1 *sat-nms* SCC Overview

The *sat-nms* NMS normally uses dial-up telephone lines (analog telephone, ISDN, GSM) for the control connections between the *sat-nms* NMS and each particular VLC. Using modems or ISDN terminal adapters, TCP/IP connections are temporarily established to the VLCs in order to monitor and control them.

The *sat-nms* SCC (Satellite Control Channel) Facility, here titled with 'one-way control', enhances the *sat-nms* System by its capability to control VLCs via satellite without the need of a terrestrial communication link.

For remote control via satellite, the *sat-nms* MNC Communication is split up into two different modes:

1. The outbound (or "one way") communication channel is a signal broadcasted by *sat-nms* NMS to all VLCs in the network. This channel sends commands to each VLC, enveloped in UDP/IP packets. The UP addressing scheme allows to address messages either to particular VLCs (using full qualified network addresses) or to broadcast messages to multiple VLCs by the means of IP broadcast address masks.

2. Besides the one-way communication channel, an IP point to point communication can be set up at one VLC at a time. This bi-directional and completely transparent network link is used to fetch the actual status of the VLC and to perform configuration or maintenance tasks where a full access to the VLC is required.

Physically, the one-way control channel uses one modem/router combination at each site. The *sat-nms* NMS may use multiple modem/router combinations for the incoming traffic to allow more than one point-to-point connection at a time.
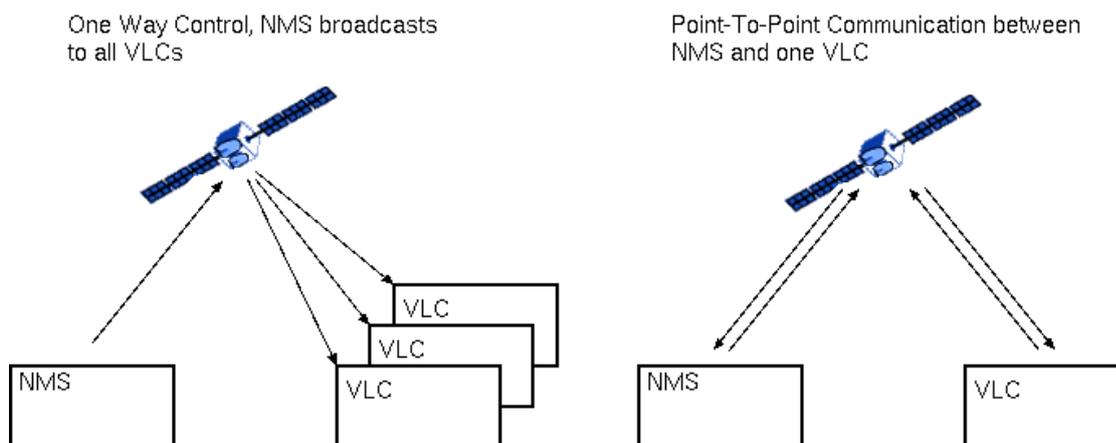

Figure 1: One Way Control vs. Point-To-Point Communication

The software uses IP routers and satellite modems for both communication methods. The outbound (one-way-) communication is done by sending UDP packets to the VLCs. If an operator requests to setup a point-to-point (P2P) link to a certain VLC, the *sat-nms* NMS commands this VLC to bring up a backward carrier at a different satellite channel enabling a bi-directional (TCP) communication to this VLC. When equipped with an appropriate router, the *sat-nms* NMS supports multiple backward channels and manages the assignment of them automatically.

www.satnms.com   SCC-Description-1512-1.doc-

2 Equipment

The **sat-nms** SCC Communication requires at each site a satellite modem and an IP router. The **sat-nms** NMS Site may optionally use multiple modem/router pairs to provide multiple point to point connections at a time. To be useful for the **sat-nms** SCC, the routers used have to be capable to route UDP broadcast packets.

Below, the typical setup of **sat-nms** SCC equipment for a VLC site is shown. This equipment consists mainly of the router, the modem and the VLC itself. The setup presumes that the site already provides the necessary RF equipment like frequency converters, amplifiers and the antenna itself to transmit and receive the user data. The **sat-nms** SCC will use this equipment as well.
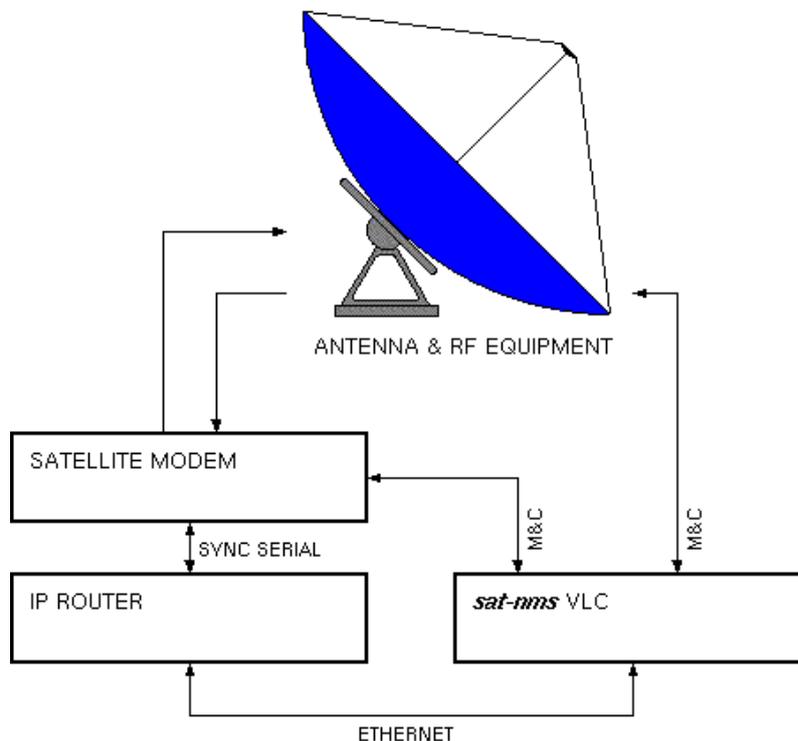
*Figure 2: Typical **sat-nms** SCC equipment for a VLC*

For the **sat-nms** NMS, the minimally required equipment is very similar. As the **sat-nms** NMS transmits the outbound channel and the modem settings constantly, they only need to be changed if the **sat-nms** SCC is switched to other channels. Normally, no monitoring and control for the **sat-nms** SCC equipment is required. If at least a monitoring of the equipment is desired, an (optional) VLC may be installed at the **sat-nms** NMS Site to perform this task.

The setup shown below provides the **sat-nms** NMS with a **sat-nms** SCC capability for the outbound channel and one inbound channel. With such a setup, an operator can control one VLC at a time as it would be attached to the **sat-nms** NMS via ISDN or an analog telephone line.
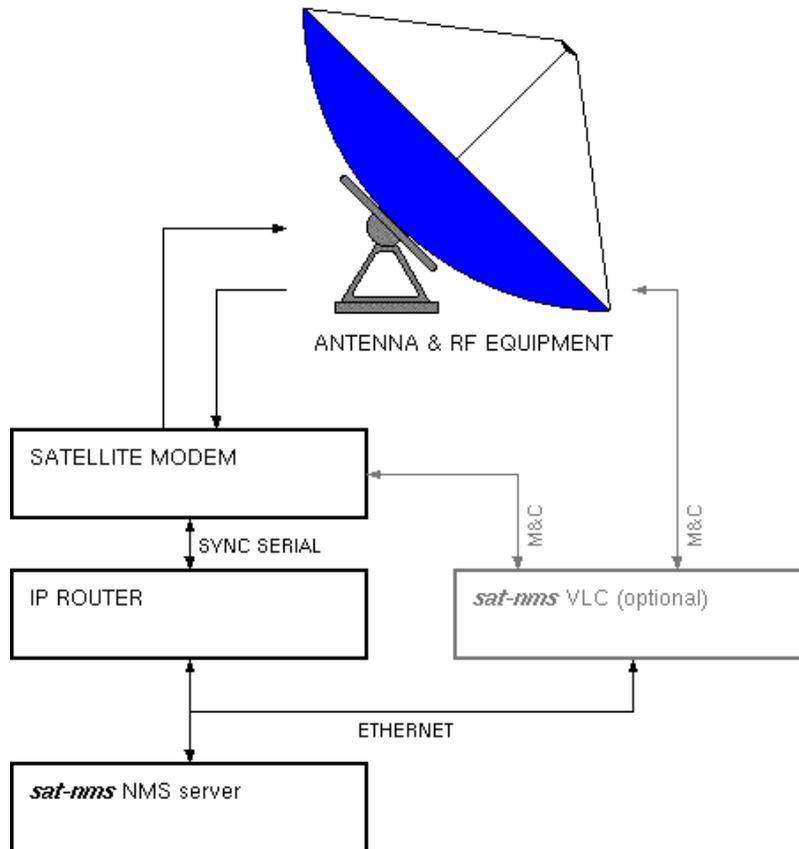
*Figure 3: Typical **sat-nms** SCC equipment for a **sat-nms** NMS with one inbound channel*

To control more than one VLC at a time, the **sat-nms** NMS may be extended for two or more inbound channels. For each additional inbound channel, one router / satellite modem pair is added. Only the receive part of the modem is used, all outgoing IP traffic gets routed through the simple outbound channel. With this configuration, no remote control of the modems is required for the normal operation of the **sat-nms** NMS. Each modem is dedicated to one inbound channel, the modem settings need not to be changed unless the definitions of the **sat-nms** SCC Channel are changed.

The setup shown in the figure below employs two inbound channels, the first handled by the modem, which also provides the outbound channel, the second one handled by a separate modem.
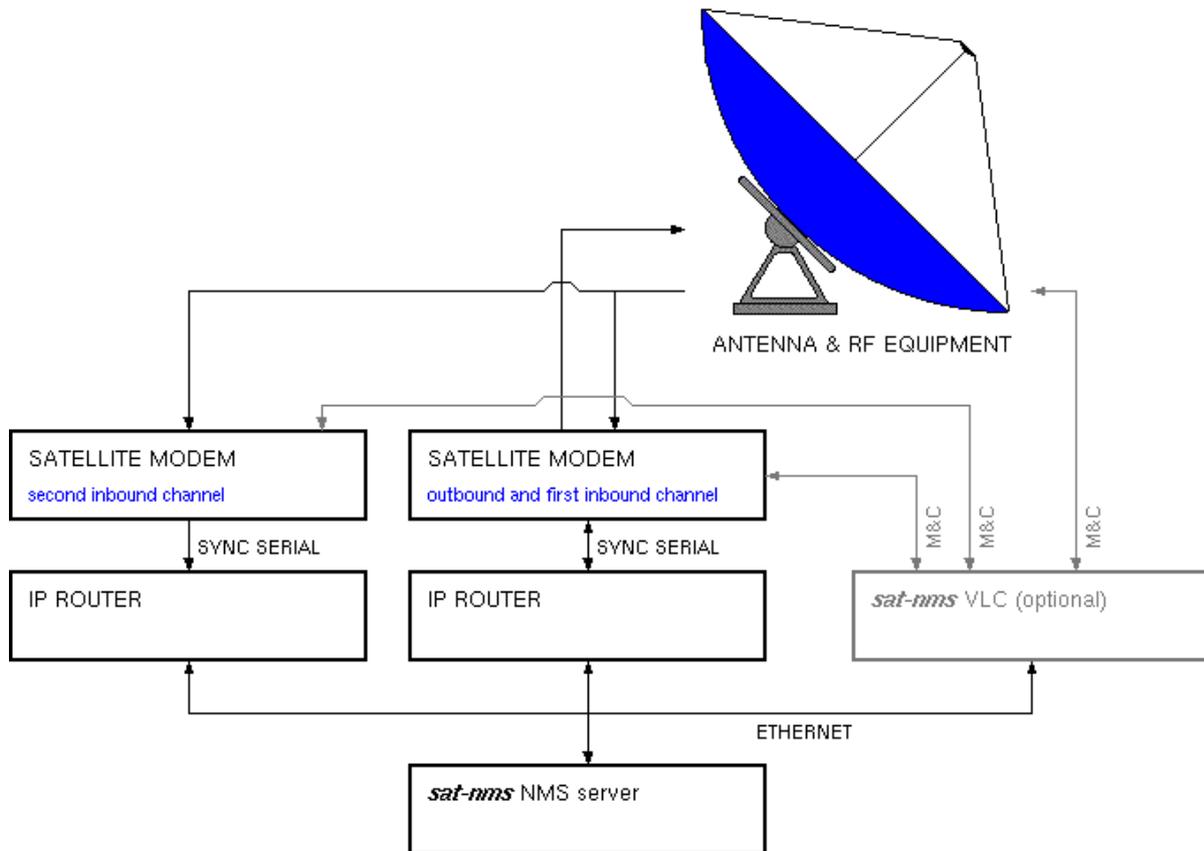
*Figure 4: Typical **sat-nms** SCC equipment for a **sat-nms** NMS with two inbound channels*

3   Channel Definition

A **sat-nms** NMS using **sat-nms** SCC to control the remote VLCs requires at least two satellite channels. The first channel is the outbound channel that is constantly transmitted by the **sat-nms** NMS. The outbound channel transports several types of data:

UDP broadcast packets which are simultaneously addressed to all VLCs: These include the heartbeat message used by the VLCs to detect the presence of the outbound channel and network configuration messages.

UDP messages which are addressed to particular VLCs. The **sat-nms** NMS controls the VLC's usage of the inbound channel(s) by such messages. They also are a backdoor to control **sat-nms** MNC Parameters at a VLC without having a point to point connection to it.

TCP messages addressed to a particular VLC: Once a point to point connection to a VLC has been made, the TCP packets from the **sat-nms** NMS to the VLC go through the outbound channel, the way back is through the inbound channel that is transmitted by this VLC. If there are multiple inbound channels, the outbound channel carries the TCP packets for all connections.

The recommended minimum data rate for a channel is 64000 bps, if there are multiple inbound channels, the outbound channel should have a proportionate bandwidth to avoid a performance bottleneck.

The figure below illustrates a configuration with two inbound channels. The outbound channel (red) is transmitted constantly by the *sat-nms* NMS. All VLCs receive this channel. Both, the second and the third VLC have a point to point connection to the *sat-nms* NMS using the two inbound channels.
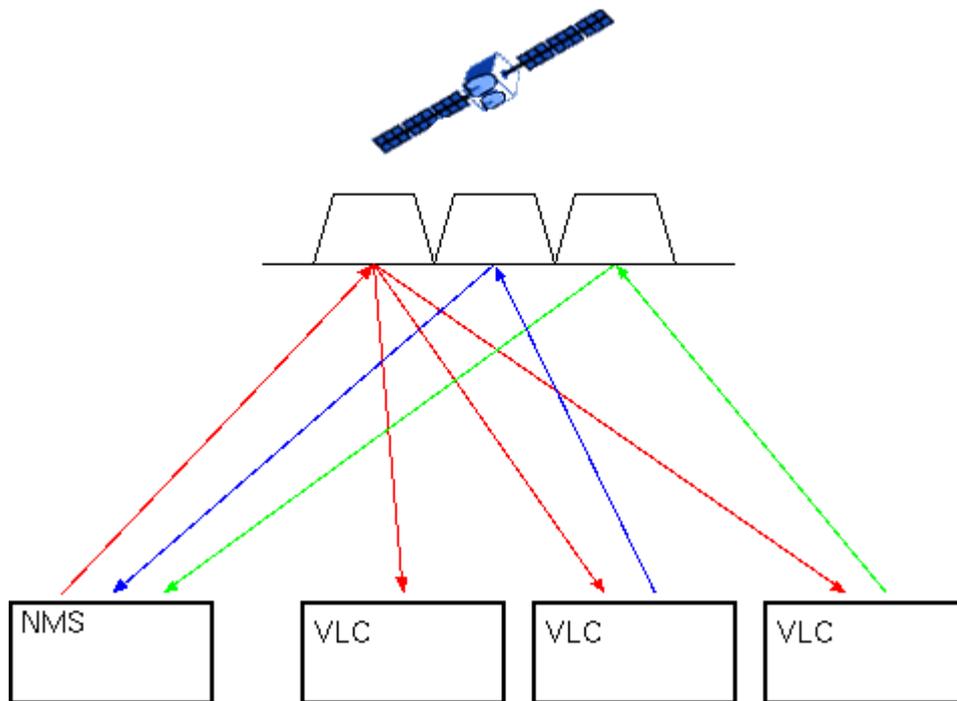

Figure 5: Satellite Channel Usage

The *sat-nms* NMS User Interface provides the 'sat-nms SCC Channel List window' showing the general parameters of the *sat-nms* SCC Channels defined for the *sat-nms* NMS together with the state / usage of the channels. It also permits to edit the channel's parameters.

Although the *sat-nms* NMS always uses only one single outbound channel, the channel list provides two of them. This is part of the mechanism which lets the *sat-nms* SCC System recover from misconfigurations. The second outbound channel acts as a backup that is used by the VLCs if the primary one is not available.

In an application where the *sat-nms* SCC Frequencies never change, you may not require this feature and simply set the parameters of both outbound channels to the same values. If however the frequency of the outbound channel shall be changed, the new frequency can be set as the second outbound channel. The system is still operational at the old frequency with this setting. After some hours then, the *sat-nms* NMS Transmit Frequency gets set to the new value, all VLCs will lose the signal sent from the *sat-nms* NMS and will find the new one as the alternate channel.
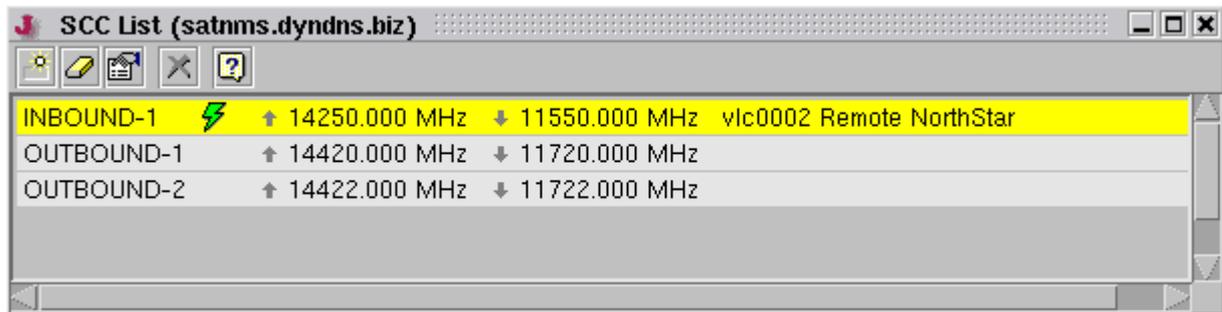
If you are using multiple 'INBOUND' channels in order to allow point to point connections to more than one VLC at a time, you have to define the additional channel in this list. Setting frequencies and data rates for the *sat-nms* SCC Channel in the list only has an effect to the receive and transmit parameters set at the remote VLCs. The satellite modems used at the *sat-nms* NMS Site have to be tuned individually to the proper settings either at their front panels or by means of the *sat-nms* MNC Capabilities.

4 IP Routing / Addressing

With the *sat-nms* SCC Option to the *sat-nms* NMS Software, the IP addresses of the VLCs and the *sat-nms* NMS can be freely configured. The addressing scheme described below is the default scheme used by the software 'out of the box'.

Each remote site gets assigned a small subnet (/28) containing 16 addresses. The first usable address in the subnet is the VLC's address; the last address is the address of the router. The subnet reserved for the first site/VLC0001 starts at 192.168.64.0. If new VLCs are created in the *sat-nms* NMS Software, these addresses are assigned automatically (but can be overwritten). The table below shows the subnet mask and the addresses of VLCs and routers for the first three sites.

VLC No.	Site Subnet	VLC Address	Router Address
VLC0001	192.168.64.0/24	192.168.64.1	192.168.64.14
VLC0002	192.168.64.16/24	192.168.64.17	192.168.64.30
VLC0003	192.168.64.32/24	192.168.64.33	192.168.64.46

The table below shows the routing necessary to make a simple *sat-nms* SCC Network Work. The example assumes IP addresses for the *sat-nms* NMS Server and the router at the *sat-nms* NMS' Site in the 192.168.1.0/24 network, but this can easily be adapted to the given addresses in a customer's LAN.

Device	Interfaces / Routes
VLC0001	Ethernet 192.168.64.1 Network 192.168.64.0/28 -> Ethernet Default Route -> Gateway 192.168.64.14
Router at VLC0001	Ethernet 192.168.64.14 Serial – Satellite Modem Network 192.168.1.0/24 -> Serial Default Route -> Null interface
sat-nms **NMS**	Ethernet 192.168.1.1 Network 192.168.1.0/24 -> Ethernet Network 192.168.64.0/18 -> Gateway 192.168.1.250
Router at *sat-nms* **NMS**	Ethernet 192.168.1.250 Serial – Satellite Modem Network 192.168.1.0/24 -> Ethernet Network 192.168.64.0/18 -> Serial
Client PC	Ethernet 192.168.1.100 Network 192.168.1.0/24 -> Ethernet Network 192.168.64.0/18 -> Gateway 192.168.1.1

Reserving the 192.168.64.0/18 subnet for the remote VLCs lets the *sat-nms* NMS control up to 1024 remote sites, which will be sufficient in most cases. The router handling the *sat-nms* NMS outbound traffic must be capable to route UDP broadcasts. Not all routers do this and the way how to configure this feature varies between vendors and router types.

The example above contains a route from the client PC to the remote VLCs, using the *sat-nms* NMS Server as gateway. The purpose of this route is to support third party programs controlling IP-based equipment at the remote sites through the *sat-nms* SCC Network Connection. The *sat-nms* NMS acts here as a gateway rather than the *sat-nms* SCC Router to support the coexistence of site-controlled via *sat-nms* SCC and such controlled vie telephone lines in the same system. The latter use the *sat-nms* NMS Server itself as the router. The *sat-nms* NMS Server has IP forwarding enabled by default; hence it will pass the packets to the *sat-nms* SCC Router unless there is a PPP connection pending for the particular site.

5   Recovery Procedures

If the VLC misses the heartbeat messages from the *sat-nms* NMS, it scans the two outbound channel definitions it did receive from the *sat-nms* NMS before. Before setting the frequency and data rate defined for a channel, the VLC checks if there is a macro called 'scc-recovery' in the 'macros' subdirectory. If such a macro is present it gets executed before the channel frequency and data rate is set. The diagram below shows what the VLC does if it fails to receive the data sent by the *sat-nms* NMS.
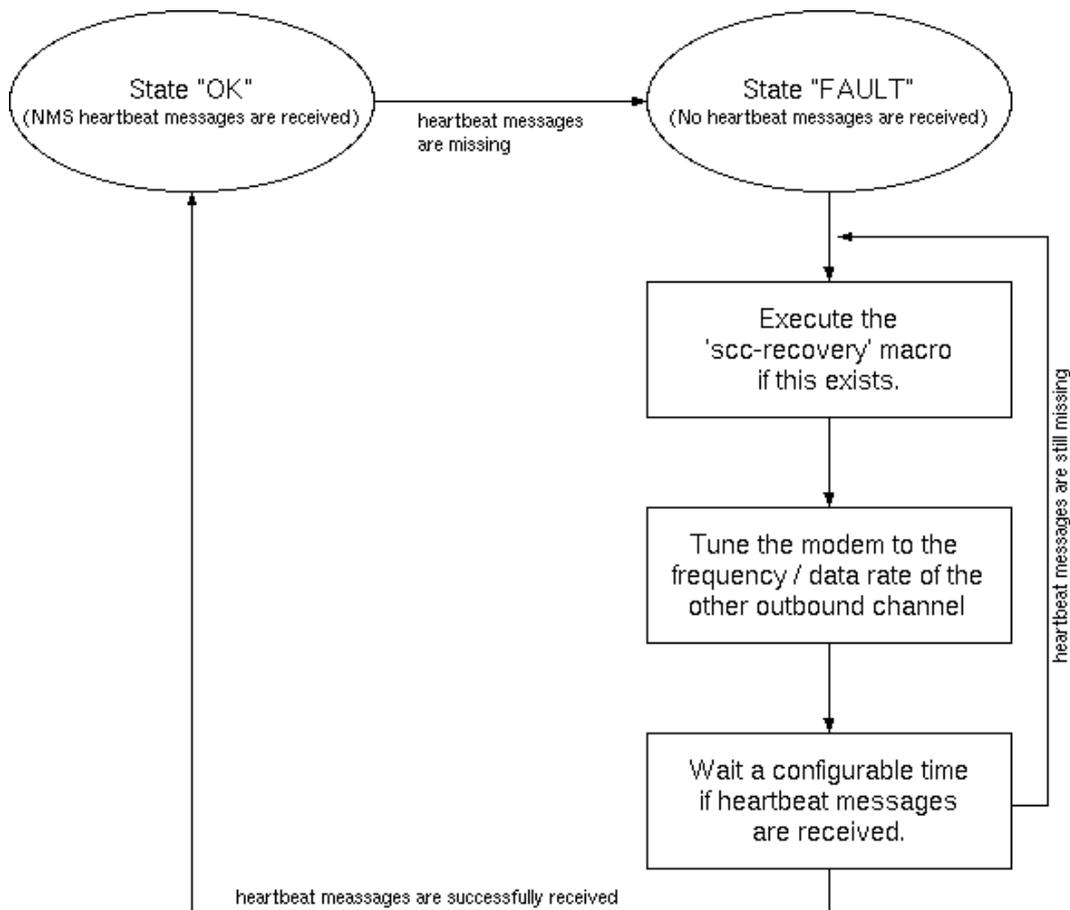
Such a recovery macro should contain all device settings necessary to receive the *sat-nms* NMS' Outbound Channel. Beside general modem settings, this macro may include the position of waveguide switches, the frequency setting of a down converter or other parameters. However it must not contain a command switching on the *sat-nms* SCC Carrier in the VLC.

If a parameter the VLC requires receiving the *sat-nms* NMS Outbound Channel gets displaced by accident, the communication with the *sat-nms* NMS immediately breaks down. This mistake cannot be undone via *sat-nms* SCC as the VLC does not receive any data from the *sat-nms* NMS. If this parameter is backed up in the *sat-nms* SCC-Recovery Macro, the VLC will successfully reinitialize the communication equipment during the recovery / channel scanning process.

A recovery macro gets recorded like any other macro while the VLC is 'online'. The Macro Management window provides a particular toolbar button that lets you store a macro as a *sat-nms* SCC-Recovery Macro on the VLC with a single mouse click.