

# BITPACKING FORMAT FOR LYNX DATA

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## 1. MULTI-CHANNEL BITPACKING FORMAT

The LYNX front end has four channels, let us name these **0**, **1**, **2**, **3**. Per the hardware, channels **0** and **1** are tied to one antenna, and channels **2** and **3** are tied to another antenna. At a given sampling instant, all four channels generate one sample each. Each sample is 2 bit quantized (see LYNX\_SB for 1 bit quantization). So the LYNX generates 8 bit (1 B) of data at each sampling instant.

Packing of the LYNX binary file is somewhat involved. The first byte in a LYNX binary file corresponds to four samples from channel **2**. Let  $M_i^{t_k}$  and  $S_i^{t_k}$  denote the magnitude and sign bit for the  $i^{\text{th}}$  channel at sample time  $t_k$ . The first byte is arranged as follows (left-most bit is most-significant)

$$\left[ S_2^{t_k} S_2^{t_{k+1}} S_2^{t_{k+2}} S_2^{t_{k+3}} M_2^{t_k} M_2^{t_{k+1}} M_2^{t_{k+2}} M_2^{t_{k+3}} \right]$$

The first and fifth bits (from the left) form the earliest 2 bit sample, and the fourth and eighth bits (from the left) form the latest 2 bit sample.

Bytes 2, 3, and 4 in the LYNX binary file similarly correspond to channels **3**, **0**, and **1**, respectively. These 4 B of data represent four samples from each of the four channels. The pattern repeats for further samples.

In summary, the bits as they appear in the binary file are arranged as follows with the usual time-order (left-most bit is most-significant):

$$[S_2 S_2 S_2 S_2 M_2 M_2 M_2 M_2 \mid S_3 S_3 S_3 S_3 M_3 M_3 M_3 M_3 \mid S_0 S_0 S_0 S_0 M_0 M_0 M_0 M_0 \mid S_1 S_1 S_1 S_1 M_1 M_1 M_1 M_1]$$

It is important to note that the byte order may not remain the same when read in to a program using a function such as `fread` on a little-endian computer. Let  $B_i^{t_k \dots k+3}$  denote the 8 bit sequence of signs and magnitudes for channel  $i$  from sample time  $t_k$  through  $t_{k+3}$ . From above, the byte order in the binary file is given as (left-most byte is most-significant)

$$\left[ B_2^{t_k \dots k+3} \mid B_3^{t_k \dots k+3} \mid B_0^{t_k \dots k+3} \mid B_1^{t_k \dots k+3} \mid B_2^{t_{k+4} \dots k+7} \mid B_3^{t_{k+4} \dots k+7} \mid B_0^{t_{k+4} \dots k+7} \mid B_1^{t_{k+4} \dots k+7} \mid \dots \right]$$

However, when a 32 bit word is read from this file on a little-endian computer, the resulting 32 bit number will have the binary representation (left-most byte is most-significant)

$$\left[ B_1^{t_k \dots k+3} \mid B_0^{t_k \dots k+3} \mid B_3^{t_k \dots k+3} \mid B_2^{t_k \dots k+3} \right]$$

Thus, proper care must be taken in reading in the binary data. Note that endianness is irrelevant if you only read one byte at a time.

The sign and magnitude bits may be converted to sample values per the following table:

$S$	$M$	value
0	0	-1
0	1	-3
1	0	+1
1	1	+3

When read correctly, the first 16 samples of radiolynx.bin must be as follows.

Channel 0: -1, -3, -3, +1, -1, +1, +1, -1, +3, +3, -3, +1, +3, +1, -1, +1

Channel 1: -1, +1, -1, +3, +1, +1, -3, -1, +3, -1, -1, -3, +1, +1, +1, +3

Channel 2: -3, -1, -1, -3, -3, -1, -1, -1, +1, -3, +1, -3, -3, -1, +3, +1

Channel 3: -1, -1, -1, -1, +1, -3, -3, -3, +1, +3, -1, -3, +3, -1, -3, +1

## 2. CHANNEL DEFINITIONS FOR TEX-CUP

TABLE 1. Channel 0 specifications

Antenna	Starboard
Sampling frequency	10 MHz
Spectral inversion	False
Passband	1573.32 MHz – 1577.52 MHz
GPS L1 C/A IF	2.503 333 333 MHz
SBAS L1 IF	2.503 333 333 MHz
Galileo E1	2.503 333 333 MHz

TABLE 2. Channel 1 specifications

Antenna	Starboard
Sampling frequency	10 MHz
Spectral inversion	False
Passband	1225.5 MHz – 1229.7 MHz
GPS L2C IF	2.516 666 667 MHz

TABLE 3. Channel 2 specifications

Antenna	Port
Sampling frequency	10 MHz
Spectral inversion	False
Passband	1573.32 MHz – 1577.52 MHz
GPS L1 C/A IF	2.503 333 333 MHz
SBAS L1 IF	2.503 333 333 MHz
Galileo E1 IF	2.503 333 333 MHz

TABLE 4. Channel 3 specifications

Antenna	Port
Sampling frequency	10 MHz
Spectral inversion	False
Passband	1225.5 MHz – 1229.7 MHz
GPS L2C IF	2.516 666 667 MHz