

Theory Of Operation/ Technical Description

The *LinkStar-STX3-PC104* operates on the *Globalstar™* LEO satellite network. LEO (Low Earth Orbit) means that there are a number of satellites in low earth orbit that constantly orbit the planet and can communicate with *Globalstar™* based devices that are within range of its current position. See Figure 1.

Since the satellite position is constantly changing, simplex devices on the ground will transmit (with no knowledge of any of the satellites locations); one or more satellites may receive the transmission. These satellites will then relay the message to the nearest satellite gateway as shown in Figure 2. Once received by the satellite gateway, the simplex message will be delivered to the simplex gateway where redundant messages are discarded and the data from the message is sent to *sci_Zone* and then *sci_Zone's* customers via the Internet.



Figure 1. A LEO Constellation of satellites

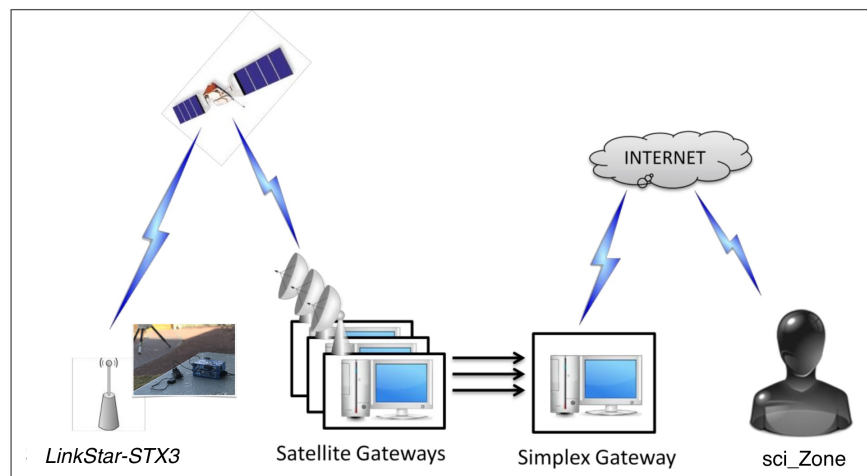


Figure 2. Simplex Messaging

Messages are composed of 1 or more 9-byte payloads. The *LinkStar-STX3-PC104* can only transmit 9-byte on-air messages, so user payloads greater than 9 bytes will require multiple on-air packets to be transmitted for each user payload. See Figure 3.

There are brief periods of time where there is no satellite in range of the simplex transmitters due to obstructions and/or satellite coverage geometry. Since a simplex device has no way of knowing if a transmitted message has been successfully received, the *LinkStar-STX3-PC104* device is

designed to send multiple (redundant) transmissions for each message being sent over the *Globalstar™* network. The default value for the number of redundant transmissions per message is three. This means that each message sent to the *LinkStar-STX3* will be transmitted three times. Each transmission will contain the exact same data payload. The redundant transmissions of each message will be sent on a randomized 5-minute nominal interval.

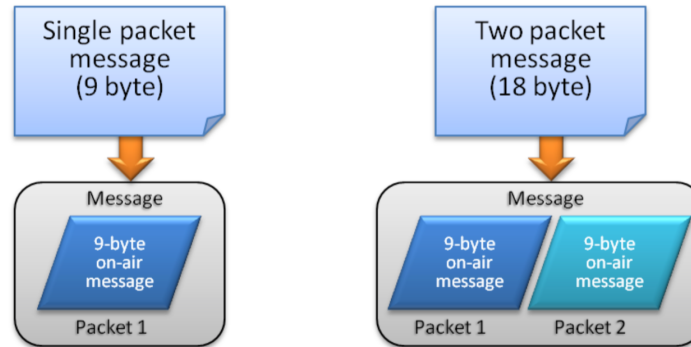


Figure 3. Messaging Packets.

The transmission sequence for a single-packet message using the default setting of three redundant transmissions is shown in Figure 4.

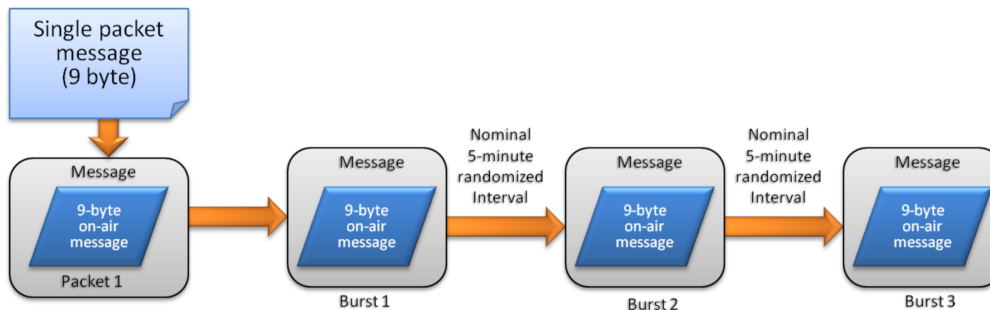


Figure 4. Redundant 9-byte message packet

The transmission sequence for a two-packet message using the default setting of 3 redundant transmissions is shown in Figure 5.

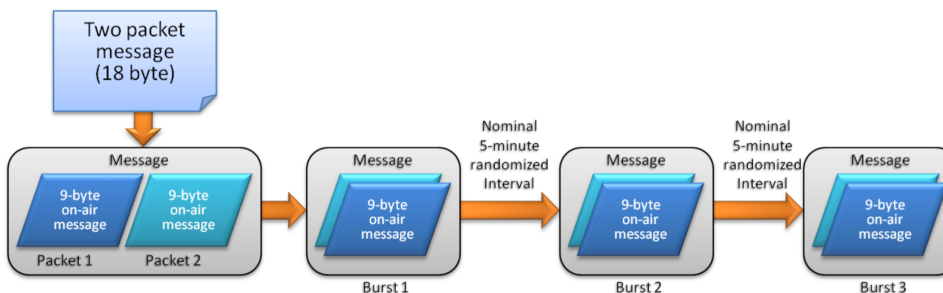


Figure 5. Redundant 18-byte message packet

For normal conditions where the transmitter has an open view of the sky, this will result in a better than 99% chance that the message will be received.

Block Diagram

The basic elements of a design utilizing the *LinkStar-STX3-PC104* simplex transmitter are shown in Figure 6 below.

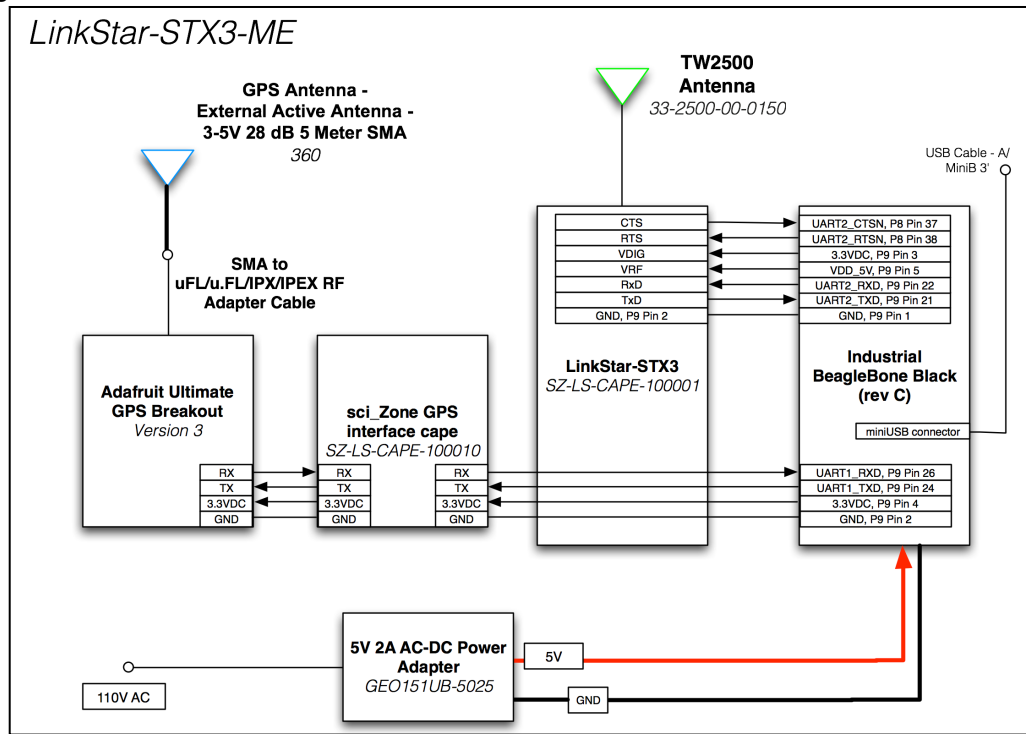


Figure 6. The *LinkStar-STX3-ME*

The *LinkStar-STX3* component of the *LinkStar-STX3-PC104* provides separate power supply inputs. The digital power supply input (VDIG) is a low power input that powers the digital portion of the *LinkStar-STX3* component. This provides the capability to leave the *LinkStar-STX3-PC104* in a low power consumption state when the transmitter RF section is idle. The RF power supply input is a high power input which is only required while the *LinkStar-STX3* is transmitting a data packet. Since the transmission duty cycle is very low, this supply may be turned off the majority of the time and only active during the transmission of a packet. Due to the random nature of the burst transmissions, and open collector output (PWR_EN) is provided by the *LinkStar-STX3-PC104* that can directly control the high current supply for VRF. This will ensure that the RF power supply is enabled for the minimum amount of time to complete each transmission. The *LinkStar-STX3* component monitors to determine when each burst has been completed without the need to query via the *BeagleBone Black*.

Transmission only occurs when the *GPS* connected via the *sci_Zone GPS Interface Cape* has verified a signal from the GPS satellite AND the location and altitude of the *LinkStar-STX3-PC104* can be verified. This allows the *LinkStar-STX3-PC104* to set the appropriate channel based on location and altitude, or block message transmission if the *LinkStar-STX3-PC104* is in a restricted area. If there is no GPS signal and if the location and altitude cannot be verified, the *LinkStar-STX3-PC104* shall not transmit a message. If the *GPS* is disconnected, inoperable, or damaged the *LinkStar-STX3-PC104* will be unable to transmit any messages.

Monitoring of the internal operation of *LinkStar-STX3-PC104* is via the *QuickSAT/VMS* web interface installed on the *LinkStar-STX3-PC104*. A USB cable provides the connection between the *BeagleBone Black* in the *LinkStar-STX3-PC104* and the user's PC (*Windows* or *MacOS*).