Learning Objective 6.7: I can receive and decode ADS-B messages from aircraft transponders.

Show your work. Write a **Documentation** line at the end (**None** if you did not collaborate).

1. **Reading the chips.** A receiver samples a message at 2 MS/s, so each 0.5 µs half of a bit is one sample, or chip. After the preamble, the first 16 chips it reads, in pairs, are

   `10 01 01 01 10 10 01 10`

   (a) Write the 8 bits these chips carry, and the byte in hex.

   bits: ____

   hex: ____

   (b) The first 5 bits are the Downlink Format and the next 3 the capability. Find both, and say whether this is an ADS-B extended squitter.

   DF: ____

   CA: ____

   (c) A noise spike makes the sixth pair read `11`: both chips high. In words, explain what the receiver does with that bit, and why the parity check matters here.

2. **The message.** gr-adsb's ADS-B Demod passes on these bits, written in hex:

`8DAE07C220483234D71CA031ACD8`

The 28 hex digits are the 112 bits: DF and CA (8 bits), ICAO (24), ME (56), and PI (24).

(a) Split the message into its ICAO address, ME field, and parity, in hex.

ICAO: _____

PI: _____

(b) The type code is the first 5 bits of ME. Find it, and say which kind of message this is.

_____

(c) After the type code and 3 category bits, the callsign is eight 6-bit characters. In the Mode S character set, 1 to 26 are A to Z, 48 to 57 are the digits 0 to 9, and 32 is a space. The eight values are 18, 3, 8, 52, 53, 49, 50, 32. Write the callsign.

_____

3. **Receiver settings.** The L18 receiver runs at 2 MS/s.

   (a) How many samples does one whole message take, preamble included? Set the triggered time sink's number of points to show one whole message with about 10 µs to spare.

   samples: ____

   points: ____

   (b) A classmate sets the PlutoSDR and the gr-adsb blocks to 1 MS/s to save processing. Explain, in words, why the ADS-B Demod can no longer read the bits.

   (c) On a run, the 20 ms plot of power shows a noise floor near 0.02 and messages whose pulses reach between 0.1 and 0.8. The ADS-B Framer's threshold is 0.3. Choose a better threshold and say what the Aircraft Table would show with each setting.

4. **What noise does.** You run `L18-adsb-rx.grc` on the simulated recording and raise the Added noise slider a step at a time.

   (a) Describe what happens to the 20 ms plot, the Messages label, and the Aircraft Table as the noise rises.

   (b) Explain, in words, why the weakest aircraft drop out first, and what that means for a real receiver.

5. **Generating and locating.** Anyone with an SDR can receive ADS-B, and a flowgraph can generate it.

   (a) The L18 generator writes a file, and `L18-adsb-tx-pluto.grc` sends the same aircraft from a PlutoSDR at 915 MHz. Explain why the course never transmits them at 1090 MHz.

   (b) gr-adsb shows an aircraft's callsign as soon as one message arrives, but its position only after it holds an even and an odd position message from that aircraft. Explain, in words, why one position message is not enough, and what a receiver that used its own location as a reference instead would get wrong for an aircraft 500 nautical miles away.