*Sky*WAN® with a SeaTel 4006 for a maritime VSAT bundle

Introduction

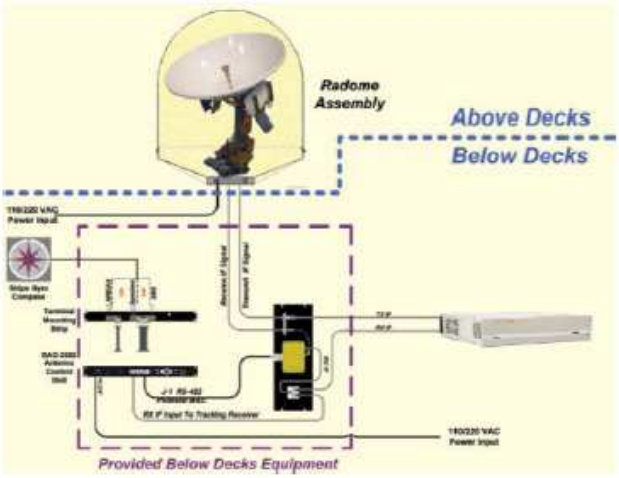
*Sky*WAN® is a pure MF-TDMA, hubless VSAT system with multiple frequency channels. It provides bandwidth on demand capability based on a DAMA (Dynamic Access Multiple Access) scheme. *Sky*WAN® provides a number of unique features and differentiates itself from other products in the market. Thru its versality *Sky*WAN® supports all kind of applications with toll quality and provides tailored communication solutions for governmental, media and enterprise.

Next to mainly land based networks, *Sky*WAN® was also used for maritime applications in the past already. Since ND SatCom itself is not active in the installation of maritime systems by itself, this was done by partner or specialized companies (VSAT installations on ships have some special requirements and have to follow several international standards). Nevertheless the usage of the *Sky*WAN® modem for maritime remote stations had a very good feedback, mainly based on the general feature set as meshed capabilities (single hop), possible single carrier operation (outbound and inbound together in one carrier), QoS features – especially for voice, automatic transmission power control for each remote (important for ships because of fast changing weather conditions), load balancing, different redundancy concepts etc. One main aspect is also the fast re-acquisition time in case of short losses of direct sight to the satellite (because of ship deck structures) or short term positioning problems of the antenna system.

Very often there are questions about the complexity to connect a *Sky*WAN® modem to a maritime antenna system, since each modem may have special requirements or need changes in the outdoor equipment like amplifier, LNB etc. This paper shall give an overview how to connect a *Sky*WAN® modem respectively what has to be adapted if connected to Seatel 4006 maritime antenna system, a quite often used antenna in the maritime market for VSAT applications. In addition some re-synchronization measurements are depicted, initiated by azimuth and elevation changes and refeeding to show the quick response time of the modem for short outages.

Maritime Antenna System SeaTel 4006

Sea Tel itself described its 06 Series as "ideal for ocean going vessels that require "always-on" broadband satellite communications… a 1-meter Ku-Band maritime VSAT antenna for SCPC, broadband, or hybrid networks. This antenna system meets the FCC's 2-degree spacing requirement, which is a remarkable achievement for a 1-meter ring focus antenna. Antenna efficiency is better than 70% across the transmit and receive bands". For more information as well as technical data please have look directly to the original flyer.



The general typical layout is depicted below (extract of the original flyer). Next to the antenna system itself an antenna controller is needed for the tracking signal and control of the antenna system. The tracking itself will be done based to a DVB carrier,

the receiver works autonomous in the controller and needs no connection to any external modem which is mainly used for the 2-way communication (no special integration to any 2-way system). General position and compass data will be provided by the ship gyro compass, dish elevation position by an internal system in the Radome assembly. Signaling information for the outdoor unit will be exchanged via the L-Band, coupled in by modems in the anyway needed Tx/Rx cables from the sat-modem to the BUC/LNB. A direct 110/120 VAC power input will be passed into the Radome to provide the power for the motors and BUC (power supply in antenna system).

The normal used SSPA used in the antenna system is a 4W BUC, driven directly by the modem, most time. Nevertheless more powerful BUCs can be used and fixed, as long as they extended no maximum dimensions and weight and can be mounted (see also below the figure, where the BUC is located in the system). Be aware that for this kind of antenna system a new balancing of weight is needed every time the original balance in weight will be changed. If the modem can not provide the needed power for the BUC via the L-band cable, the used BUC will need a direct AC input for power, provided by Seatel in the antenna.

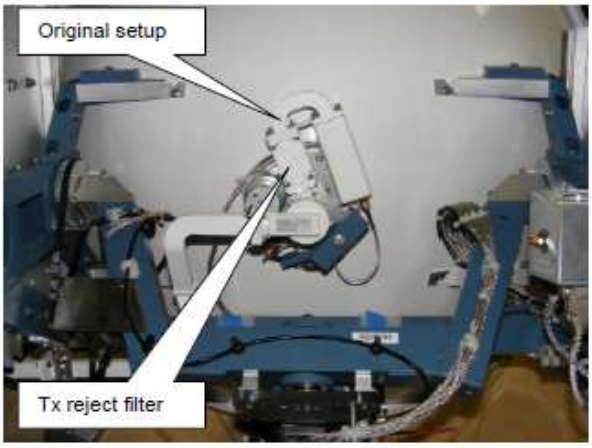
The ACU Antenna Control Unit (DAC-2202) acts, except for start-ups, or changing operation with different transponders or satellites, permits unattended operation. Housed in a standard 19 rack mount enclosure it can be directly joined together with our *Sky*WAN® modem. The front panel contains function keys used to select the desired information to be displayed, and/or changed. All external connections are made through connectors mounted on the rear panel, same for the *Sky*WAN® modem. The DAC-2202 automatically calculates the Elevation, Azimuth and Polarization pointing angles based on the ships Latitude, Longitude and the desired Satellite Longitude position. A programmable pattern search will automatically scan the area for a desired satellite if no signal is found. The DAC-2202 requires satellite signal input to its internal Satellite ID Tracking Receiver to keep the antenna peaked on satellite. This internal receiver is a DVB compliant DSS compatible Satellite Identification receiver. Its input allows full coverage wide L-Band (950 to 2150 MHz) for tracking video transponders in all TVRO satellites and may be set to Single Channel Per Carrier (SCPC), or Narrow Band IF (NBIF) mode to allow tracking an L-BAND satellite beacon or narrow band data carrier (DVB carrier is always preferred).

Maybe as an additional information for real operation: If the SeaTel antenna is losing contact to satellite and is not aligned any longer because of some reasons, the antenna does not start automatically the search sequence but needs a manual restart by pressing a button or via IP network.

Mechanical Adaption for SkyWAN usage

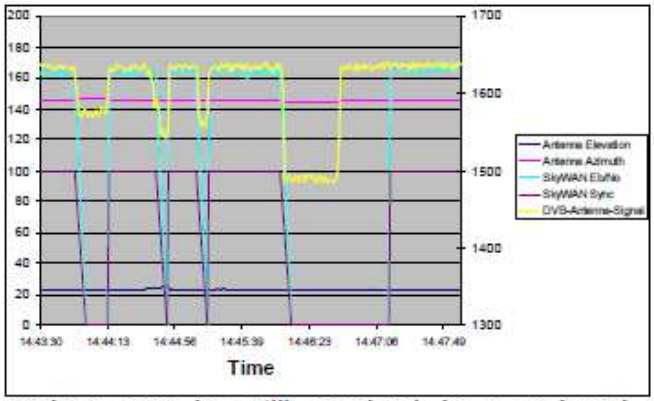
The Seatel 4006 will be initially shipped with an own DRO-LNB and fully assemblies. For the *Sky*WAN® modem a high stability LNB is required, normally a pre-selected PLL type one. This chosen LNB (NJR model) with the correct LO frequency is mainly bundled already together with the *Sky*WAN® modem. As a result a replacement of the LNB is required. Since the NJR LNB is larger as the original one, it would hit the balancing weight next to the rotary joint. Therefore a small waveguide extension is needed as seen in the picture below. This extension is ~ 3cm and in conjunction with the mounted LNB nearly the same balance for the antenna is given, so no big additional action is required.

Important: Since the SeaTel antenna already **includes a transmit reject filter** no additional one is allowed/used. Since most time an own transmit reject filter is shipped with the *Sky*WAN® modem, having the same dimension as the required waveguide extension, do not use the filter for the extension or instead the original used filter from SeaTel.



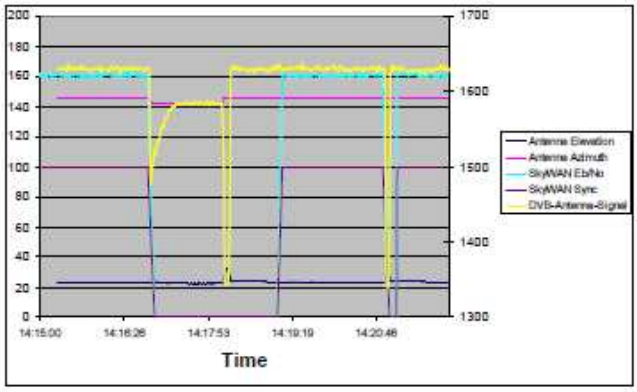
Re-Synchronisation behaviour after azimuth and elevation deviations

It is normally in the interests of a modem manufacturer to gain more information about the speed of the re-synchronisation process after the connection was lost because of temporarily shadowing effects or re-positioning effects caused by the antenna system given by other shocks (bumps or other quick shits in direction etc.). Therefore we tested the re-synchronisation behaviour of the SkyWAN modem by "de-alignment" of the azimuth or elevation angle and refeeding to the correct position.



In the figures the Es/No values of the received transmit signal as well as circular grade value (indication of an active 2-way communication) polls and as well as grabbed DVB-carrier used for antenna tracking are mapped in one graph. Signal degradation was imitated by elevation and azimuth deviation of 1-2°.

For a larger outage of the 2-way link (whereas the DVB tracking signal at the modem may be still received in a reduced way) for more than 1:30min, the re-synchronisation time for the modem is around 1min, since the complete logon sequence is restarted and has to be done from scratch (please keep in mind the receive lock is done



much quicker, but the complete 2-way link is observed). For smaller outages below 30 seconds the re-synchronisation time is almost the same (most time) or max 5 seconds (sometimes) after the initial position was found again. Why there are sometimes a small delay in the re-sync can not explained in an exact way so far and has to be investigated in detail, since this happens just after a complete logon sequence was done before.

The decision for the modem when to do a complete logon sequence is triggered by an internal timer which is correlated to the "storage time" of the actual used corrected rtt. If a re-synchronisation is needed in this time, the modem assumes to take the "old" rrt time since nearly nothing should be changed meanwhile. After the timer is expired, the modem starts with a larger searching and measurement range, which takes some more time to run through the initial phase until to get the fine synchronization. The timer is not an implemented flexible variable, but fixed, so far. Depending to the increased usage of the modem, this can be changed in the next releases to enlarge the possible outage time for not fast moving units (the SkyWAN modem itself needs no GPS coordinates neither very exact rtt values in the initial start sequence). A test phase which maximum time may be still usable depending of location and situation is missing so far and has to be done for optimal settings.

Conclusion

Using a *Sky*WAN® modem for maritime VSAT application together with standard stabilized antenna system like the SeaTel 4006 is not a big issue regarding the interoperability. The antenna subsystem is working in quite autonomous mode; special adoptions between antenna system and modem are not required. Sole exception is the replacement of the LNB and simple waveguide extension because of mechanical reasons, but without any big influence to the balancing of weight. As long as the ACU of the antenna system does a proper tracking to the right satellite the modem will log to his configured network.

In case of short outages the *Sky*WAN® modem is able to re-sync nearly just is time with the done re-alignment of the antenna to the satellite – in seconds. For larger outages the modem in the actual implementation starts an initial logon sequence, which takes ~ 1min. To enlarge this time respectively to change this responsible timer to a configurable variable is planned for upcoming software releases. Nevertheless the actual version shows in general already a nearly perfect operation for maritime VSAT solutions.