LONG RANGE COMMUNICATIONS ON THE MOVE

De heer M.R. Yeo, SNXP Ltd

Dit artikel is mede tot stand gekomen door tussenkomst van de heer G. Cupido, SurCom International BV.

Het maken van een satellietverbindingen was voor lange tijd slechts mogelijk vanuit een statische positie of opstelling. Het zogenaamde 'rijdend' verbinding maken was niet in beeld bij het landoptreden. Dat dit een operationele beperking inhoudt en tevens een kwetsbaar punt in ons optreden is, dat is wijd en zijd bekend; ook bij onze tegenstanders. Vanaf 2006 is door de Nederlandse troepen ervaring opgedaan met de zogenaamde X-wing antenne. Een antenne die deze beperking voor zover als mogelijk moest wegnemen. De ontwikkelingen hebben niet stil gestaan en *Longe Range Communications on the Move* zijn inmiddels een operationele realiteit. In dit artikel wordt daarop nader ingegaan, waarbij ook de door Defensie gekozen oplossingsrichtingen worden belicht.

INTRODUCTION

One of the most important developments in long range communications has been the use of satellites to provide mobile and flexible solutions for military operations.

Satellite Communications (SatCom) is the only way to communicate over significant distances in areas with unreliable or non-existent infrastructure. UHF satcom or TacSat as it is commonly known has been widely adopted because of its low cost, ease of use and small size. TacSat has the added benefit of standardisation and interoperability which has led it to be widely deployed across practically every platform used by NATO and coalition partners.

UHF SatCom originally used a dedicated transceiver, these days the transceiver function is an operating mode of standard military radios. The TacSat option of these military radios was originally designed for use with high gain directional antennas where the operator is required to point the antenna towards the satellite. This is fine for fixed installations or "SatCom on the Pause" where the operator has time to set up and point the antenna.

A lot of effort has gone in to providing TacSat on moving platforms. Large ships and submarines have used UHF Satcom for many years employing complex, costly, steerable antennas and large dedicated radio installations. Aircraft have also been equipped with UHF SatCom for long range communications beyond line of sight; again these are extremely expensive installations.

TACSAT ON THE MOVE - THE DUTCH MOD SOLUTION

The SNXP Company was invited by DMO (Defensie Materieel Organisatie) to provide a reliable, low cost, SatCom on the move solution (SOTM) for medium sized land vehicles operating in small groups at almost any location.

UHF SOTM Antenna Fitted with Magnetic Mount

Vehicles on the move bounce around and point in all directions, so an omni-directional antenna is required. The elevation of the satellite above the horizon depends on the latitude of deployment and location of the satellite. In order to provide maximum flexibility in deployment the antenna must operate over a wide range of elevations.

The omni-directional antenna chosen by SNXP is manufactured by Cobham PLC because it has the best gain over an elevation range from 10 to 90°. It was also favoured by NATO in an extensive evaluation of SOTM antennas for the same reason.

ANTENNA INTERFACE UNIT

The best omni-directional antennas still have a lower gain than directional antennas and this is worse at lower elevations. Therefore in order to mitigate this reduced gain, SNXP provided an antenna interface unit (IFU) which boosts the transmit power to the antenna and increases the receive sensitivity. When vehicles operate in close formation, transmissions from one vehicle can 'blind' the receiver on an adjacent vehicle. This is called co-site interference and is addressed by including high performance filtering within the IFU.

UHF SOTM Antenna Installed on Bushmaster (on top, front) en de SOTM X/Ka band antenne van L3 (on top rear)

Antenna Interface Unit (IFU)

The DC power for the IFU is fed either directly via a four pin weatherproof connector or remotely via the coax cable from the radio. When operating in the remote power mode, the DC power is multiplexed on to the radio cable using a bias tee which is shown in the figure *Bias Tee for Remote Power and Operation of IFU*. The bias tee uses the same four pin weatherproof connector and also includes a switch to turn the IFU on and off remotely.

Bias Tee for Remote Power and Operation of IFU

The HPA used in the IFU includes and automatic level control circuit (ALC) so that the desired output power is held constant even if the input power varies. This ensures that the correct power is transmitted even if there is significant cable loss between the radio and the IFU. For example if the radio is providing 20 Watts of transmit power and the cable connected to the radio has 4 dB of loss, the radio power is reduced to 8 Watts, the ALC circuit in the IFU automatically compensates for this boosting the power to the desired level. The IFU includes a switch to provide a choice of three levels of transmit power.

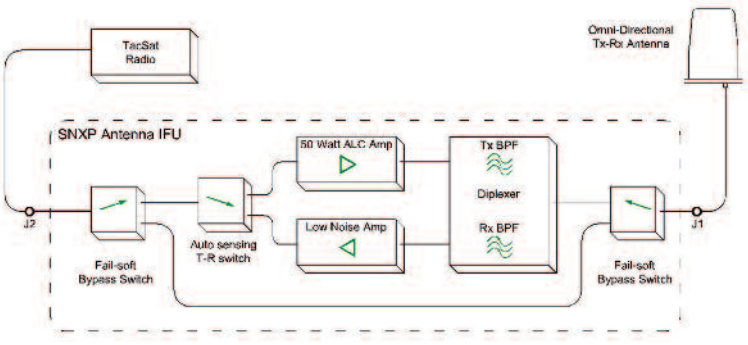
The receive path of the IFU has gain of 40 dB and a noise figure of less than 2 dB. This guarantees the sensitivity of the receiver no matter what the cable loss to the radio or the noise figure of the radio. For example a typical radio can have a noise figure in the region of 6 dB and it is not uncommon to have 4 dB of loss in the cable connected to the radio. This would present a receiver noise figure of 10 dB. The IFU reduces this noise figure to 2 dB improving the receiver noise performance by more than 8 dB.

The functional block diagram of the IFU is shown below; it is connected between the TacSat radio and the omni-directional antenna. When no DC power is applied, the IFU defaults to the bypass state and the radio is connected to the antenna.

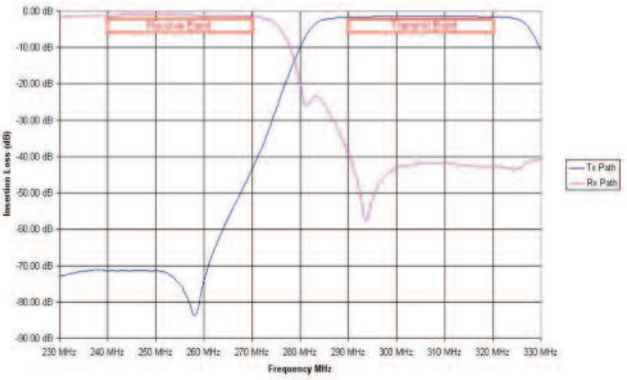
When powered up the IFU is normally in the receive mode where the receive signals from the antenna pass through the diplexer, low noise amplifier and transmit-receive switch to the radio.

When the radio is transmitting the IFU automatically switches to the transmit mode and the signal from the radio is fed through the 50 Watt amplifier and diplexer to the antenna.
The transmit and receive performance of the diplexer is shown in the figure below. When the IFU is operating in the receive mode the Rx path of the diplexer provides 40 dB of rejection of unwanted signals in the transmit band. In the Rx mode the HPA is in a low current standby condition and the Tx path of the diplexer provides 40 dB of rejection to any residual noise in the receive band coming out of the HPA.

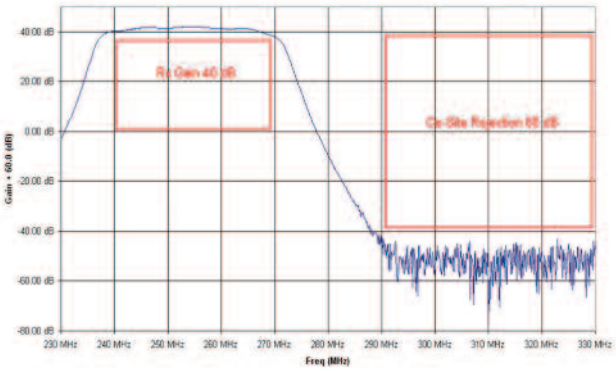
When the microphone key is pressed the IFU detects the Tx signal from the radio, flips the T-R switch and activates the power amplifier to boost the Tx signal. The transition from the standby receive mode to transmit mode takes place in less than 35 microseconds to ensure that no Tx data is lost. When transmitting the receive path of the diplexer reduces any leakage of the transmit signal entering the receiver by 40 dB.



Functional Block Diagram of the SOTM Solution Showing Detail of the IFU



Measured Response of Diplexer



Measurement of Receive Path Through IFU Showing Co-Site Rejection

The IFU has been tested by an independent agency who confirmed that it supports all current SCPC and DAMA waveforms.

The LNA includes additional filtering to further reduce unwanted signals in the transmit band. The complete receive path gain response is shown in the figure below. The combination of the diplexer and LNA filtering provides 80 dB of co-site interference.

SUMMARY

The solution provided by SNXP enables reliable long range communications from almost any moving platform and supports all current SCPC and DAMA waveforms. The high performance antenna and IFU work with existing TacSat radios to increase flexibility, simplify installation, improve performance and overcome operational challenges.

Fotomateriaal met dank aan de heer Cupido

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