Radio System

The radio transceiver is a 2.4-GHz Direct Sequence Spread Spectrum (DSSS) Gaussian Frequency Shift Keying (GFSK) baseband modem radio that connects to the central processor unit (CPU) via a serial peripheral interface (SPI). A power amplifier increases the power of the output radio signal in order to increase its effective range.

The radio operates in the worldwide 2.4-GHz Industrial, Scientific, and Medical (ISM) frequency band (2.400 GHz–2.4835 GHz). It divides the ISM band into 78 channels, each of which are 1 MHz wide.

DSSS generates a redundant bit pattern, known as a Pseudo Noise (PN) code for each bit to be transmitted. The receiver utilizes a copy of the same PN code as the transmitter (the system for synchronizing PN codes at connection time is described below in the Rendezvous Hopping section) and a matched filter to find signals on the same frequency which are transmitted using the same PN code. The filter will not respond to either random noise (except in very unlikely events) or signals transmitted using other PN codes.
Using the DSSS radio transceiver as a base band radio, the radio system implements a frequency hopping spread spectrum (FHSS) system in software by shifting frequencies between every transmitted DSSS packet according to an agree upon pseudo-random pattern.
All Nomadio's equipment operates at a data rate of 31.25kbps.

Theory of Operation

The React transmitter is the link master. The vehicle transceiver (separate certification) is the link slave.

At startup, the slave advertises its availability by transmitting a Service message. If the slave is bound to a master, the master’s Global Unique Identifier (GUID) is included in the Service message. During this time the master and slave are unsynchronized. Each device hops through the rendezvous channel set at its own rate and offset.

When the desired master (or any unbound master if the slave is unbound) detects the Service message, it replies with a Connect message containing various link parameters, including the master’s clock. The slave synchronizes its clock value to the master’s and synchronizes the start of its clock periods to the timing carried in the Connect message. From this point forward the devices hop on a synchronized basis 100 times per second.

All data transmission is initiated by the master. During most timeslots, the master sends a packet of command data to the slave, and the slave responds with an Ack message on the same channel. If the master is ready for new telemetry information it sends a request as part of its command packet. The slave then sends a data packet on the following timeslot, using the channel the request was received on.