# Date:

July 10th 2019

# Log Files:

Four files with more the 10 acoustic **transmissions**:

* /Users/Simba/Google\_Drive/repositories/acoustic\_tests/Transmitted\_data/10\_07\_2019\_13\_01\_13\_stats.mat
* /Users/Simba/Google\_Drive/repositories/acoustic\_tests/Transmitted\_data/10\_07\_2019\_12\_20\_44\_stats.mat
* /Users/Simba/Google\_Drive/repositories/acoustic\_tests/Transmitted\_data/10\_07\_2019\_11\_57\_55\_stats.mat
* /Users/Simba/Google\_Drive/repositories/acoustic\_tests/Transmitted\_data/10\_07\_2019\_10\_00\_27\_stats.mat

Two files of **received** captured data:

* /Users/yairmazal/Google\_Drive/repositories/acoustic\_tests/Raw\_captures/Eilat\_July\_19/10\_07\_2019/raw\_capture\_log\_10\_07\_2019\_\_12\_56\_54.mat
* /Users/yairmazal/Google\_Drive/repositories/acoustic\_tests/Raw\_captures/Eilat\_July\_19/10\_07\_2019/raw\_capture\_log\_10\_07\_2019\_\_12\_21\_36.mat

# Transmission Structure

## Messages

Transmissions included four concatenated MAVLink messages:

* scaled\_svs (ID 212, payload length- 19B) – Due to malfunction of the SVP these messages include only timestamps, a “Reserved” field (unclear use), and zeros.
* chamber\_status (ID 218, payload length- 10B)
* global\_position\_int (ID33, payload\_length- 44B)
* pinger\_data (ID234, payload\_length- 12B)

Message fields are written in Big Endian.

* **Payload data is reordered with respect to the xml as explained in:**

[**https://mavlink.io/en/guide/serialization.html**](https://mavlink.io/en/guide/serialization.html)

## Overhead

Out of the 117B of each transmission 12B (10.2%) may be considered structural bytes, in the sense that they belong to the MAVLink header, and do not change over the course of the mission.

Additionally, more bytes such as MSB’s and generally slowly varying data may possess small entropy.

|  |  |  |  |
| --- | --- | --- | --- |
| Bytes # | Context | Expected format | Expected entropy / correlation |
| 1-6 | scaled\_svs header | 254,19, seq, sys, comp,212 | 0,0,?,0,0,0 |
| 7-25 | scaled\_svs payload | time\_boot\_ms – uint32 – 4B (bytes 7-10)  Speed\_of\_Sound – float – 4B (bytes 11-14)  Depth – float – 4BB (bytes 15-18)  Temperature – uint16 – 2B (bytes 23-24)  Status – uint8 – 1B (byte 25)  Reserved – float – 4B (bytes 19-22) | Supposedly slowly varying data, physical grounds.  Due to physical limitations on range of data MSB should have small entropy |
| 26-27 | scaled\_svs CRC | ? | ? |
| 28-33 | chamber\_status header | 254,10, seq, sys, comp, 218 | 0,0,?,0,0,0 |
| 34-43 | chamber\_status payload | time\_boot\_ms – uint32 – 4B (bytes 34-37)  temperature – unit16 – 2B (bytes 38-39)  humidity – unit16 – 2B (bytes 40-41)  chamber\_num – uint8 – 1B (byte 42)  pressure – uint8 – 1B (byte 43) | Supposedly slowly varying data, physical grounds.  Due to physical limitations on range of data MSB should have small entropy |
| 44-45 | chamber\_status CRC | ? | ? |
| 46-51 | global\_position\_int header | 254,44, seq, sys, comp, 33 | 0, 0,?,0,0,0 |
| 52-95 | global\_position\_int payload | time\_boot\_ms – uint32 – 4B (bytes 52-55)  lat – uint32 – 4B (bytes 56-59)  lon – uint32 – 4B (bytes 60-63)  alt – float – 4B (bytes 64-67)  relative\_alt – float – 4B (bytes 68-71)  bottom\_clearnce – float – 4B (bytes 72-75)  depth – float – 4B (bytes 76-79)  vx – float – 4B (bytes 80-83)  vy – float – 4B (bytes 84-87)  vz – float – 4B (bytes 88-91)  hdg – float – 4B (bytes 92-95) | All data except velocity and heading is either slowly varying.  Some fields have MSB’s limited by physical limitations.  Data is expected to be correlated/ predictable. |
| 96-97 | global\_position\_int CRC | ? | ? |
| 98-103 | pinger\_data header | 254,12, seq, sys, comp, 234 | 0, 0,?,0,0,0 |
| 104-115 | pinger\_data payload | time\_boot\_ms – uint32 – 4B (bytes 104-107)  range – float – 4B (bytes 108-111)  azimuth – float – 4B (bytes 112-115) | Data is supposedly slowly varying. |
| 116-117 | pinger\_data CRC | ? | ? |

# Missions with Captured Data

## Mission from 12:20

### Stats:

* Number of transmissions: 45-7 = 38 (first seven transmissions occurred before recording at receiving side began).
* Number of receptions: 34
* Acquisition failed: 3

### Files:

* Transmitted: 10\_07\_2019\_12\_20\_44\_stats.mat
* Received: raw\_capture\_log\_10\_07\_2019\_\_12\_21\_36.mat

### Technical details:

* First **7** transmissions prior to capture start, and are discarded. First legit sequence ID 182.
* Color coding:
  + Green – fully successful recovery
  + Yellow - Partially successful recovery, sequence IDs based on structure **without** forcing it.
  + Orange - Partially successful recovery, sequence IDs based on structure **with** forcing it. Forcing includes a known mask, and running sequencr IDs.
  + Red – Acquisition failure/ nothing received/ nonsense.

| Transmission # | Transmission sequence IDs | Reception # | Reception sequence IDs | Successful recovery – standard decode | recovery discarding MAVLink CRC  [recovered / delta from standard] | **Structure bits** BER  [%] | **Overall** BER [%] |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 182, 183, 184, 185 | 1 | 182, 183 | 0 | 2 / 2 | 22.91% | 29.16% |
| 2 | 188, 189, 190, 191 | 2 | 188,189,190 | 2 | 3 / 1 | 2.08% | 1.06% |
| 3 | 194, 195, 196, 197 | 3 | 194,195,196,197 | 4 | 4 / 0 | 0 | 0 |
| 4 | 200, 201, 202, 203 | 4 | 200, 201, 202, 203 | 4 | 4 / 0 | 0 | 0 |
| 5 | 205, 206, 207, 208 | 5 | 205, 206, 207, 208 | 4 | 4 / 0 | 0 | 0 |
| 6 | 211, 212, 213, 214 | 6 | 212 | 0 | 0 / 0 | 40.62% | 41.02% |
| 7 | 216, 217, 218, 219 | -- | Acquisition failed | -- | -- | -- | -- |
| 8 | 222, 223, 224, 225 | -- | Nothing received | -- | -- | -- | -- |
| 9 | 228, 229, 230, 231 | 7 | 228, 229, 230, 231 | 4 | 4 / 0 | 0 | 0 |
| 10 | 233, 234, 235, 236 | 8 | 233, 234, 235 | 0 | 3 / 3 | 3.12% | 3.31% |
| 11 | 239, 240, 241, 242 | 9 | 239 | 0 | 1 / 1 | 43.75% | 48.29% |
| 12 | 245, 246, 247, 248 | 10 | 245, 246, 247, 248 | 3 | 4 / 1 | 0 | 2.02% |
| 13 | 251, 252, 253, 254 | 11 | 251 | 0 | 0 / 0 | 13.54% | 16.66% |
| 14 | 0, 1, 2, 3 | 12 | 0, 1, 2, 3 | 2 | 4 / 2 | 0 | 6.08% |
| 15 | 6, 7, 8, 9 | 13 | 6, 7, 8, 9 | 4 | 4 / 0 | 0 | 0 |
| 16 | 11, 12, 13, 14 | 14 | 11, 12, 13, 14 | 4 | 4 / 0 | 0 | 0 |
| 17 | 16, 17, 18, 19 | 15 | 16, 17, 18 | 1 | 3 / 2 | 5.20% | 5.55% |
| 18 | 22, 23, 24, 25 | 16 | 24 | 0 | 0 / 0 | 20.83% | 30.98% |
| 19 | 27, 28, 29, 30 | 17 | 27, 28, 29, 30 | 3 | 4 / 1 | 0 | 0 |
| 20 | 32, 33, 34, 35 | 18 | 32, 33, 34, 35 | 4 | 4 / 0 | 0 | 0 |
| 21 | 38, 39, 40, 41 | 19 | 38, 39, 40, 41 | 4 | 4 / 0 | 0 | 0 |
| 22 | 43, 44, 45, 46 | 20 | 43, 44, 45, 46 | 4 | 4 / 0 | 0 | 0 |
| 23 | 49, 50, 51, 52 | 21 | 49, 50, 51, 52 | 4 | 4 / 0 | 0 | 0 |
| 24 | 55, 56, 57, 58 | 22 | 55, 56, 57, 58 | 4 | 4 / 0 | 0 | 0 |
| 25 | 60, 61, 62, 63 | 23 | 60, 61, 62, 63 | 4 | 4 / 0 | 0 | 0 |
| 26 | 66, 67, 68, 69 | 24 | 66, 67, 68, 69 | 4 | 4 / 0 | 0 | 0 |
| 27 | 71, 72, 73, 74 | 25 | 71, 72, 73, 74 | 4 | 4 / 0 | 0 | 0 |
| 28 | 76, 77, 78, 79 | 26 | 76, 77, 78, 79 | 4 | 4 / 0 | 0 | 0 |
| 29 | 82, 83, 84, 85 | 27 | 82, 83, 84, 85 | 4 | 4 / 0 | 0 | 0 |
| 30 | 87, 88, 89, 90 | 28 | 87, 88, 89, 90 | 4 | 4 / 0 | 0 | 0 |
| 31 | 93, 94, 95, 96 | 29 | 93, 94, 95, 96 | 4 | 4 / 0 | 0 | 0 |
| 32 | 98, 99, 100, 101 | 30 | 98, 99, 100, 101 | 4 | 4 / 0 | 0 | 0 |
| 33 | 104, 105, 106, 107 | 31 | 104, 105, 106, 107 | 4 | 4 / 0 | 0 | 0 |
| 34 | 110, 111, 112, 113 | 32 | 110, 111, 112 | 1 | 4 / 3 | 0 | 12.17% |
| 35 | 115, 116, 117, 118 | 33 | 115, 116 | 0 | 1 / 1 | 27.08% | 32.05% |
| 36 | 121, 122, 123, 124 | 34 | Nonsense | 0 | 0 / 0 | 44.79% | 49.57% |
| 37 | 126, 127, 128, 129 | -- | Acquisition failed | -- | -- | -- | -- |
| Summary | | | | | | | |
| 37 transmissions | | 34 receptions | | 92/148 (62%) | 109/148 (73.6%) | 6.58% | 8.18% |

## Summary

* 37 transmissions, 34 receptions, 3 lost transmissions.
* 148 MAVLink messages transmitted.
* Recovered messages:
  + Standard decoding: 92/148 (62%).
  + Ignoring MAVLink CRC 109/148 (73%).
  + Forcing the structure does not seem to help.
    - When it forced and CRC is accounted for it will always failed (means we didn’t have any messages in which only the structural bytes got corrupted).
    - If CRC is discarded, we can always find 4 messages as we imposed the structure. However, what can we say about the fidelity of the data?
* Overall BER was 8.18% (postprocessing result).
* Structural bytes BER was 6.58%. Even though the two aren’t same, this value helps us as it can provide an estimate regarding BER in the channel in real time. Moreover, this estimate does not require a model for the channel.

## Mission from 12:56

### Stats:

* Number of transmissions: 38 (not all are relevant, alignment was done with timestamps and sequence IDs).
* Number of receptions: 12
* Acquisition failed: 9

### Files:

* Transmitted: 10\_07\_2019\_13\_01\_13\_stats.mat
* Received: raw\_capture\_log\_10\_07\_2019\_\_12\_56\_54.mat

### Technical details:

* Color coding:
  + Green – fully successful recovery
  + Yellow - Partially successful recovery, sequence IDs based on structure **without** forcing it.
  + Orange - Partially successful recovery, sequence IDs based on structure **with** forcing it. Forcing includes a known mask, and running sequencr IDs.
  + Red – Acquisition failure/ nothing received/ nonsense.

| Transmission # | Transmission sequence IDs | Reception # | Reception sequence IDs | Successful recovery – standard decode | recovery discarding MAVLink CRC  [recovered / delta from standard] | **Structure bits** BER  [%] | **Overall** BER [%] |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4 | 17, 18, 19, 20 | 1 |  |  |  |  |  |
| 5 | 23-26 |  |  |  |  |  |  |
| 6 | 28-31 | 2 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 12 | 63-66 |  |  |  |  |  |  |
| 13 | 69-72 | 3 |  |  |  |  |  |
| 14 | 74-77 |  |  |  |  |  |  |
| 15 | 80-83 | 4 |  |  |  |  |  |
| 16 | 86-89 |  |  |  |  |  |  |
| 17 | 92-95 | 5 |  |  |  |  |  |
| 18 | 98-101 |  |  |  |  |  |  |
| 19 | 104-107 |  |  |  |  |  |  |
| 20 | 110, 111, 112, 113 |  |  |  |  |  |  |
| 21 | 116, 117, 118, 119 | 6 |  |  |  |  |  |
| 22 | 122, 123, 124, 125 | 7 |  |  |  |  |  |
| 23 | 128-131 | 8 |  |  |  |  |  |
| 24 | 134-137 | 9 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 27 |  | 10 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 31 |  | 11 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 38 |  | 12 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Summary | | | | | | | |
| 35 transmissions | | 12 receptions | | 92/148 (62%) | 109/148 (73.6%) | 6.58% | 8.18% |