Operational Description

Newtrax provides low power wireless mesh network for monitoring and control applications in harsh environments. The WN-100 is a system integrator targeted battery-powered programmable Wireless Node RTU (it's why we require a **modular approval**).

WN-100 nodes forming a mesh network communicate using a Frequency Hopping Spread Spectrum wireless communication protocol implemented with a TI MSP430F1612IPM microcontroller and a Xemics DP1203-C9153 multi-channel FSK transceiver in the 902-928MHz ISM band.

Hardware description:

There are three major hardware functionalities on the WN-100:

- the power supply unit
- the logic unit
- the radio transceiver unit

The power supply unit is, in fact, a buck converter circuitry. The input (VBatt) must be within the range of 3.0 to 5.5 VDC and is generally supply from battery (one lithium or 3 alkaline in series). The converter (U3) down converts the voltage to a regulated 3.0 VDC. The switching frequency used here is 1.5 MHz and the supplied current is between 0.03 mA and 72.00 mA depending of the WN-100 operating mode.

The logic unit is composed by a MCU (U1), a low power 32.768 kHz watch crystal (Y1) and 22 I/Os to connect the wireless node (WN-100) to the system integrator platform. The MCU monitors these I/Os and control the radio transceiver unit. The MCU clock used is 8 MHz and is provide by an on-chip DCO. The watch crystal is used as time reference and for DCO calibration.

The radio transceiver unit regroups the shielded radio transceiver (U2) and the RPSMA antenna connector (K1). The transceiver is a direct conversion (zero IF) half duplex transceiver and is claimed "902MHz ETSI compliant" by its manufacturer, Semtech. A 39.000 MHz crystal is used by a sigma-delta PLL to tune an on-chip VCO to the selected frequency (902-928 MHz). The transmitter can be configured to 1 of 4 available output powers i.e. 0, 5, 10 or 15 dBm. The antenna is AC coupled with the transceiver. The ground plane for the antenna is the bottom layer of the PCB, a 1.8 by 2.0 inch copper plane with minimal discontinuities. The two antennas we want to certify with our WN-100 are:

- Linx ANT-916-CW-RCL
- Linx ANT-ELE-S01-005 (3.0dBi)

The first one is a 1/4 wave dipole with 2.4 dBi gain. The second is an antenna whip dipole with 3.0 dBi gain.

Communication protocol description:

Communication is performed with Frequency Hopping Spread Spectrum over 64 channels of 200 kHz each (spreading over the entire band). The protocol is built on classic master/slave architecture. The master calculates the frequency used in a pseudo-random fashion for all messages exchanged between the master and the slave except the beacon. The pseudo random algorithm is based on an excellent random generator with a very long period of 2x10e18. The transceiver can emit at 0, 5, 10 or 15dBm and modulates in FSK.

Communication is possible only between a master and a slave.

Communication is broken down into frames:

- A Frame is a time interval of fixed duration, 0.687sec.
- Each frame is subdivided in a fixed number (50) of time slots of 13.7 msec
- During this period a master sends a Beacon, informs its slave of the activities to come (Allocation), listens for communication requests from slaves, performs the different allocated transmission and finally does its different maintenance and application tasks.

The beacon:

- Provides frequency and time synchronization as well as information on allocation messages, activity authorized and cluster identification in the current frame.
- The beacon message hops according to an endlessly repeating train (a sequence) of 40 frequencies determined randomly over a set of 64 frequencies based on the unique master address. As for the communication channel, the pseudo random algorithm is based on an excellent random generator with a very long period of 2x10e18.
- The beacon message is send each frame (every 0.687 sec) and the beacon message duration is less than 5 msec. Hence a frequency used once in the beacon train would emit less than 5 msec every 27.48 sec.