SMARTBALL v1.0

DATAGRAM SPECIFICATIONS V0.3

last update – 02/10/2019

INTRODUCTION

Smartballs send and receive specific UDP Datagrams, this choice has been made over OSC, Artnet or other kind of existing protocol to save bandwidth as much as possible. This protocol is still in active development and will likely to evolve during the alpha and beta test phase.

This document is compatible with the following release:

- hardware v1.x : https://github.com/siteswapjuggler/smartball-hardware
- firmware v0.31 beta 1 : https://github.com/siteswapjuggler/smartball-firmware/tree/v0.31-beta.1
- externals v0.3 beta 1 : https://github.com/siteswapjuggler/smartball-externals/tree/v0.3-beta.1

VERSION NOTE

Structure change:

- Packet format updated to take advantage of UDP packet informations

Command updates:

- Stream now has a flag to describe the data content of the stream
- IMU flag has new bits for Fusion algorithm feedback

New commands:

- Set config settings
- Save config settings

Removed commands:

- DeepSleep

SUMMARY

DATAGRAM STRUCTURE

UPSTREAM PACKETS .....

Upstream datagram are made as described below:

- Command 1 byte
- Data (optional)

CMD – Command

Commands byte is unique to every message.

DATA (optional)

Data depends on each command and is optional. See command description below for further information.

DOWNSTREAM PACKETS.....

Downstream datagram are made as described below:

- Id number 2 bytes
- Serial number 2 bytes
- Command 1 byte
- Data depending on length

ID – ID Number

Two bytes uint16 serial number.

SN – Serial Number

Two bytes uint16 serial number.

CMD – Command

Commands byte is unique to every message.

DATA (optional)

Data depends on each command and is optional. See command description below for further information.

UPSTREAM COMMANDS

PING

Ping command trigger a pong answer.

CMD
0x01

REBOOT

Reboot command trigger the reboot of the ball (*does not work on first boot after firmware update*).

CMD
0x02

FACTORY SETTINGS

Factory settings command sets new factory settings value. Factory settings includes a serial number, a device flag and an adc scaling factor.

CMD	DATA
0x10	5 bytes

DATA STRUCTURE:

- serial number: uint16 value from 0 to 65535
- device flag: 16 bits flag describing available devices
- adc scaling factor: unsigned Q15.1 value from 0.0 to 6553.5

SN_MSB	SN_LSB	FLAG_MSB	FLAG_LSB	SCL_MSB	SCL_LSB

DEVICE FLAG STRUCTURE:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-	-	-	-	BUZ	MOT	IRL	IMU	RGB

SAVE FACTORY SETTINGS

Save factory command trigger EEPROM writing of the factory settings.

CMD
0x11

GENERAL SETTINGS

General settings command sets new general settings value. General settings includes the id number.

CMD	DATA
0x12	1 bytes

DATA STRUCTURE:

- id number: uint8 value from 0 to 255

ID

SAVE GENERAL SETTINGS

Save general settings command trigger EEPROM writing of the general settings.

CMD
0x13

COLOUR (FOREGROUND)

Colour command change current colours according to the number of RGB values sent. To be clearer data length will implicitly tell the ball which colour mode to apply, see options below:

- 3 values: 1 colour mode
- 6 values: 2 colours mode (1 per hemisphere)
- 9 values: 3 colours mode (3 pairs of opposite leds)
- 18 values: 6 colours mode (6 individual leds)

CMD	DATA
0x20	variable

DATA STRUCTURE:

- Colour 1 Red value : uint8 value from 0 to 255
- Colour 1 Green value : uint8 value from 0 to 255
- Colour 1 Blue value : uint8 value from 0 to 255
- (optional) colour 2/3/4/5/6 RGB values

R1	G1	B1	(R2)	(G2)	(B2)	and so on…

COLOUR (BACKGROUND)

Background colour command change the current background colours according to the number of RGB values sent. Background colour is the second colour of the stroboscopic effect. Data structures and options are the as the foreground colour command.

CMD	DATA
0x22	variable

STREAM

Stream command act almost the same way as colour command apart that you can address multiple balls at one time. Doing this you need to add one extra data byte to precise the number of colours sent for each ball. Balls will change colours according to its id numbers modulo the number of channels sent in the stream.

CMD	DATA
0x21	variable

DATA STRUCTURE:

- Flag : describe the data sent in the stream
- Offset : id offset of the stream
- Series of data 1
- (optional) Series of data 2, etc…

STREAM FLAG STRUCTURE:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LOOP	-	-	-	-	-	MOT	IRL	STB	MST	N_COL2			N_COL1		

DATA STRUCTURE EXAMPLE:

Even serial number balls goes red & blue while odd serial number balls goes black & white:

FLAG	OFFSET	RGB1.1	RGB1.2	RGB2.1	RGB 2.2
0x00 0x02	0x00	0xFF 0x00 0x00	0x00 0x00 0xFF	0xFF 0xFF 0xFF	0x00 0x00 0x00

This command has been design for the first 30 balls during the alpha tests. Future firmware will use customisable id values instead of serial numbers.

IMU SETTINGS

IMU settings command will change current IMU feedback settings.

CMD	FLAG
0x30	variable

DATA STRUCTURE:

- IMU flag: 8 bits flag describing available feedbacks.

DEVICE FLAG STRUCTURE:

7	6	5	4	3	2	1	0
-	-	-	-	TMP	MAG	GYR	ACC

ACCELEROMETER RANGE

Accelerometer range command will change current accelerometer full-scale range settings.

CMD	PAR
0x32	variable

DATA STRUCTURE:

- Full-scale parameter: 8 bits parameter.

PARAMETER VALUES:

- 0x00: -2g / +2g.
- 0x01: -4g / +4g.
- 0x02: -8g / +8g.
- 0x03: -16g / +16g (default).

GYROSCOPE RANGE

Gyroscope range command will change current gyroscope full-scale range settings.

CMD	PAR
0x33	variable

DATA STRUCTURE:

- Full-scale parameter: 8 bits parameter.

PARAMETER VALUES:

- 0x00: -250dps / +250dps.
- 0x01: -500dps / +500dps.
- 0x02: -1000dps / +1000dps.
- 0x03: -2000dps / +2000dps (default).

SAVE IMU SETTINGS

Save IMU command trigger EEPROM writing of the IMU settings.

CMD
0x031

INFRARED

Infrared command change the current value of the infrared channel PWM.

CMD	DATA
0x40	2 bytes

DATA STRUCTURE:

- value : uint16 value from 0 to 1023

VAL_MSB	VAL_LSB

MOTOR

Motor command change the current value of the motor channel PWM.

CMD	DATA
0x50	2 bytes

DATA STRUCTURE:

- value : uint16 value from 0 to 1023

MSB	LSB

STROBE

Strobe command change the current interval of the inner stroboscopic effect. Using this effect switch between foreground and background colour every *n* milliseconds.

CMD	DATA
0x60	2 bytes

DATA STRUCTURE:

- interval (ms) : Q14.2value from 0. to 500.

MASTER

Master command is a global dimmer for every colour channel. The dimmer value does not affect the colours memory it only change the amount of colours forwarded to the RGB Leds.

CMD	DATA
0x70	2 bytes

DATA STRUCTURE:

- dimmer : Q14.2 value from 0. to 100.

DOWNSTREAM COMMANDS

PONG

Pong is answering the ping command.

ID		SN		CMD
MSB	LSB	MSB	LSB	0x01

BATTERY VALUE

Battery feedback transmit V_{share} voltage value stored as $1/100^{th}$ Volts per LSB.

ID		SN		CMD	DATA
MSB	LSB	MSB	LSB	0x00	2 bytes

DATA STRUCTURE:

- value: Q14.2 value from 0V to 5.2V, this value is adjusted by the adc scaling factory setting.

VAL_MSB	VAL_LSB

IMU VALUES

IMU feedback transmit IMU values according to the current IMU flag.

ID		SN		CMD	DATA
MSB	LSB	MSB	LSB	0x30	variable

DATA STRUCTURE:

- IMU flag: 8 bits flag describing available feedbacks (see IMU settings for description)
- (optional) accelerometer XYZ : 6 bytes containing the XYZ Q14.2 values of the accelerometer.
- (optional) gyroscope XYZ : 6 bytes containing the XYZ Q14.2 values of the gyroscope.
- (optional) magnetometer XYZ : 6 bytes containing the XYZ Q14.2 values of the magnetometer.
- (optional) temperature : Q14.2 temperature value.

DATA STRUCTURE EXAMPLE:

Optional data stacks after directly after the flag depending on enable bits order.

FLAG	GYR_XYZ	TEMP
0x0A	6 bytes	2 bytes

DOCUMENT VERSION	
v1.0	Initial release
v1.1	Loop bit correction in stream flag