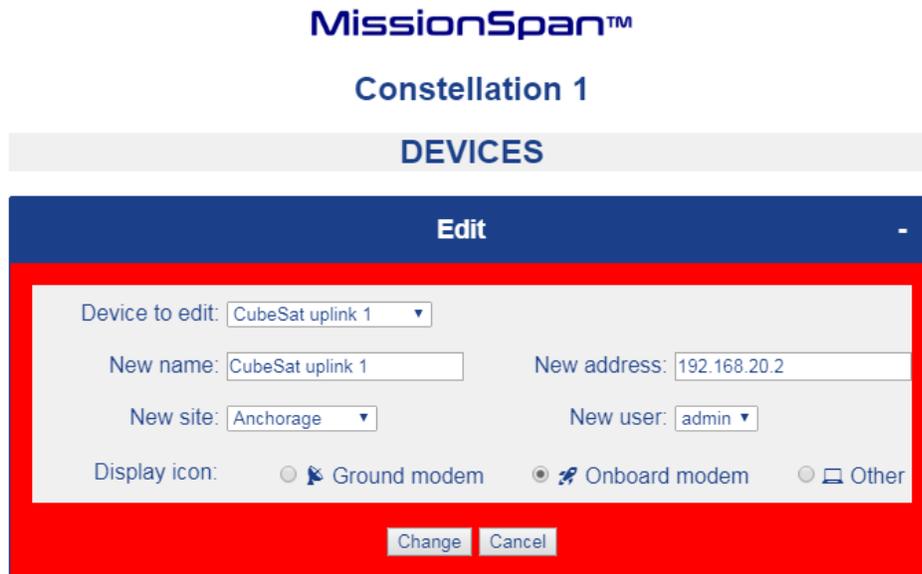


Figure 4-9 Setting MissionSpan to access Modem Simulator on another computer

5 Appendix: Troubleshooting Guide

Most issues that occur when using MissionSpan to communicate with the modem simulator are due to firewall restrictions. MissionSpan itself does not require any firewall permissions. However, the modem simulator does require permissions.

If problems are being experienced in connecting MissionSpan to the modem simulator, open up the firewall application on the computer that the modem simulator is installed on and select the option that allows a program through the firewall (often titled 'Allow a program or feature through Windows Firewall'). Search for 'Node.js: Server-side JavaScript' (**Figure 5-1**). Enable the application and select *OK*.

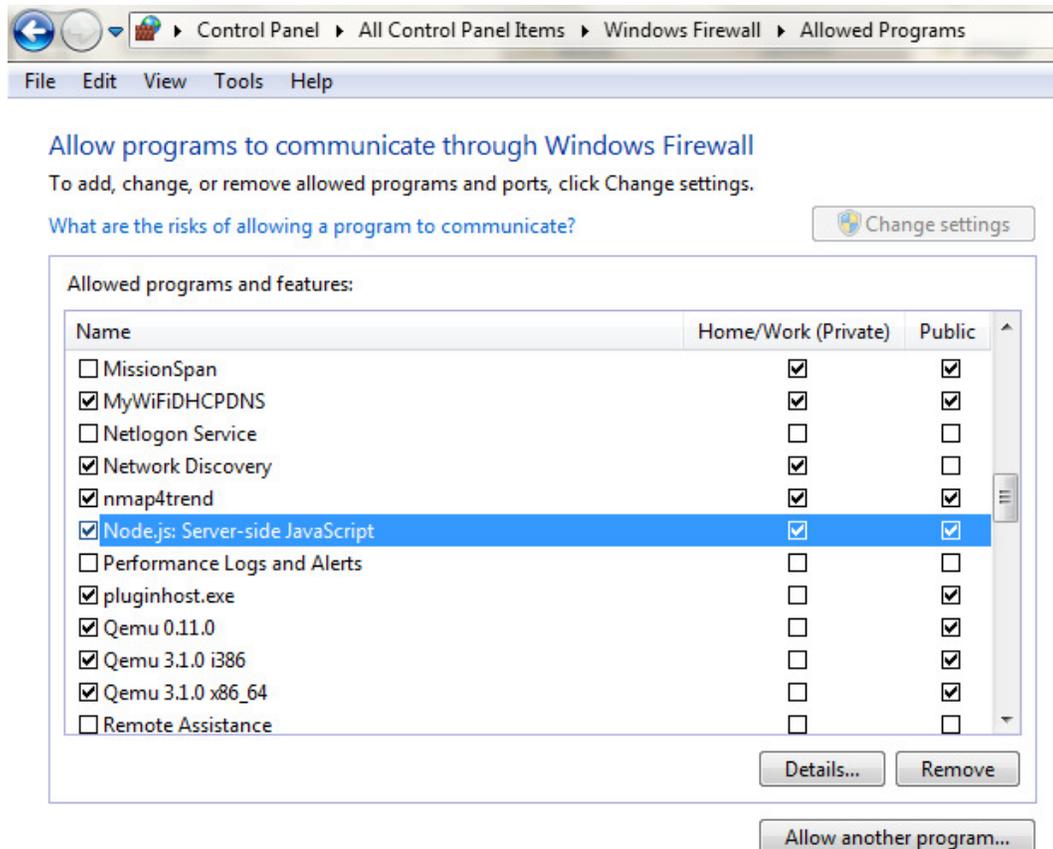


Figure 5-1 Allowing the Modem Simulator to communicate through a firewall

If this does not fix the issue then other things to try are as follows:

- Check the IP address and subnet mask being used for the modem or modem simulator. Make sure that you can ping the address from the computer on which MissionSpan is installed.

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- If using the modem simulator, try installing it initially on the same computer as MissionSpan and try to connect to it from MissionSpan using the local host address 127.0.0.1:3000.
- Look for error messages in the MissionSpan system log to see if these indicate abnormal behaviour, such as permissions problems accessing files or files being missing. If this happens, then reinstall MissionSpan as an administrator.
- Although MissionSpan supports multiple instances running at the same time, old instances that have not been closed properly can potentially interfere with file access. In this case start Windows Task Manager and close all instances of MissionSpan and start again. Similarly, for the modem web server.
- If a connection issue arises when using MissionSpan's command line interface, refresh the page (reselect the CLI tab from the fly-out navigation menu) as even when the problem has been fixed (e.g. by changing firewall permissions) the connection still needs to be restarted.