

MOTOROLA SB5101 Cable Modem Overview



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| 1.1.1 | | |



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1 Introduction

The SB5101 Cable Modem is a stand-alone unit with an external power supply, it is the latest product in the Motorola Surfboard range, the SB5101 will be produced alongside the existing SB5100 modem and will eventually replace it.



Figure 1: SB5101 Cable Modem

The SB5101 offers both Ethernet and USB interface connectivity to ensure compatibility with almost any PC or Macintosh network-ready computer system. The SB5101 Cable Modem received DOCSIS 2.0 certification in Cable Labs Certification wave 28 (April 2004). The SB5101E EuroDOCSIS Cable Modem received the corresponding EuroDOCSIS 2.0 certification in ECW 16 in September 2004.

A top panel standby switch has been added for additional end-user security. It disconnects the USB and Ethernet connection to the CPE without disconnecting the cable modem from the RF network; providing a simple but effective reassurance for the customer that their PC is safe from unwanted external access.

2 SB5101 Key Features

- Optimised to fully utilize 6 MHz DOCSIS Cable Channels
- DOCSIS 1.1 and 2.0 certified, backwards compatible with DOCSIS 1.0
- USB and Ethernet network connectivity allows simple installation.
- Standby switch enhances security.
- Up to 100 times faster than a 56k analog phone modem.
- No telephone lines needed — always on, always connected.
- Compatible with Windows®, Macintosh® and UNIX® computers.
- Attractive vertical design saves desk space.
- Advanced DOCSIS 2.0 hardware platform
- Supports up to 63 users (1 via USB and up to 62 via Ethernet)
- Ethernet and USB connections are bridged allowing LAN traffic between USB device and Ethernet LAN
- Ethernet and USB cables included in the package
- 10/100BaseT Ethernet (auto sensing)
- Remote Management via SNMP and Remote Configuration via TFTP
- Software upgradeable over the network
- Compact external power supply
- Platform independent modem with HTML-based user interface for status troubleshooting
- Front panel LED 's for easy troubleshooting
- User guide translates in multiple languages
- Installation Assistant on CD-ROM gives guidance through the installation process.
- Global safety approval &certificates:
- CB scheme (EN60950/IEC950)
- CE-Evaluation test report (EN55022/EN55024)
- UL approved
- Microsoft WHQL approved

3 SB5101 Benefits for the MSO and End User

3.1 Connectivity

The USB port is an important interface for MSOs because it can dramatically reduce their installation time and installation cost. The USB interface was introduced in most PCs starting in 1997. Practically all PCs from 1998 onward were sold with a USB interface. The USB interface allows a user to connect up to 127 devices simultaneously without ever having to open their PC. The MSO saves time by not having to open a PC to install an Ethernet NIC card to install a cable modem. In fact, the USB interface simplifies the cable modem installation so much that in many cases the consumer will be able to self-install the modem, thus making the SB5101 an ideal choice for retail or self installation. In addition to saving time the consumer and MSO will no longer need to invest additional funds for a NIC card. Currently Windows 98, Windows 2000 and Windows XP support the USB interface.

A 10/100BaseT Ethernet interface is also available for those customers who do not have a PC with an active USB port or wish to continue to use the Ethernet interface, the connections are bridged so if the MSO allows multiple devices may connect through the Modem simultaneously.

3.2 Standby Switch

The SB5101 series also features a standby switch that temporarily disconnects the modem from the PC, thus allowing for a greater degree of security when the user is not surfing while keeping the modem on the network, thus allowing the modem to be monitored, updated, and maintained by the MSO continuously.

3.3 User Guide

The SB5101 User Guide is available in multiple languages including German, English, French (including Canadian French), Portuguese (including Brazilian Portuguese), Danish, Swedish, Korean, Japanese, Simplified and Traditional Chinese, Polish, Dutch and Spanish.

3.4 Modem Set Up and Diagnostics

The SB5101 has an html based web page that will allow an MSO engineer or a customer to easily troubleshoot any problems with connecting the modem onto the HFC network. In addition there is a Motorola developed program called Stormwatch which allows a dynamic GUI for both local and remote access to an individual Cable Modem.

In addition Motorola has developed a Modem Configuration File utility called "Beachcomber" which is designed to simplify the production and maintenance of the essential config files.

3.5 Logistics

Motorola has invested in a very sophisticated product fulfilment operation based in Scotland which allows the SB5101 and its accessories to be customised to the needs of individual operators.

4 SB5101 Architecture.

The key physical component portion of the SB5101 system is the BCM3349 chip (Broadcom). The BCM3349 is a single-chip that supports the two advanced communication technologies required by the DOCSIS 2.0 specification – advanced time division multiple access (A-TDMA) and synchronous code division multiple access (S-CDMA). Other parts of the Cable Modem include a BCM3419 Silicon Tuner, SDRAM, non-volatile storage (Flash), Ethernet interface, and USB interface. The SB5101 provides 16 Service ID's (SIDs) rather than the 4 available with the SB5100, this provides much greater flexibility for the provision of multiple services with individual QoS, determined by the needs of the service, data, voice, video etc.

4.1 Technical Specifications:

| SB5101 | |
|------------------------------------|--|
| GENERAL | |
| Interface to PC | Ethernet 10/100-BaseT, RJ-45 connector, USB |
| Data Protocol | TCP/IP |
| Dimensions | 15.75cmHx5.52cmW x 15.24cmL |
| Cable Interface | Female F-Connector, 75 Ω |
| DOWNSTREAM | |
| Modulation | 64 or 256 QAM |
| Maximum Data Rate | 27 Mbps (in 64QAM mode) or 38 Mbps (in 256QAM mode) (limited by transmission protocol) |
| Bandwidth | 6 MHz |
| Maximum Symbol Rates | 5.069 Msym/s (64QAM) 5.361 Msym/s (256QAM) |
| Operating Level Range | -15 to +15 dBmV |
| Input Impedance | 75 ohms (nominal) |
| Total Input Power | < 30 dBmV |
| Frequency Range | 88-860 MHz (\pm 30 kHz min step size) |
| UPSTREAM | |
| Upstream Modulation | 16QAM or QPSK, (8, 32, 64 and 128 QAM with A-TDMA or S-CDMA enabled CMTS) |
| Maximum Upstream Transmission Rate | 10 Mbps (30Mbps with A-TDMA or S-CDMA enabled CMTS) |
| Bandwidth | 200, 400, 800, 1.6 MHz, 3.2 MHz; |



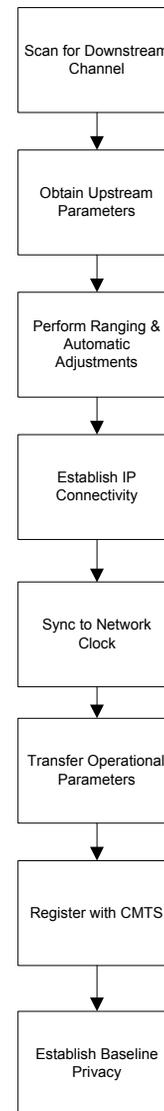
| SB5101 | |
|-----------------------|--|
| | 6.4MHz with A-TDMA or S-CDMA enabled CMTS |
| Symbol Rates | 160, 320, 640, 1280, and 2560 ksym/s, 5120 ksyms/s with A-TDMA or S-CDMA enabled CMTS |
| Operating Level Range | +8 to +55 dBmV (8, 16QAM) +8 to +58 dBmV (QPSK) +8 to +54 dBmV (32, 64 QAM) +8 to +53 dBmV (S-CDMA) |
| Output Impedance | 75 ohms (nominal) |
| Total Input Power | < 35 dBmV (varies by symbol rate) |
| Frequency Range | 5-42 MHz (edge to edge) |
| | |
| ENVIRONMENTAL | |
| Power | 9 Watts (nominal) |
| Input Power | 100-240 VAC 50-60 Hz |
| Operating Temperature | 0 to +40 °C |
| Storage Temperature | -30 to +80 °C |
| Operating Humidity | 0-95% RH, non-condensing |

5 DOCSIS - Overview

The DOCSIS system was developed to enable hardware and systems interoperability and automated configuration and management. Cable Modems (CM's) and Cable Modem Termination Systems (CMTS's) from various vendors will operate on the same network, using the common DOCSIS standards and protocols. In this model, a CM is authorized by the CMTS for use on the network, and configures itself according to parameters that are passed to it from the head-end. This sequence of events will occur automatically in the background, so the user will be unaware of the activity. The following paragraph describes the process of how a CM "logs on" to the network.

When the CM is powered on, it follows one of two scenarios. If it is logging on to the network for the first time (or the data frequency has been changed), the CM automatically scans the frequency spectrum to locate the data frequency. If the CM has previously accessed the network, it will lock onto the data frequency automatically (the previous session value is stored). Once the CM finds the DOCSIS data signal, it looks for a message that contains the basic parameters for the upstream (frequency, modulation, symbol rate, FEC format, etc.). The CM can then transmit a message to the CMTS requesting additional information that will enable it to connect to the network. Through a series of messages and interactions, the CM will establish IP connectivity using DHCP, (dynamic addressing), and then will receive a configuration file via TFTP that has additional parameters the CM needs to configure itself. Once the CM has been configured, it will register with the CMTS and be authorized for use of the network. If Baseline Privacy has been enabled, the final step of the initialization is establishing the parameters to use Baseline Privacy.

Once the CM has been configured and authorized, it can use the network like any standard Ethernet network device. The Operations Support System (OSS) software in the CMTS communicates with all the CMs and has the ability to re-configure them to use different channels, to change their parameters, and to disable their ability to use the network.





6 SB5101 Indicators and their use for diagnostic purposes.

The indicators on the surfboard modem are designed to be helpful to both the end user and the network operator. The indicators allow an initial diagnosis to be made as to the likely cause of reported problem. The problems which can be diagnosed divide into the modem itself, the power light does not go solid green; the HFC network, either the Receive or Send does not go solid green; the IP network, the Online does not go solid green or finally the user CPE, no activity light.

| LED/ Label | Description (Indication) |
|-------------------|---|
| Power | OFF/Startup (post test)/ ON |
| Receive | Scanning for RF/ Locked to Downstream RF |
| Send | Ranging with CMTS/ Acquired upstream RF |
| Online | Acquiring IP connectivity/ Operational |
| PC Activity | Indicates traffic seen by CM |
| Standby | Indicates state of Standby Option |

7 WEB Page Diagnostic Tool.

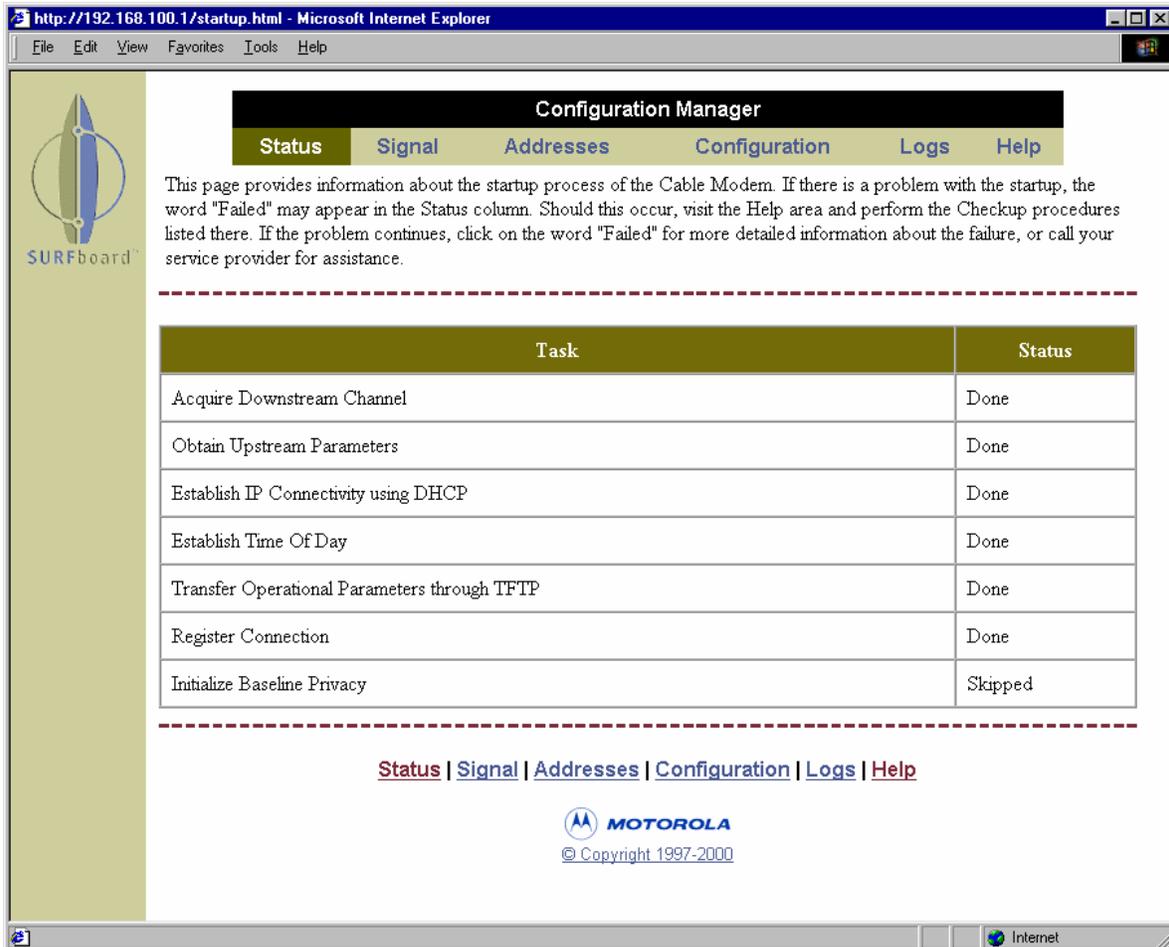
The Cable Modem has three active interfaces, the HFC, the Ethernet and the USB and each interface has both a MAC and an IP address associated with it. When operating normally it is the IP address of the HFC interface that is used for diagnostic access to the modem. However the IP address associated with the Ethernet interface is always available to the client side network, unless it has been disabled by management command. This means that a PC on the client side can access the WEB pages within the modem using the reserved address 192.168.100.1. This is a non-routed address so it cannot be reached from the Internet (routed) side of the network

The SB5100 family of modems contain an internal DHCP server, which is active until the modem registers with the CMTS. In the case of a problem that prevents the modem from completing its registration, the modem can still give an IP address to the client PC to enable diagnostics access. This address is given with a very short lease (around 10 seconds) so that as soon as the registration does complete the client PC obtains its proper IP address from the core network DHCP server.

The WEB interface consists of the following pages:

7.1 The Status Page

This Page shows the main steps in the registration process, in this case a successful registration a failed step would be marked in red. The “skipped” entry for baseline privacy is because this facility has not been activated via the configuration file.



Configuration Manager

[Status](#) | [Signal](#) | [Addresses](#) | [Configuration](#) | [Logs](#) | [Help](#)

This page provides information about the startup process of the Cable Modem. If there is a problem with the startup, the word "Failed" may appear in the Status column. Should this occur, visit the Help area and perform the Checkup procedures listed there. If the problem continues, click on the word "Failed" for more detailed information about the failure, or call your service provider for assistance.

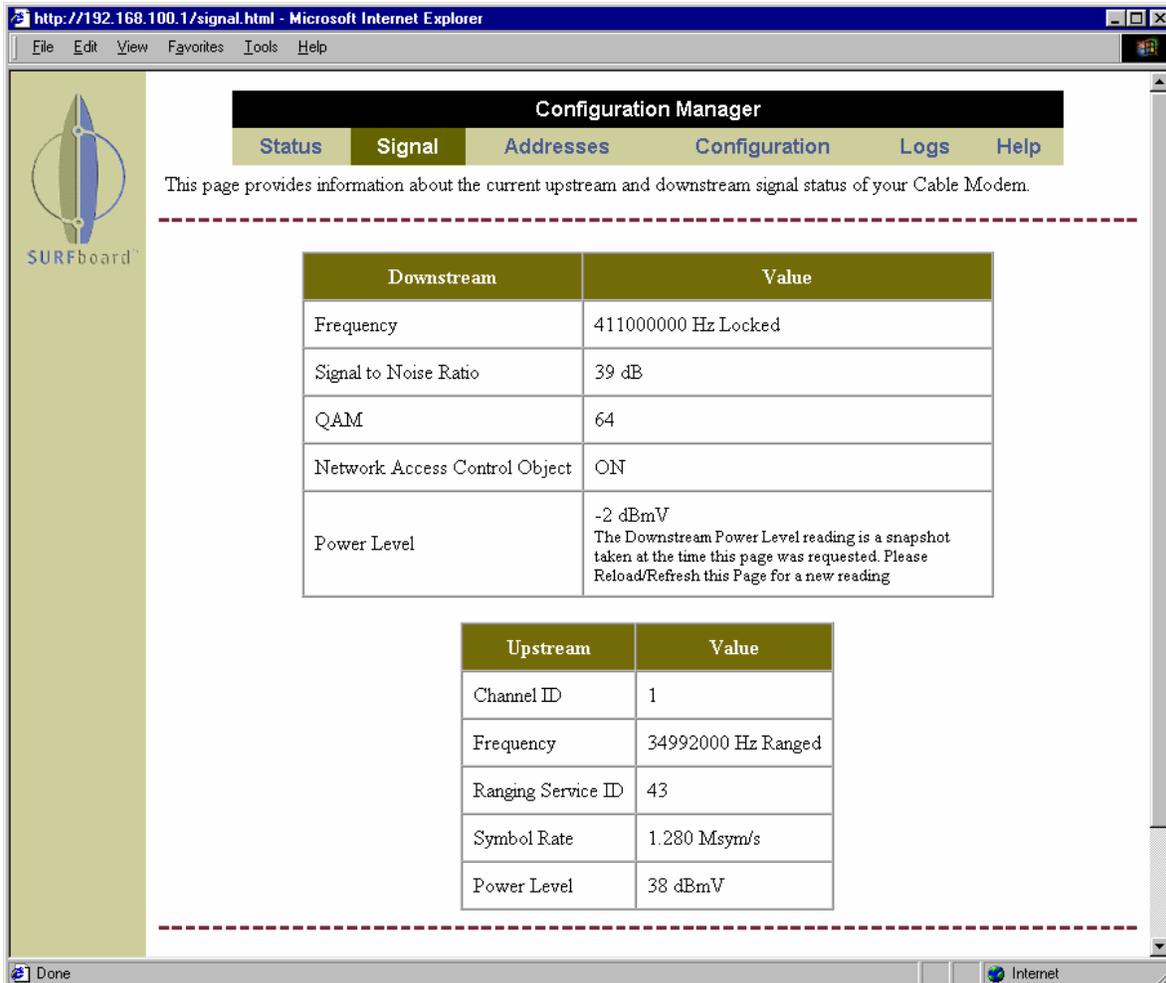
| Task | Status |
|--|---------|
| Acquire Downstream Channel | Done |
| Obtain Upstream Parameters | Done |
| Establish IP Connectivity using DHCP | Done |
| Establish Time Of Day | Done |
| Transfer Operational Parameters through TFTP | Done |
| Register Connection | Done |
| Initialize Baseline Privacy | Skipped |

[Status](#) | [Signal](#) | [Addresses](#) | [Configuration](#) | [Logs](#) | [Help](#)

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7.2 The Signal Page

This page shows the downstream and upstream RF signal characteristics, in this case for an operational modem. One important feature of this page is that shows the signal to noise ratio on the down stream and the power level on the upstream, both good indicators of the condition of the HFC network link.



The screenshot shows a web browser window titled "http://192.168.100.1/signal.html - Microsoft Internet Explorer". The browser's menu bar includes "File", "Edit", "View", "Favorites", "Tools", and "Help". The page content features a "Configuration Manager" header with a navigation menu containing "Status", "Signal", "Addresses", "Configuration", "Logs", and "Help". Below the header, a message states: "This page provides information about the current upstream and downstream signal status of your Cable Modem." The page is divided into two main sections by dashed lines, each containing a table of signal data.

Downstream Signal Characteristics Table:

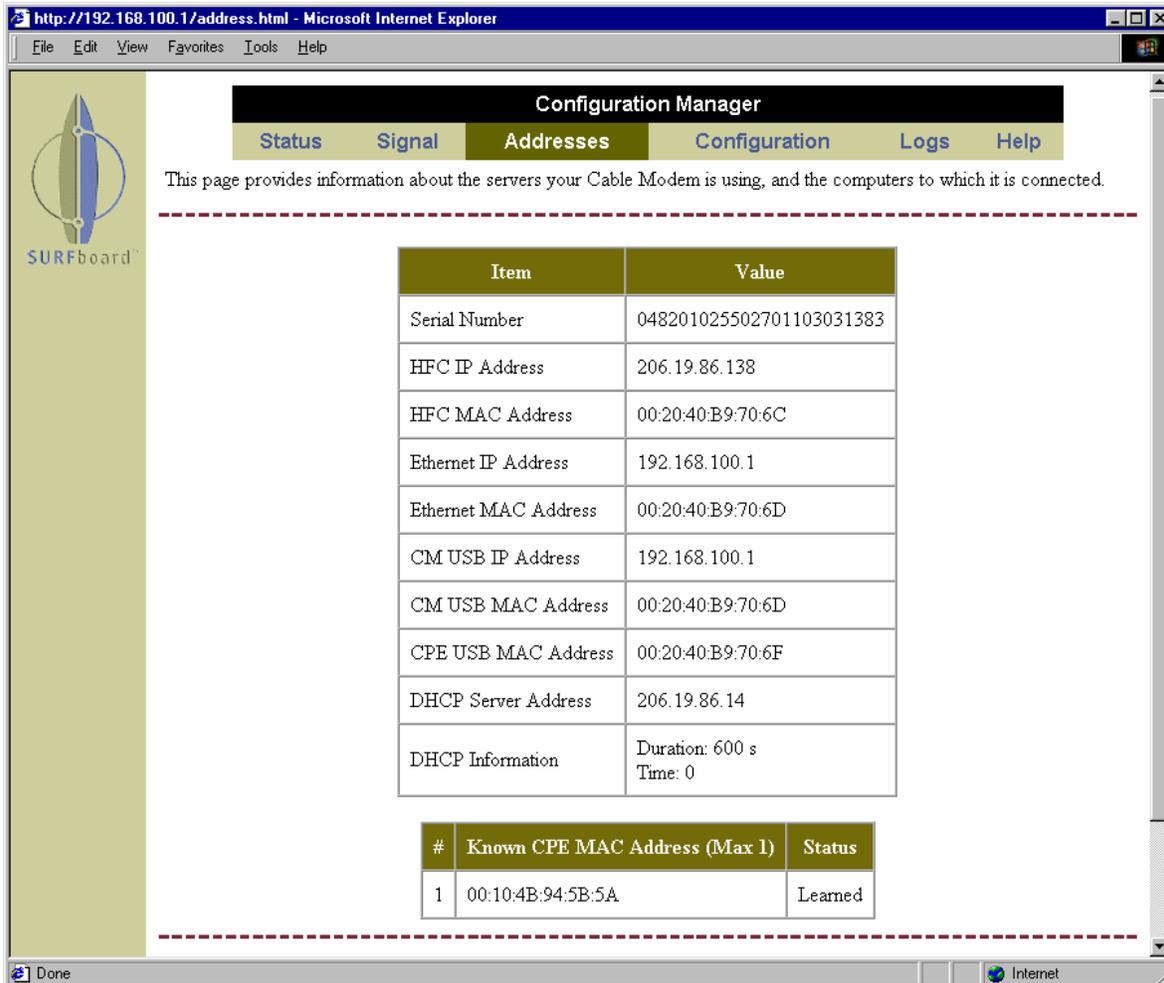
| Downstream | Value |
|-------------------------------|--|
| Frequency | 411000000 Hz Locked |
| Signal to Noise Ratio | 39 dB |
| QAM | 64 |
| Network Access Control Object | ON |
| Power Level | -2 dBmV The Downstream Power Level reading is a snapshot taken at the time this page was requested. Please Reload/Refresh this Page for a new reading |

Upstream Signal Characteristics Table:

| Upstream | Value |
|--------------------|--------------------|
| Channel ID | 1 |
| Frequency | 34992000 Hz Ranged |
| Ranging Service ID | 43 |
| Symbol Rate | 1.280 Msym/s |
| Power Level | 38 dBmV |

7.3 The Addresses Page

This page is concerned with the link level and network level addressing in use by the modem. It serves to confirm that the correct DHCP information is being used and it also identifies the client CPE in use, in this case limited to one device.



The screenshot shows a web browser window with the address bar displaying `http://192.168.100.1/address.html - Microsoft Internet Explorer`. The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The page content features a 'Configuration Manager' header with a navigation menu containing Status, Signal, Addresses (selected), Configuration, Logs, and Help. Below the menu, a text block states: 'This page provides information about the servers your Cable Modem is using, and the computers to which it is connected.' The main content area contains two tables. The first table lists various network items and their values. The second table lists known CPE MAC addresses and their status.

| Item | Value |
|----------------------|----------------------------|
| Serial Number | 048201025502701103031383 |
| HFC IP Address | 206.19.86.138 |
| HFC MAC Address | 00:20:40:B9:70:6C |
| Ethernet IP Address | 192.168.100.1 |
| Ethernet MAC Address | 00:20:40:B9:70:6D |
| CM USB IP Address | 192.168.100.1 |
| CM USB MAC Address | 00:20:40:B9:70:6D |
| CPE USB MAC Address | 00:20:40:B9:70:6F |
| DHCP Server Address | 206.19.86.14 |
| DHCP Information | Duration: 600 s Time: 0 |

| # | Known CPE MAC Address (Max 1) | Status |
|---|-------------------------------|---------|
| 1 | 00:10:4B:94:5B:5A | Learned |



7.4 The Configuration Page

This page allows the option (if made available) of configuring locally some of the parameters that govern the behaviour of the modem. One possibility is to disable the built in DHCP server perhaps because a client is already using the same address band.

Configuration Manager

[Status](#) | [Signal](#) | [Addresses](#) | **[Configuration](#)** | [Logs](#) | [Help](#)

This page provides information about the manually configurable settings of the Cable Modem.

Configuration

Frequency Plan: North American Standard/HRC/IRC

Upstream Channel ID: 1

Frequency (Hz): 411000000

DHCP Server Enabled
The SURFboard cable modem can be used as a gateway to the Internet by a maximum of 32 users on a Local Area Network (LAN). When the Cable Modem is disconnected from the Internet, users on the LAN can be dynamically assigned IP Addresses by the Cable Modem DHCP Server. These addresses are assigned from an address pool which begins with 192.168.100.11 and ends with 192.168.100.42. Statically assigned IP addresses for other devices on the LAN should be chosen from outside of this range

Note:
Resetting the cable modem to its factory default configuration will remove all stored parameters learned by the cable modem during prior initializations. The process to get back online from a factory default condition could take from 5 to 30 minutes. Please reference the cable modem User Guide for details on the power up sequence.

[Status](#) | [Signal](#) | [Addresses](#) | **[Configuration](#)** | [Logs](#) | [Help](#)

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7.5 The Logs Page.

This page can be very useful as it shows what has happened to the modem since power on. The log space is used in a cyclic manner and the most recent entry is at the top. In this case the modem has gone into normal operating mode and the timestamps start when the modem has contacted the time of day server.

Configuration Manager

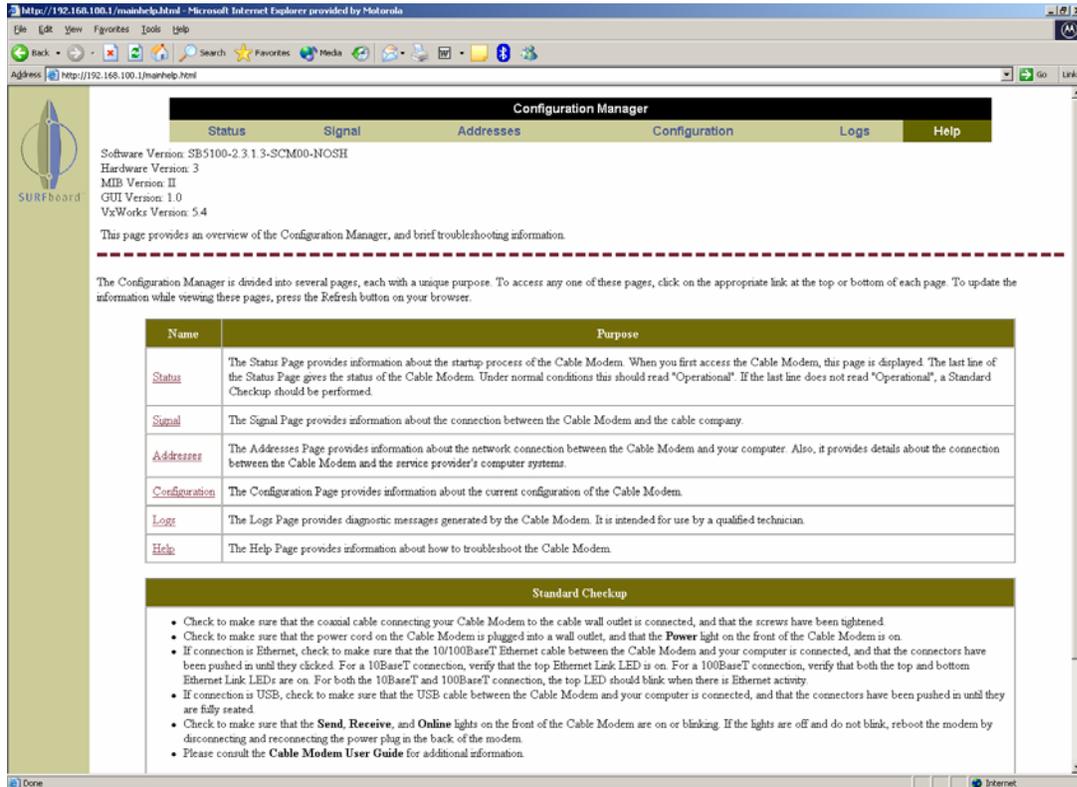
Status Signal Addresses Configuration **Logs** Help

This page displays detailed information intended for use by an authorized Motorola Corporation Cable Modem technician.

| Time | Priority | Code | Message |
|--------------|---------------|--------|--|
| 001006193734 | 7-Information | F502.1 | Bridge Forwarding Enabled. |
| 001006193734 | 7-Information | F502.3 | Bridge Learning Enabled. |
| 001006193734 | 7-Information | B518.0 | Baseline Privacy is skipped |
| 001006193734 | 7-Information | I500.0 | Registration Completed |
| 001006193734 | 7-Information | I0.0 | REG-RSP Registration Response |
| 001006193734 | 7-Information | I0.0 | REG-REQ Registration Request |
| 001006193734 | 7-Information | D509.0 | Retrieved TFTP Config generic.cm SUCCESS |
| 001006193734 | 7-Information | D507.0 | Retrieved Time..... SUCCESS |
| ***** | 7-Information | D511.0 | Retrieved DHCP SUCCESS |

7.6 The Help Page

This final page serves to explain the function of the previous pages as well as containing information on the software versions in use.



The screenshot shows a web browser window displaying the Configuration Manager interface. The browser address bar shows the URL: `http://192.168.100.1/mainhelp.html`. The page title is "Configuration Manager".

At the top, there is a navigation menu with the following items: **Status**, **Signal**, **Addresses**, **Configuration**, **Logs**, and **Help**. The **Help** item is currently selected.

Below the navigation menu, the page displays the following software versions:

- Software Version: SB5100-2.3.1.3-SCM00-NOSH
- Hardware Version: 3
- MB Version: II
- GUI Version: 1.0
- VxWorks Version: 5.4

The main content area contains the following text:

This page provides an overview of the Configuration Manager, and brief troubleshooting information.

The Configuration Manager is divided into several pages, each with a unique purpose. To access any one of these pages, click on the appropriate link at the top or bottom of each page. To update the information while viewing these pages, press the Refresh button on your browser.

| Name | Purpose |
|-------------------------------|---|
| Status | The Status Page provides information about the startup process of the Cable Modem. When you first access the Cable Modem, this page is displayed. The last line of the Status Page gives the status of the Cable Modem. Under normal conditions this should read "Operational". If the last line does not read "Operational", a Standard Checkup should be performed. |
| Signal | The Signal Page provides information about the connection between the Cable Modem and the cable company. |
| Addresses | The Addresses Page provides information about the network connection between the Cable Modem and your computer. Also, it provides details about the connection between the Cable Modem and the service provider's computer systems. |
| Configuration | The Configuration Page provides information about the current configuration of the Cable Modem. |
| Logs | The Logs Page provides diagnostic messages generated by the Cable Modem. It is intended for use by a qualified technician. |
| Help | The Help Page provides information about how to troubleshoot the Cable Modem. |

Below the table, there is a section titled "Standard Checkup" with the following instructions:

- Check to make sure that the coaxial cable connecting your Cable Modem to the cable wall outlet is connected, and that the screws have been tightened.
- Check to make sure that the power cord on the Cable Modem is plugged into a wall outlet, and that the **Power** light on the front of the Cable Modem is on.
- If connection is Ethernet, check to make sure that the 10/100BaseT Ethernet cable between the Cable Modem and your computer is connected, and that the connectors have been pushed in until they clicked. For a 10BaseT connection, verify that the top Ethernet Link LED is on. For a 100BaseT connection, verify that both the top and bottom Ethernet Link LEDs are on. For both the 10BaseT and 100BaseT connection, the top LED should blink when there is Ethernet activity.
- If connection is USB, check to make sure that the USB cable between the Cable Modem and your computer is connected, and that the connectors have been pushed in until they are fully seated.
- Check to make sure that the **Send**, **Receive**, and **Online** lights on the front of the Cable Modem are on or blinking. If the lights are off and do not blink, reboot the modem by disconnecting and reconnecting the power plug in the back of the modem.
- Please consult the **Cable Modem User Guide** for additional information.

8 Stormwatch

Stormwatch is a diagnostic tool to monitor and troubleshoot Cable Modems from the CPE or Head-End.



Stormwatch provides a real-time visual status of SURFboard Cable Modems it also provides the status of the standard SNMP objects on any DOCSIS Modem

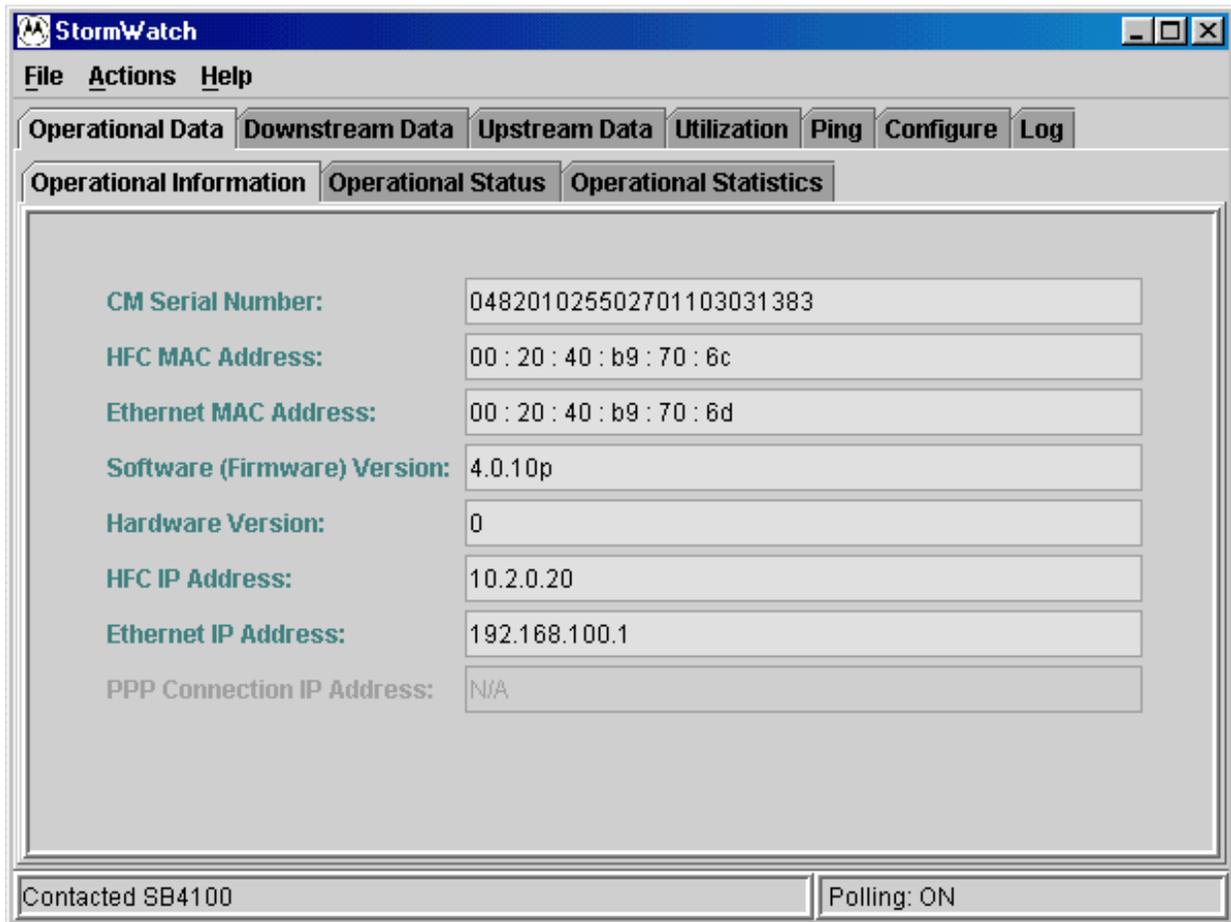
Stormwatch monitors Cable Modem via SNMP objects

Stormwatch can be CPE or Head-end based

The Stormwatch application allows for one time load, or a permanent installation. It is also available in two versions one of which is read only and the other is read write. In the read only version the drop down tags which allow options to be changed do not appear hence there is no way to modify modem parameters.

8.1 Operational Data

This page shows general information about the modem, in particular what version of software is in use.



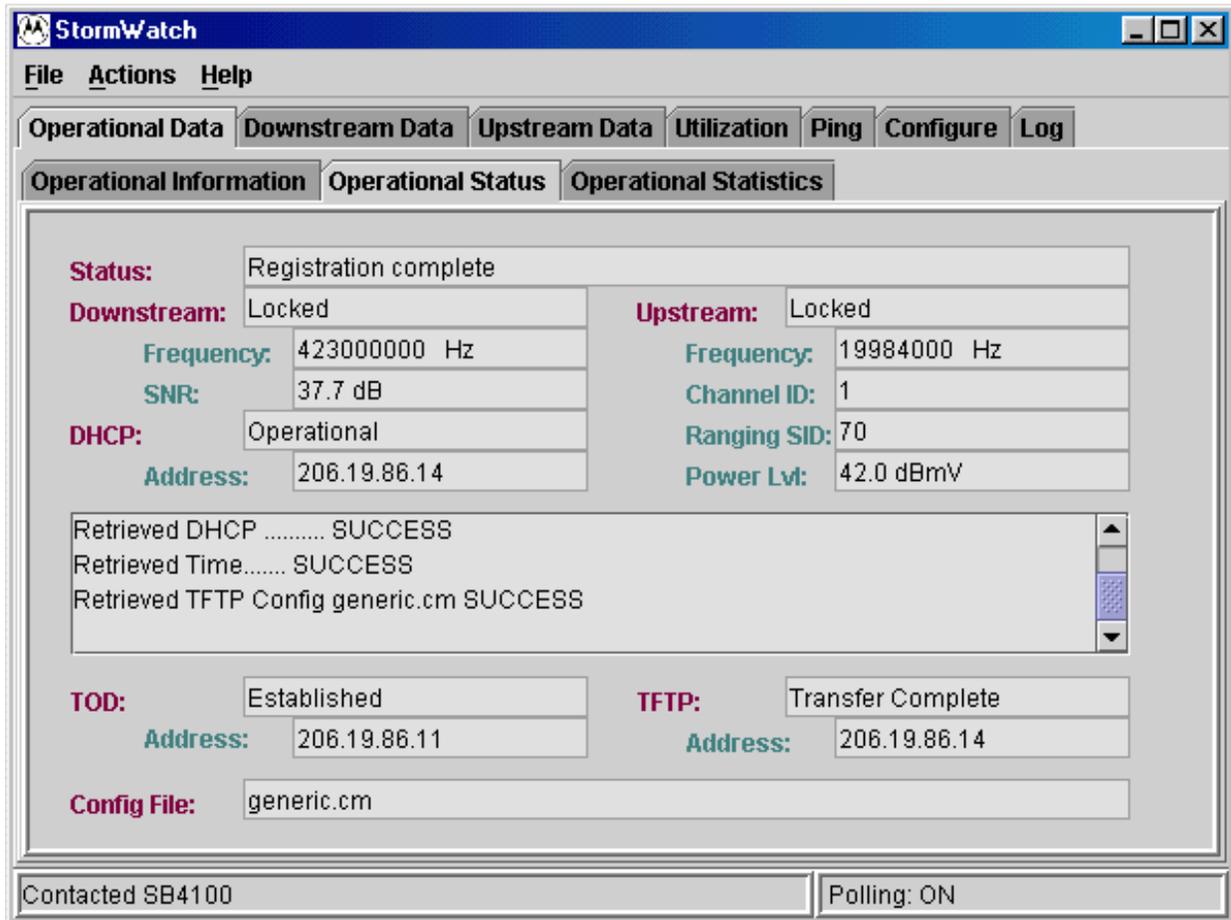
The screenshot displays the StormWatch web interface. The main menu includes 'Operational Data', 'Downstream Data', 'Upstream Data', 'Utilization', 'Ping', 'Configure', and 'Log'. Under 'Operational Data', there are sub-tabs for 'Operational Information', 'Operational Status', and 'Operational Statistics'. The 'Operational Information' tab is active, showing the following details:

| | |
|------------------------------|-----------------------------|
| CM Serial Number: | 048201025502701103031383 |
| HFC MAC Address: | 00 : 20 : 40 : b9 : 70 : 6c |
| Ethernet MAC Address: | 00 : 20 : 40 : b9 : 70 : 6d |
| Software (Firmware) Version: | 4.0.10p |
| Hardware Version: | 0 |
| HFC IP Address: | 10.2.0.20 |
| Ethernet IP Address: | 192.168.100.1 |
| PPP Connection IP Address: | N/A |

At the bottom of the interface, it shows 'Contacted SB4100' and 'Polling: ON'.

8.2 The Operational Status Page.

This page shows the operational status of the modem, in this case fully operational. As this is a dynamic page variations in signal to noise or power levels can be viewed in (almost) real time. In this case the screen shows that the modem has loaded a configuration file called generic.cm again this is useful confirmation that the required file is actually in use.



StormWatch

File Actions Help

Operational Data Downstream Data Upstream Data Utilization Ping Configure Log

Operational Information Operational Status Operational Statistics

| | | |
|--------------------|-----------------------|-------------------------------|
| Status: | Registration complete | |
| Downstream: | Locked | Upstream: Locked |
| Frequency: | 423000000 Hz | Frequency: 19984000 Hz |
| SNR: | 37.7 dB | Channel ID: 1 |
| DHCP: | Operational | Ranging SID: 70 |
| Address: | 206.19.86.14 | Power Lvl: 42.0 dBmV |

```
Retrieved DHCP ..... SUCCESS
Retrieved Time..... SUCCESS
Retrieved TFTP Config generic.cm SUCCESS
```

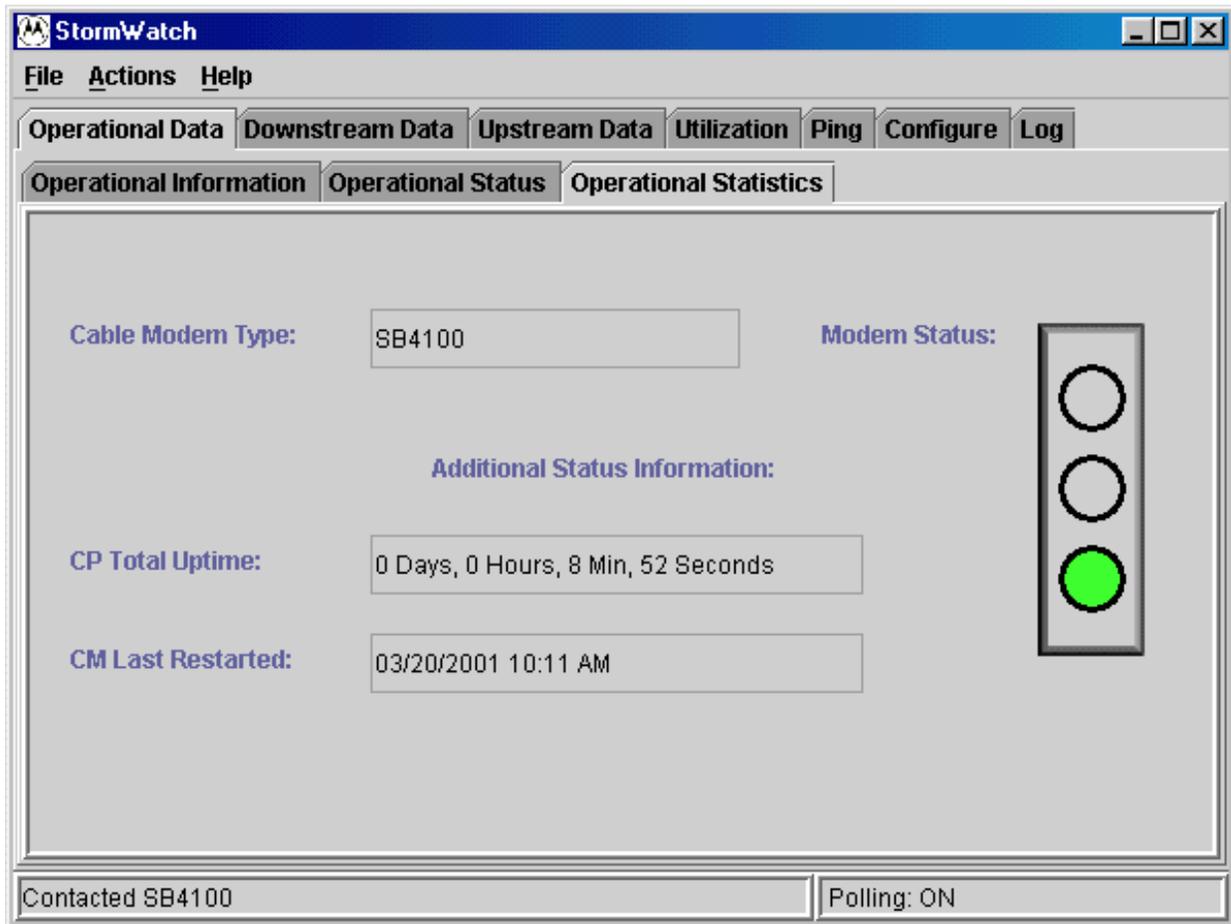
| | | | |
|-----------------|--------------|-----------------|-------------------|
| TOD: | Established | TFTP: | Transfer Complete |
| Address: | 206.19.86.11 | Address: | 206.19.86.14 |

Config File: generic.cm

Contacted SB4100 | Polling: ON

8.3 The Operational Statistics Page.

The main feature of this page is to confirm how long the modem has been operating



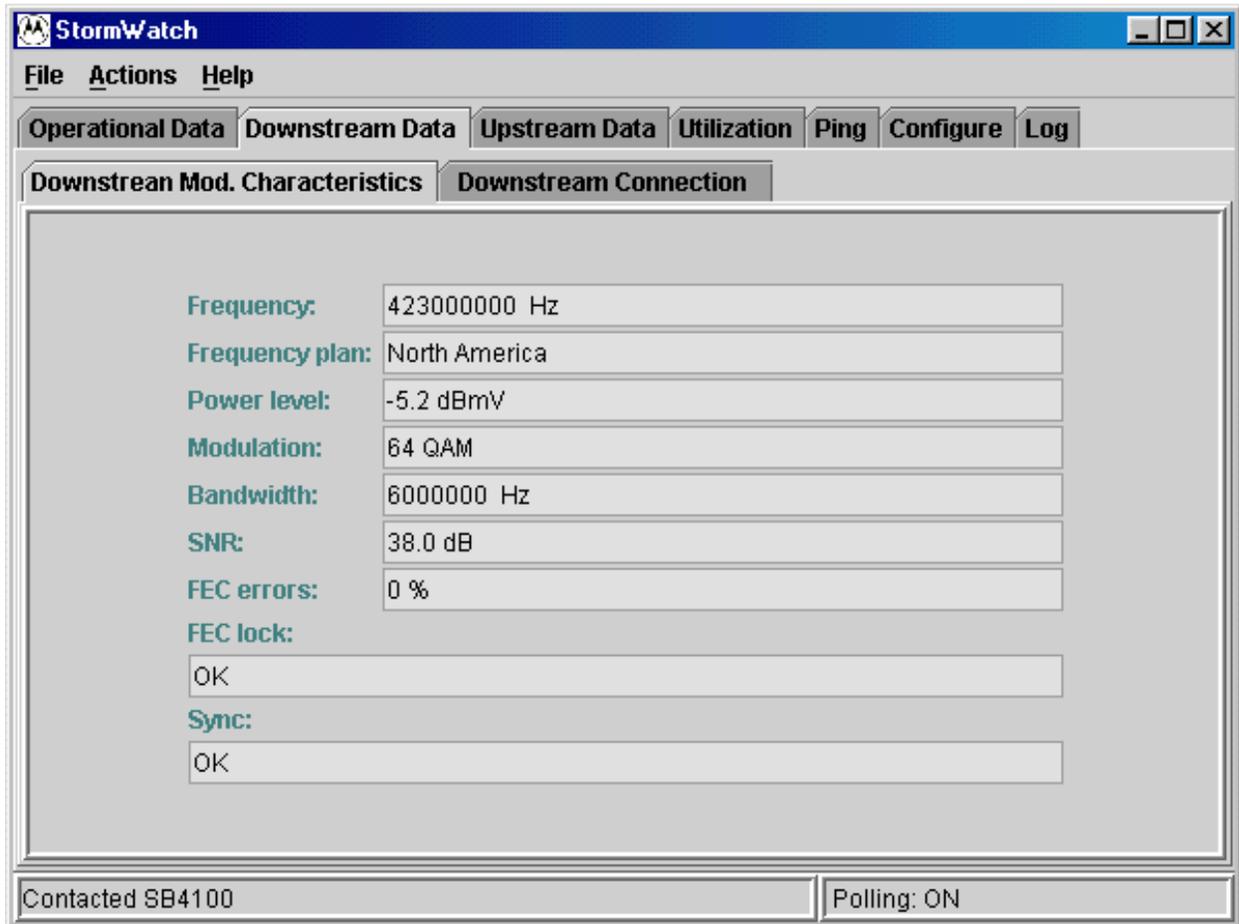
The screenshot displays the StormWatch web interface for a cable modem. The window title is "StormWatch". The main menu includes "File", "Actions", and "Help". Below the menu are several tabs: "Operational Data", "Downstream Data", "Upstream Data", "Utilization", "Ping", "Configure", and "Log". The "Operational Statistics" tab is currently selected. The main content area shows the following information:

- Cable Modem Type:** SB4100
- Modem Status:** Indicated by a vertical stack of three circles, with the bottom circle being green.
- Additional Status Information:**
 - CP Total Uptime:** 0 Days, 0 Hours, 8 Min, 52 Seconds
 - CM Last Restarted:** 03/20/2001 10:11 AM

At the bottom of the interface, there are two status indicators: "Contacted SB4100" and "Polling: ON".

8.4 The Downstream Modulation Characteristics Page

This page shows the physical characteristics of the downstream link and in particular the signal to noise ration and whether any FEC errors have been detected.



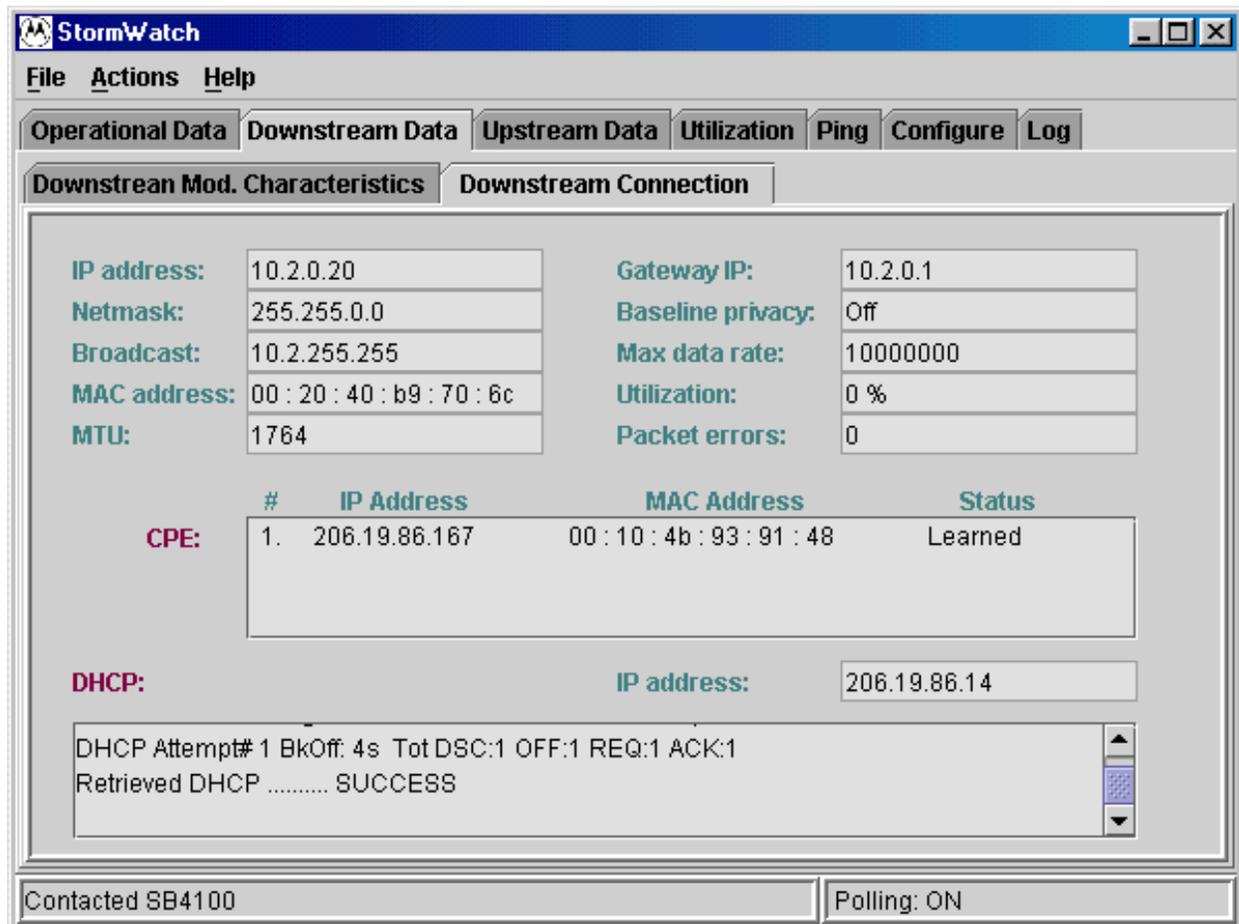
The screenshot shows the StormWatch software interface. The window title is "StormWatch". The menu bar includes "File", "Actions", and "Help". The main area has several tabs: "Operational Data", "Downstream Data", "Upstream Data", "Utilization", "Ping", "Configure", and "Log". The "Downstream Data" tab is selected, and within it, the "Downstream Mod. Characteristics" sub-tab is active. The main content area displays the following data:

| | |
|-----------------|---------------|
| Frequency: | 423000000 Hz |
| Frequency plan: | North America |
| Power level: | -5.2 dBmV |
| Modulation: | 64 QAM |
| Bandwidth: | 6000000 Hz |
| SNR: | 38.0 dB |
| FEC errors: | 0 % |
| FEC lock: | OK |
| Sync: | OK |

At the bottom of the window, there are two status indicators: "Contacted SB4100" and "Polling: ON".

8.5 The Downstream Connection Page

This page displays IP specific information about the downstream connection it shows which client CPE addresses have been learned and also any packet errors that have occurred.



StormWatch

File Actions Help

Operational Data Downstream Data Upstream Data Utilization Ping Configure Log

Downstream Mod. Characteristics Downstream Connection

| | | | |
|---------------------|-----------------------------|--------------------------|----------|
| IP address: | 10.2.0.20 | Gateway IP: | 10.2.0.1 |
| Netmask: | 255.255.0.0 | Baseline privacy: | Off |
| Broadcast: | 10.2.255.255 | Max data rate: | 10000000 |
| MAC address: | 00 : 20 : 40 : b9 : 70 : 6c | Utilization: | 0 % |
| MTU: | 1764 | Packet errors: | 0 |

| # | IP Address | MAC Address | Status |
|----------------|---------------|-----------------------------|---------|
| CPE: 1. | 206.19.86.167 | 00 : 10 : 4b : 93 : 91 : 48 | Learned |

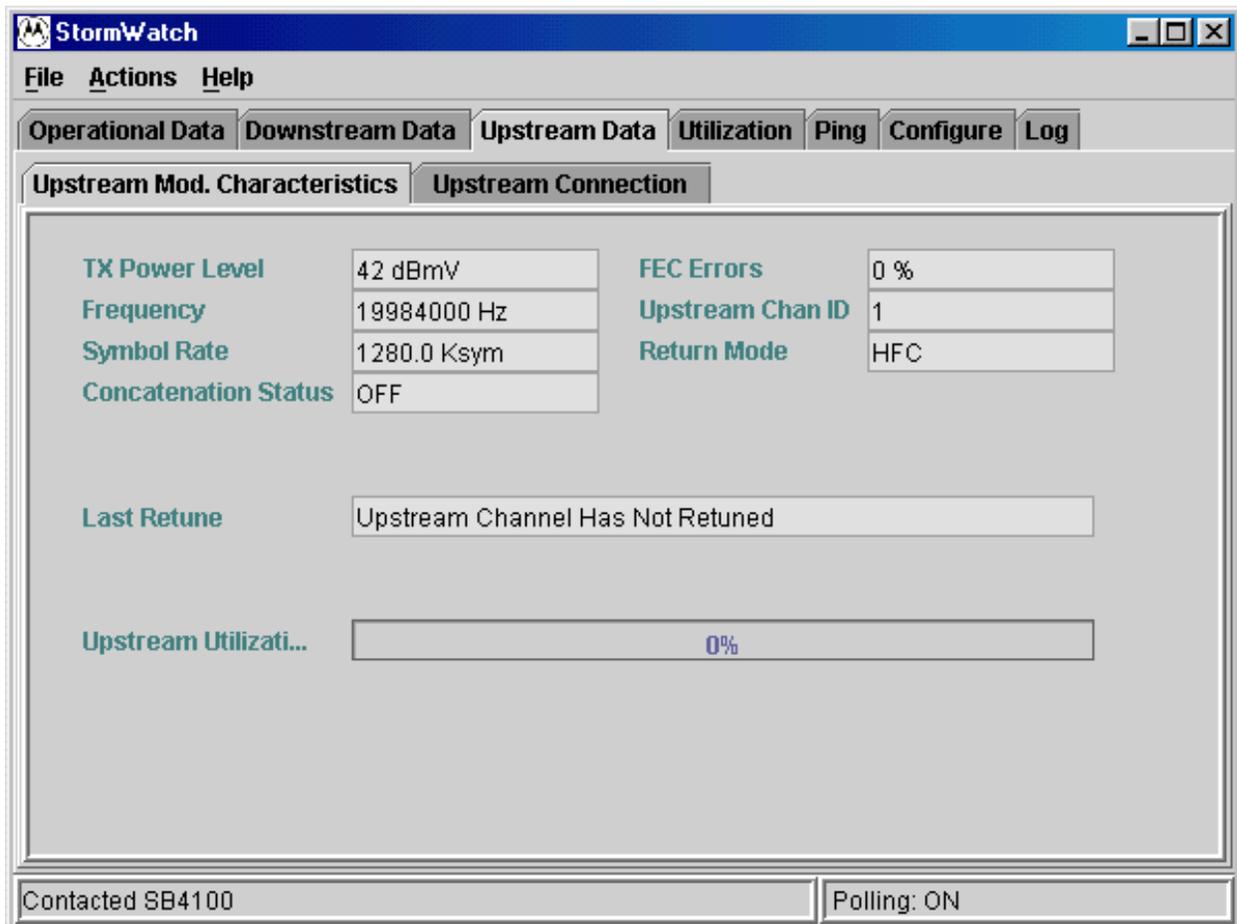
DHCP: IP address: 206.19.86.14

DHCP Attempt# 1 BkOff: 4s Tot DSC:1 OFF:1 REQ:1 ACK:1
Retrieved DHCP SUCCESS

Contacted SB4100 | Polling: ON

8.6 The Upstream Modulation Characteristics Page.

This page contains important physical information about the performance of the upstream link. In particular it shows the Power Level and whether or not the modem has retuned, both good indicators of link integrity.



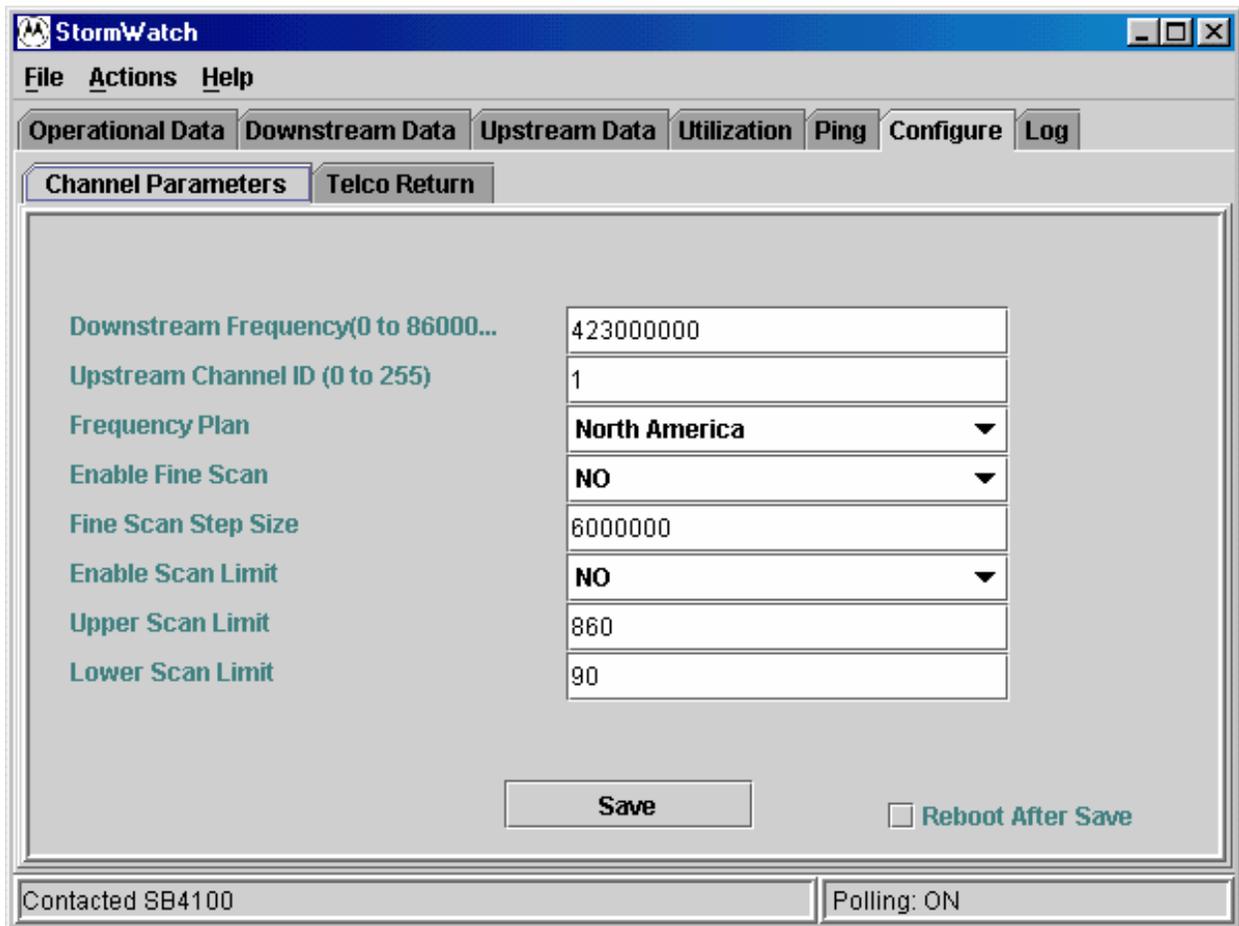
The screenshot shows the StormWatch application window with the 'Upstream Mod. Characteristics' tab selected. The interface includes a menu bar (File, Actions, Help) and a series of tabs: Operational Data, Downstream Data, Upstream Data, Utilization, Ping, Configure, and Log. The 'Upstream Mod. Characteristics' tab is active, displaying the following data:

| | | | |
|------------------------------|----------------------------------|-------------------------|-----|
| TX Power Level | 42 dBmV | FEC Errors | 0 % |
| Frequency | 19984000 Hz | Upstream Chan ID | 1 |
| Symbol Rate | 1280.0 Ksym | Return Mode | HFC |
| Concatenation Status | OFF | | |
| Last Retune | Upstream Channel Has Not Retuned | | |
| Upstream Utilizati... | 0% | | |

At the bottom of the window, there are two status indicators: 'Contacted SB4100' and 'Polling: ON'.

8.7 The Channel Parameters Page

This page allows certain parameters to be set on the modem if that facility has been allowed. One possibility may be to lock the modem to different frequency plan when moving between networks for diagnostic purposes.



The screenshot shows a web browser window titled "StormWatch" with a menu bar (File, Actions, Help) and a navigation bar (Operational Data, Downstream Data, Upstream Data, Utilization, Ping, Configure, Log). The "Configure" tab is active, and the "Channel Parameters" sub-tab is selected. The configuration area contains the following fields:

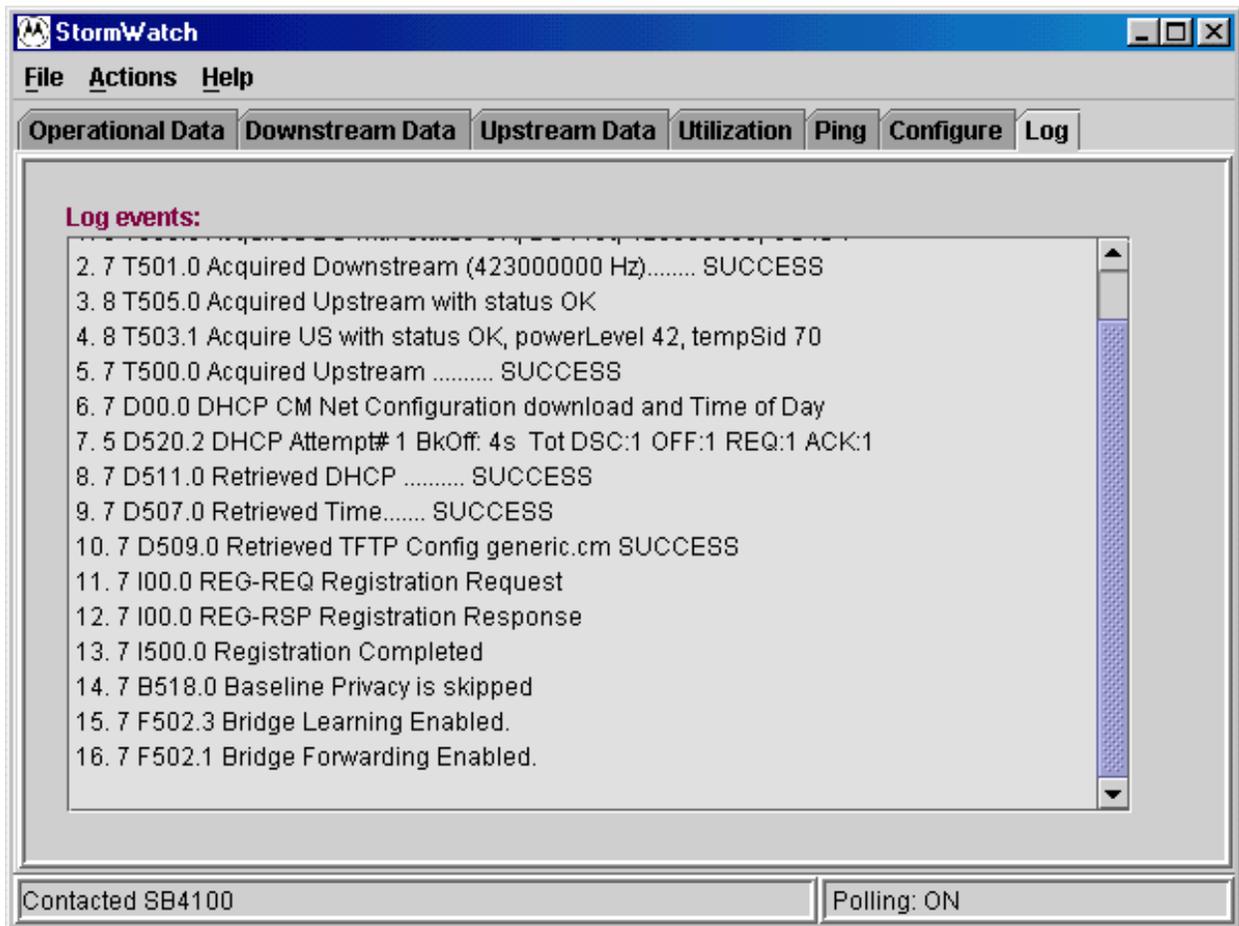
| | |
|------------------------------------|-----------------|
| Downstream Frequency(0 to 86000... | 423000000 |
| Upstream Channel ID (0 to 255) | 1 |
| Frequency Plan | North America ▼ |
| Enable Fine Scan | NO ▼ |
| Fine Scan Step Size | 6000000 |
| Enable Scan Limit | NO ▼ |
| Upper Scan Limit | 860 |
| Lower Scan Limit | 90 |

At the bottom of the configuration area, there is a "Save" button and a checkbox labeled "Reboot After Save" which is currently unchecked. The status bar at the bottom of the window shows "Contacted SB4100" and "Polling: ON".

8.8 The Log Page

This page is dynamic and new logs are added at the bottom of the screen in the style of a standard scrolling window. This log shows the final stages of a successful connection sequence.

In addition to the screens themselves there is also the option of using drop down menus to set particular parameters should than facility have been enabled.



StormWatch

File Actions Help

Operational Data Downstream Data Upstream Data Utilization Ping Configure Log

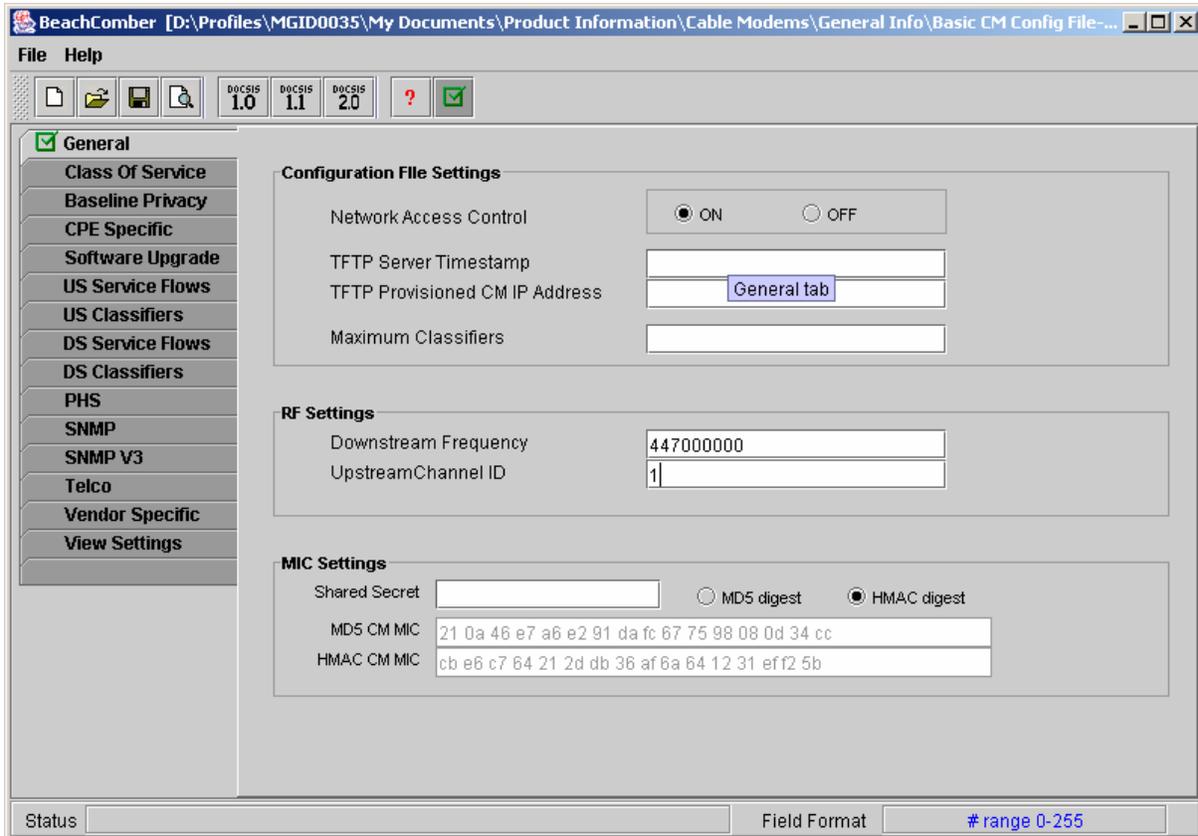
Log events:

- 2. 7 T501.0 Acquired Downstream (423000000 Hz)..... SUCCESS
- 3. 8 T505.0 Acquired Upstream with status OK
- 4. 8 T503.1 Acquire US with status OK, powerLevel 42, tempSid 70
- 5. 7 T500.0 Acquired Upstream SUCCESS
- 6. 7 D00.0 DHCP CM Net Configuration download and Time of Day
- 7. 5 D520.2 DHCP Attempt# 1 BkOff: 4s Tot DSC:1 OFF:1 REQ:1 ACK:1
- 8. 7 D511.0 Retrieved DHCP SUCCESS
- 9. 7 D507.0 Retrieved Time..... SUCCESS
- 10. 7 D509.0 Retrieved TFTP Config generic.cm SUCCESS
- 11. 7 I00.0 REG-REQ Registration Request
- 12. 7 I00.0 REG-RSP Registration Response
- 13. 7 I500.0 Registration Completed
- 14. 7 B518.0 Baseline Privacy is skipped
- 15. 7 F502.3 Bridge Learning Enabled.
- 16. 7 F502.1 Bridge Forwarding Enabled.

Contacted SB4100 Polling: ON

9 Modem Profiler - Beachcomber

Beachcomber is a DOCSIS 1.0/1.1/2.0 Cable Modem Configuration file editor which runs on Windows, Linux and Unix based systems. It features a simple Java based user interface which includes checking of data fields as they are entered. It is a tool designed to make life easier for both the experienced operator by automating the configuration process and for the less experienced operator by providing extensive help facilities.

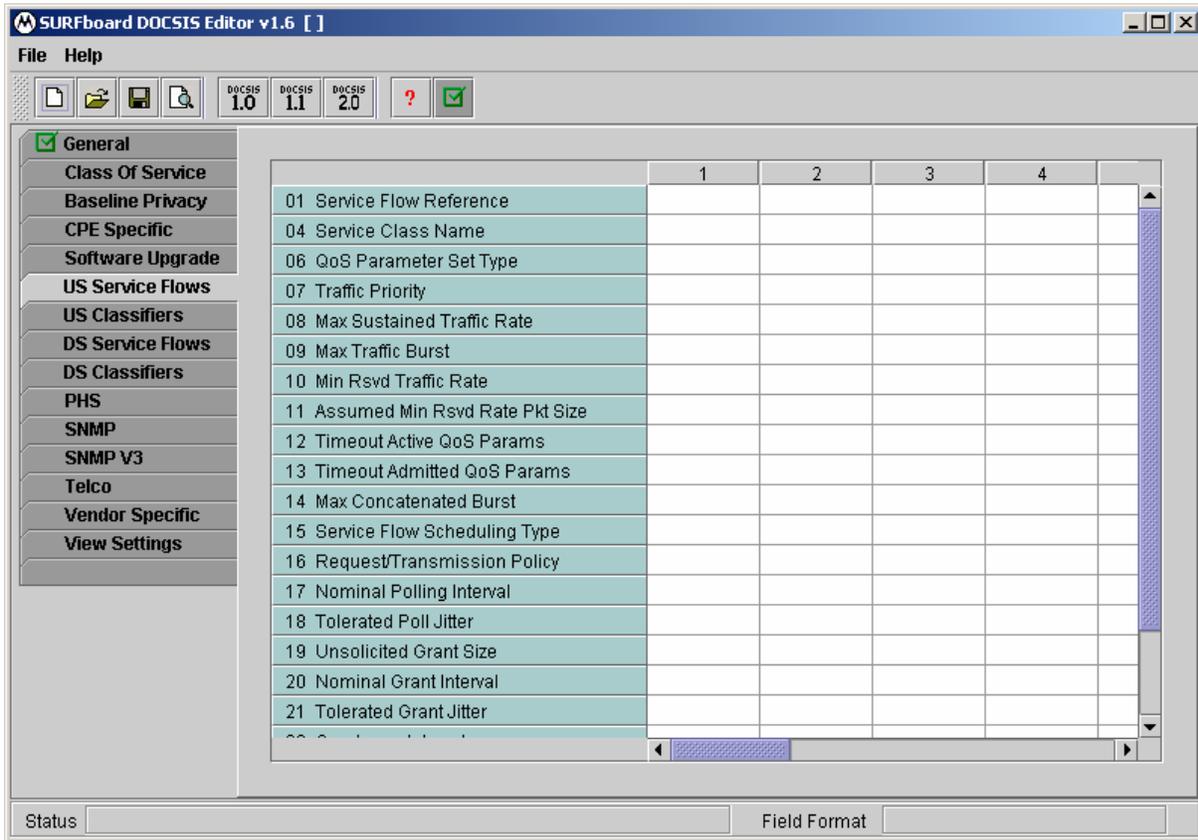


The screenshot shows the BeachComber application window with the following configuration settings:

- Configuration File Settings:**
 - Network Access Control: ON OFF
 - TFTP Server Timestamp: [Empty text box]
 - TFTP Provisioned CM IP Address: [General tab]
 - Maximum Classifiers: [Empty text box]
- RF Settings:**
 - Downstream Frequency: 447000000
 - UpstreamChannel ID: 1
- MIC Settings:**
 - Shared Secret: [Empty text box] MD5 digest HMAC digest
 - MD5 CM MIC: 21 0a 46 e7 a6 e2 91 da fc 67 75 98 08 0d 34 cc
 - HMAC CM MIC: cb e6 c7 64 21 2d db 36 af 6a 64 12 31 eff2 5b

The interface includes a sidebar with categories like General, Class Of Service, Baseline Privacy, CPE Specific, Software Upgrade, US Service Flows, US Classifiers, DS Service Flows, DS Classifiers, PHS, SNMP, SNMP V3, Telco, Vendor Specific, and View Settings. The status bar at the bottom shows 'Status' and 'Field Format # range 0-255'.

DOCSIS 1.1 introduced the idea of Service Flows with individual QoS levels so that an operator can distinguish between the QoS requirements of different types of end user service and allocate the resources required to ensure the customer actually receives the service they are paying for. Beachcomber allows the definition of both the upstream and downstream service flows and the classifiers which determine the admission to those flows, the graphical presentation makes it easy to see what is being configured and to compare the details of different configurations.



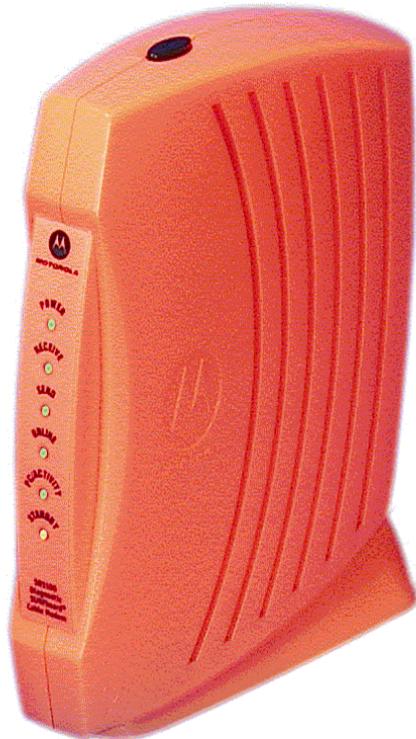
The screenshot shows the SURFboard DOCSIS Editor v1.6 interface. The main window displays a configuration table with the following structure:

| | 1 | 2 | 3 | 4 |
|-----------------------------------|---|---|---|---|
| 01 Service Flow Reference | | | | |
| 04 Service Class Name | | | | |
| 06 QoS Parameter Set Type | | | | |
| 07 Traffic Priority | | | | |
| 08 Max Sustained Traffic Rate | | | | |
| 09 Max Traffic Burst | | | | |
| 10 Min Rsvd Traffic Rate | | | | |
| 11 Assumed Min Rsvd Rate Pkt Size | | | | |
| 12 Timeout Active QoS Params | | | | |
| 13 Timeout Admitted QoS Params | | | | |
| 14 Max Concatenated Burst | | | | |
| 15 Service Flow Scheduling Type | | | | |
| 16 Request/Transmission Policy | | | | |
| 17 Nominal Polling Interval | | | | |
| 18 Tolerated Poll Jitter | | | | |
| 19 Unsolicited Grant Size | | | | |
| 20 Nominal Grant Interval | | | | |
| 21 Tolerated Grant Jitter | | | | |

The interface also includes a sidebar with various configuration categories such as General, Class Of Service, Baseline Privacy, CPE Specific, Software Upgrade, US Service Flows, US Classifiers, DS Service Flows, DS Classifiers, PHS, SNMP, SNMP V3, Telco, Vendor Specific, and View Settings. The top menu bar includes File and Help, and the status bar at the bottom shows Status and Field Format.

10 Diagnostic Modem

The diagnostic modem is physically the same as a customer modem except that it is orange in colour, it has a small jack socket on the rear and it has a special “shelled” version of the microcode. This is a simplified Korn shell system, which allows the user to log onto the device and set diagnostic switches to trace and log what is happening on the network. This is a very powerful tool for tracing intermittent and otherwise difficult faults.



10.1 Diagnostic Cable Modem Command Line Interface Notes

The CLI can only be accessed via an “*rlogin*” based Telnet client or the Diagnostic Console Cable and the DIAG port on the back of the modem. Modems that are going to be used as Diagnostic Tools and use the CLI must have the “*SHELL*” version of modem firmware.

10.1.1 Connecting to the Cable Modem via Diagnostic Console Cable:

The CLI can be accessed via the Diagnostic Console Cable and the DIAG port on the back of the modem. This is typically done via “Windows HyperTerminal” with the following settings:

- Bits per second: 38400
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

Diagnostic cables are supplied with the modems.

10.1.2 Connecting to the Cable Modem via Ethernet and an “rlogin” based Telnet Client:

Modem Ethernet IP address: 192.168.100.1
To access CLI from HFC side: rlogin <modem IP address from DHCP>
To access CLI from client CPE: rlogin 192.168.100.1

10.1.3 Logging Into the Cable Modem:

Login name: target
Password: first 15 digits of the unit serial number (*It is best to copy these into a Notepad Window first, then copy/paste to the Terminal Window you are using for access.*)

10.1.4 Key Commands:

| | |
|---|--|
| Addressing | Displays modem addressing information (<i>Ethernet MAC and IP</i>) |
| arpstorm | Displays ARP Storm filter statistics |
| blpinfo | Displays Baseline Privacy Key Management information |
| bootChange | Changes modem boot parameters |
| bridge | Displays state of bridge forwarding layer and statistics |
| clrcpemac <xx-xx-xx-xx-xx> | Clear one static CPE MAC address from Table of known CPE's. Number of CPE's (Controlled by TFTP TLV Value <i>MaxCPE</i>) |
| config | Use to set modem configuration settings, such as starting frequency ranges, known frequency and other registration/scanning parameters |
| cpemac | Lists MAC addresses known by the modem including those provisioned and learned. |
| defaultcfg | Sets the modem back to factory defaults |
| dhcpc | Displays modem DHCP configuration information received from server |
| dlfile | Downloads new software image from a specified server through TFTP |
| dsdiag | Displays downstream diagnostic information, (frequency, SNR, FEC lock status) |
| eventlog | Displays event logs up to 173 entries, with wraparound buffer |
| exit quit | Exit the login session |
| factSetCliOff | Turns off CLI after next reboot |
| help ? | Lists available CLI commands |
| haltreset | Cancels reset action request |



| | |
|--------------------------------|--|
| hosts | Displays VxWorks host name table |
| I | Displays a summary of each task and associated TCB (Task Control Block) |
| ifconfig | Display information about all attached network interfaces |
| ifconfig [interface] | Displays information about specific interface |
| ipcache | Displays IP filter cache information |
| ifcachestat | Displays IP filter cache statistics |
| ipfilter | Displays state of IP filters |
| lkAddr [addr] | Displays Engineering symbols whose values are near a specified value |
| llcfilter | Displays LLC filter information |
| macstat | Displays MAC packet counts and statistics |
| memShow | Displays system memory partition blocks and statistics |
| multicast | Displays multicast protocol information |
| netstat | Displays statistics for all protocols |
| netstat -icmp | Displays statistics for ICMP |
| netstat -ip | Displays IP statistics |
| netstat -inet | Displays all active connections for IP sockets |
| netstat -rn | Displays routing tables |
| netstat -tcp | Displays statistics for the TCP protocol |
| netstat -udp | Displays statistics for the UDP protocol |
| ping <x.x.x.x> | Ping an IP address |
| ping <hostname> | Ping an IP host by name (<i>names are only configurable at the Engineering Diagnostic Level</i>) |
| quit | Exits the login session |
| reset | Reset the Cable Modem |
| rlogin <hostname> | Establishes a rlogin session to <i>hostname</i> (<i>names are only configurable at the Engineering Diagnostic Level</i>) |
| routes | Displays host and network routing table |
| setdbg | Sets some debug flags (<i>see below</i>) |
| startuplog | Displays startup log information |
| telnet <x.x.x.x> | Establishes a telnet session |
| tftpinfo | Displays TFTP information |
| usdiag | Displays upstream diagnostic information, (SID, power level, frequency, rate) |
| ver | Displays software/hardware versions |

10.1.5 Key Debug Flags:

<Set through CLI *setdbg* command>

<By default, they are set to 0, except QAM 16 Preamble is set to 1>

| | |
|----------------------------|---|
| Ignore Auto Update | IF 1, Do not auto update the Firmware image upon registration IF 0, Auto update the Firmware image as designated by TFTP Config file |
| Canned Registration | IF 1, DHCP, TOD, TFTP will be bypassed and canned registration will be used |
| Fine Scan on | IF 1, Do fine scan |
| Use Scan Limit | IF 1, Perform scan within parameters of the defined scan limits |
| DHCP Debug On | IF 1, DHCP Debug statements are displayed |
| Config Debug On | IF 1, Config Debug statements are displayed |
| TOD Debug On | IF 1, Time of Day Debug statements are displayed |



| | |
|----------------------------|---|
| Reg Debug On | IF 1, Registration Req/Res values are displayed |
| Scan Debug On | IF 1, Then each frequency tested will be printed scan |
| MMT Cmd Debug On | IF 1, MMT Debug statements are displayed |
| Range Debug On | IF 1, Ranging Debug statements are displayed |
| UCD Debug On | IF 1, UCD Debug statements are displayed |
| UU Debug On | IF 1, Unit Update debug statements are displayed |
| CLI Off | IF 1, Turns off CLI shell. Use vxWorks Operating System Shell |
| BLP Off | IF 1, Turns off Baseline Privacy. |
| QAM16 Preamble | IF 1, use QAM 16. IF 0, use QPSK |
| Frequency step size | Set to Values (50000 - 8000000 Mhz): [default = 6000000] |
| Scan lower limit | Set lower Scan Limit Starting Point (0 - 800 MHz) |
| Scan upper limit | Set lower Scan Limit Starting Point (0 - 900 MHz) |



11 Reference Material

Motorola has shipped over 20 million modems since 1996 and has monitored the actual in service failure rate over that time. The results are summarised below:

- **SB2100**
 - After 12 months and more than 93k units shipped, the SB2100 has an AFFR of <.97%, and an actual MTBF of 95 years
- **SB3100**
 - After 24 months and more than 1.6M units shipped, the SB3100 has an AFFR of <.5%, and an actual MTBF of 225 years
- **SB4100**
 - After 20 months and more than 3.4M units shipped, the SB4100 product has an AFFR of <.19%, and an actual MTBF of 514 years
- **SB4200**
 - After 12 months and more than 4M units shipped, the SB4200 product had an AFFR of <.08%, and an actual MTBF of 525 years
- **SB5100**
 - After 6 months and more than 3M units shipped, the SB5100 product has an AFFR of <.005%, and an actual MTBF of over 525 years