Strelka Ground Station RF Protocol

# Preface:

This document outlines the radio protocol implemented using the LoRa modulation technique for communications between the Strelka device and the ground station.

# Packet Structure:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Identifier** | **Protocol version** | **Sender unique ID** | **Receiver unique ID** | **Payload** | **CRC32** |
| **Data type** | uint8\_t | uint8\_t | uint32\_t | uint32\_t | uint8\_t | uint32\_t |
| **Length (bytes)** | 1 | 1 | 4 | 4 | variable | 4 |
| **Description** | Signify the packet type | Signify the protocol version | Hardware ID of transmitting device | Hardware ID of receiving device | Fields containing fixed length payloads | 32-bit CRC checksum |

The unique ID of the Strelka can be obtained from the first 32 bits of the hardware ID contained in the STM32’s ROM. The ground station must know this ID so that it can choose which nodes it is speaking to.

The unique ID of the ground station is always 0x00000000.

Protocol version is a number from 0 to 255. This protocol outline is version 0.

Contents

[Preface: 1](#_Toc156324424)

[Packet Structure: 1](#_Toc156324425)

[Payload Fields: 5](#_Toc156324426)

[BAT\_VOL\_REQ 5](#_Toc156324427)

[BAT\_VOL\_RES 5](#_Toc156324428)

[CONTINUITY\_REQ 5](#_Toc156324429)

[CONTINUITY \_RES 5](#_Toc156324430)

[FIRE\_DROGUE\_REQ 5](#_Toc156324431)

[FIRE\_DROGUE\_RES 6](#_Toc156324432)

[FIRE\_MAIN\_REQ 6](#_Toc156324433)

[FIRE\_MAIN\_RES 6](#_Toc156324434)

[GPS1\_STATE\_REQ 6](#_Toc156324435)

[GPS1\_STATE\_RES 6](#_Toc156324436)

[GPS2\_STATE\_REQ 7](#_Toc156324437)

[GPS2\_STATE\_RES 7](#_Toc156324438)

[ACCEL1\_STATE\_REQ 7](#_Toc156324439)

[ACCEL1\_STATE\_RES 7](#_Toc156324440)

[ACCEL2\_STATE\_REQ 8](#_Toc156324441)

[ACCEL2\_STATE\_RES 8](#_Toc156324442)

[GYRO1\_STATE\_REQ 8](#_Toc156324443)

[GYRO1\_STATE\_RES 8](#_Toc156324444)

[GYRO2\_STATE\_REQ 9](#_Toc156324445)

[GYRO2\_STATE\_RES 9](#_Toc156324446)

[MAG1\_STATE\_REQ 9](#_Toc156324447)

[MAG1\_STATE\_RES 9](#_Toc156324448)

[MAG2\_STATE\_REQ 10](#_Toc156324449)

[MAG2\_STATE\_RES 10](#_Toc156324450)

[BARO1\_STATE\_REQ 10](#_Toc156324451)

[BARO1\_STATE\_RES 10](#_Toc156324452)

[BARO2\_STATE\_REQ 10](#_Toc156324453)

[BARO2\_STATE\_RES 11](#_Toc156324454)

[FLASH\_MEMORY\_STATE\_REQ 11](#_Toc156324455)

[FLASH\_MEMORY\_STATE\_RES 11](#_Toc156324456)

[FLASH\_MEMORY\_CONFIG\_SET 11](#_Toc156324457)

[GPS\_TRACKING\_CONFIG\_REQ 11](#_Toc156324458)

[GPS\_TRACKING\_CONFIG\_RES 12](#_Toc156324459)

[GPS\_TRACKING\_CONFIG\_SET 12](#_Toc156324460)

[GPS\_TRACKING\_PACKET 12](#_Toc156324461)

[STREAM\_PACKET\_TYPE\_0 13](#_Toc156324462)

# Payload Fields:

## BAT\_VOL\_REQ

Request battery voltage.

Identifier: 0xXX

Payload:

*No payload fields.*

## BAT\_VOL\_RES

Battery voltage response.

Identifier: 0xXX

Payload:

|  |  |
| --- | --- |
| Name | Battery voltage |
| Value | - |
| Data type | float32\_t |
| Length (bytes) | 4 |

## CONTINUITY\_REQ

Request continuity.

Identifier: 0xXX

Payload:

*No payload fields.*

## CONTINUITY \_RES

Continuity response.

Payload:

|  |  |  |
| --- | --- | --- |
| Name | Drogue e-match state | Main e-match state |
| Value | *ematchState* | *ematchState* |
| Data type | uint8\_t | uint8\_t |
| Length (bytes) | 1 | 1 |

*ematchState*

|  |  |
| --- | --- |
| Value | Result |
| 0 | *OPEN\_CIRCUIT* |
| 1 | *SHORT\_CIRCUIT* |
| 2 | *GOOD* |
| 3 | *EMATCH\_ERROR* |

## FIRE\_DROGUE\_REQ

Fire drogue channel request.

Identifier: 0xXX

Payload:

*No payload fields.*

## FIRE\_DROGUE\_RES

Fire drogue channel response.

Identifier: 0xXX

Payload:

|  |  |
| --- | --- |
| Name | Fire drogue result |
| Value | 0 – success, 1 - error |
| Data type | uint8\_t |
| Length (bytes) | 1 |

## FIRE\_MAIN\_REQ

Fire main channel request.

Identifier: 0xXX

Payload:

*No payload fields.*

## FIRE\_MAIN\_RES

Fire main channel response.

Identifier: 0xXX

Payload:

|  |  |
| --- | --- |
| Name | Fire main result |
| Value | 0 – success, 1 - error |
| Data type | uint8\_t |
| Length (bytes) | 1 |

## GPS1\_STATE\_REQ

Request GPS 1 state.

## GPS1\_STATE\_RES

GPS 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | GPS good | Latitude | Longitude | Altitude | Satellites tracked |
| Value | 0 – error, 1 - good | *Decimal degrees* | *Decimal degrees* | *Units of ‘m’* | - |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t | uint8\_t |
| Length (bytes) | 1 | 4 | 4 | 4 | 1 |

## GPS2\_STATE\_REQ

Request GPS 2 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## GPS2\_STATE\_RES

GPS 2 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | GPS good | Latitude | Longitude | Altitude | Satellites tracked |
| Value | 0 – error, 1 - good | *Decimal degrees* | *Decimal degrees* | *Units of ‘m’* | - |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t | uint8\_t |
| Length (bytes) | 1 | 4 | 4 | 4 | 1 |

## ACCEL1\_STATE\_REQ

Request accelerometer 1 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## ACCEL1\_STATE\_RES

Accelerometer 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | acc good | accX | accY | accZ |
| Value | 0 – error, 1 - good | *Units of ‘g’* | *Units of ‘g’* | U*nits of ‘g’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## ACCEL2\_STATE\_REQ

Request accelerometer 2 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## ACCEL2\_STATE\_RES

Accelerometer 2 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | acc good | accX | accY | accZ |
| Value | 0 – error, 1 - good | *Units of ‘g’* | *Units of ‘g’* | U*nits of ‘g’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## GYRO1\_STATE\_REQ

Request gyroscope 1 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## GYRO1\_STATE\_RES

Gyroscope 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | gyro good | gyroX | gyroY | gyroZ |
| Value | 0 – error, 1 - good | *Units of ‘deg/s’* | *Units of ‘deg/s’* | *Units of ‘deg/s’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## GYRO2\_STATE\_REQ

Request gyroscope 2 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## GYRO2\_STATE\_RES

Gyroscope 2 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | gyro good | gyroX | gyroY | gyroZ |
| Value | 0 – error, 1 - good | *Units of ‘deg/s’* | *Units of ‘deg/s’* | *Units of ‘deg/s’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## MAG1\_STATE\_REQ

Request magnetometer 1 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## MAG1\_STATE\_RES

Magnetometer 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | mag good | magX | magY | magZ |
| Value | 0 – error, 1 - good | *Units of ‘uT’* | *Units of ‘uT’* | *Units of ‘uT’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## MAG2\_STATE\_REQ

Request magnetometer 2 state.

## MAG2\_STATE\_RES

Magnetometer 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | mag good | magX | magY | magZ |
| Value | 0 – error, 1 - good | *Units of ‘uT’* | *Units of ‘uT’* | *Units of ‘uT’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## BARO1\_STATE\_REQ

Request barometer 1 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## BARO1\_STATE\_RES

Barometer 1 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | baro good | Pressure | Temperature | Altitude |
| Value | 0 – error, 1 - good | *Units of ‘Pa’* | *Units of ‘deg C’* | *Units of ‘m’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## BARO2\_STATE\_REQ

Request barometer 2 state.

Identifier: 0xXX

Payload:

*No payload fields.*

## BARO2\_STATE\_RES

Barometer 2 state response.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | baro good | Pressure | Temperature | Altitude |
| Value | 0 – error, 1 - good | *Units of ‘Pa’* | *Units of ‘deg C’* | *Units of ‘m’* |
| Data type | uint8\_t | float32\_t | float32\_t | float32\_t |
| Length (bytes) | 1 | 4 | 4 | 4 |

## FLASH\_MEMORY\_STATE\_REQ

Request flash memory state.

Identifier: 0xXX

Payload:

*No payload fields.*

## FLASH\_MEMORY\_STATE\_RES

Flash memory state response.

Identifier: 0xXX

Payload:

|  |  |  |
| --- | --- | --- |
| Name | flash good | Write speed |
| Value | 0 – error, 1 - good | *Units of ‘Hz’* |
| Data type | uint8\_t | float32\_t |
| Length (bytes) | 1 | 4 |

## FLASH\_MEMORY\_CONFIG\_SET

## GPS\_TRACKING\_CONFIG\_REQ

Request GPS tracking configuration.

Identifier: 0xXX

Payload:

*No payload fields.*

## GPS\_TRACKING\_CONFIG\_RES

GPS tracking configuration response.

Identifier: 0xXX

Payload:

|  |  |  |
| --- | --- | --- |
| Name | gps good | Chirp frequency |
| Value | 0 – error, 1 - good | *Units of ‘Hz’* |
| Data type | uint8\_t | float32\_t |
| Length (bytes) | 1 | 4 |

## GPS\_TRACKING\_CONFIG\_SET

Set GPS tracking configuration.

Identifier: 0xXX

Payload:

|  |  |
| --- | --- |
| Name | Chirp frequency |
| Value | *Units of ‘Hz’* |
| Data type | float32\_t |
| Length (bytes) | 4 |

## GPS\_TRACKING\_PACKET

GPS tracking data packet.

Identifier: 0xXX

Payload:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Latitude | Longitude | Altitude | Satellites tracked |
| Value | *Decimal degrees* | *Decimal degrees* | *Units of ‘m’* | - |
| Data type | float32\_t | float32\_t | float32\_t | uint8\_t |
| Length (bytes) | 4 | 4 | 4 | 1 |

STREAM\_PKT\_CONFIG

Configuration of data streaming

Identifier: 0xXX

Payload:

*<Start of payload>*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Packet type 0 enable | Packet type 0 stream frequency | Packet type 1 enable | Packet type 1 stream frequency |
| Value | *1 or 0* | *Units of Hz* | *1 or 0* | *Units of Hz* |
| Data type | uint8\_t | float32\_t | uint8\_t | float32\_t |
| Length (bytes) | 1 | 4 | 1 | 4 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Packet type 2 enable | Packet type 2 stream frequency | Packet type 3 enable | Packet type 3 stream frequency | Packet type 4 stream frequency | Packet type 4 stream frequency |
| *1 or 0* | *Units of Hz* | *1 or 0* | *Units of Hz* | *Units of Hz* | *Units of Hz* |
| uint8\_t | float32\_t | uint8\_t | float32\_t | float32\_t | float32\_t |
| 1 | 4 | 1 | 4 | 4 | 4 |
| Packet type 5 enable | Packet type 5 stream frequency | Packet type 6 enable | Packet type 6 stream frequency | Packet type 7 stream frequency | Packet type 7 stream frequency |
| *1 or 0* | *Units of Hz* | *1 or 0* | *Units of Hz* | *Units of Hz* | *Units of Hz* |
| uint8\_t | float32\_t | uint8\_t | float32\_t | float32\_t | float32\_t |
| 1 | 4 | 1 | 4 | 4 | 4 |

*<End of payload>*

## STREAM\_PACKET\_TYPE\_0

Data streaming packet.

Identifier: 0xXX

Payload:

*<Start of payload>*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | System time | Latitude | Longitude | GPS Altitude | Satellites tracked |
| Value | *Milliseconds since boot* | *Decimal degrees* | *Decimal degrees* | *Units of ‘m’* | - |
| Data type | uint32\_t | float32\_t | float32\_t | float32\_t | uint8\_t |
| Length (bytes) | 4 | 4 | 4 | 4 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Acceleration X | Acceleration Y | Acceleration Z | Velocity X | Velocity Y | Velocity Z |
| *Units of ‘g’* | *Units of ‘g’* | *Units of ‘g’* | *Units of m/s* | *Units of m/s* | *Units of m/s* |
| float32\_t | float32\_t | float32\_t | float32\_t | float32\_t | float32\_t |
| 4 | 4 | 4 | 4 | 4 | 4 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Barometer Altitude | Angular velocity X | Angular velocity Y | Angular velocity Z | Quaternion 1 | Quaternion 2 |
| *Units of m* | *Units of rad/s* | *Units of rad/s* | *Units of rad/s* | *q1* | *q2* |
| float32\_t | float32\_t | float32\_t | float32\_t | float32\_t | float32\_t |
| 4 | 4 | 4 | 4 | 4 | 4 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Quaternion 3 | Quaternion 4 | Battery voltage | Flight State |  |  |
| *q3* | *q4* | *Units of V* | *Enum defined below* |  |  |
| float32\_t | float32\_t | float32\_t | uint8\_t |  |  |
| 4 | 4 | 4 | 1 |  |  |

*<End of payload>*

***Flight State:***

|  |  |
| --- | --- |
| State description | Value |
| Idle on pad | 0 |
| Launched | 1 |
| Burnout | 2 |
| Apogee | 3 |
| Main chute deploy | 4 |
| Landed | 5 |

## STREAM\_PACKET\_TYPE\_1

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_2

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_3

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_4

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_5

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_6

Data streaming packet.

Identifier: 0xXX

Payload:

## STREAM\_PACKET\_TYPE\_7

Data streaming packet.

Identifier: 0xXX

Payload: