LVX2

Specifications

v1.0 2023.06

LIVOX

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This document describes the specifications of LVX2 format v1.0. The LVX2 file is a point cloud file format developed by Livox Tech, based on the company's LiDAR sensors. This file format allows users to play the point cloud file at a base frequency of 20 Hz. At the same time, users can also acquire point data from a single device from this file for more complex algorithm development.

LVX2 Format Definition

The format contains binary data consisting of public header block, private header block, device info block, and point cloud data block.

PUBLIC HEADER BLOCK
PRIVATE HEADER BLOCK
DEVICE INFO BLOCK
POINT DATA BLOCK

All data are in little-endian format. The header block consists of file signature, version information, and a magic code. The length of the device info block is variable, capable of accommodating any number of devices. The point cloud data block has point cloud data organized by package, and these packages are organized by frames in each file.

Data Types

The following data types are used in the LVX2 format.

- char (1 byte)
- unsigned char (1 byte)
- short (2 bytes)
- unsigned short (2 bytes)
- int (4 bytes)
- unsigned int (4 bytes)
- long long (8 bytes)
- unsigned long long (8 bytes)
- float (4 bytes IEEE floating point format)
- double (8 bytes IEEE floating point format)

Public Header Block

Item	Format	Size
File Signature (“livox_tech”)	char[16]	16 bytes
Version-A	char	1 bytes
Version-B	char	1 bytes
Version-C	char	1 bytes
Version-D	char	1 bytes
Magic Code	unsigned int	4 bytes

File Signature: The file signature must contain “livox_tech” as it is required by the LVX2 specification. These characters can be checked by Livox Viewer as an initial determination of file type. Note that the first 10 bytes should be “livox_tech”, and the last 6 bytes should be zero filled.

Version: Version a is 2. Version b is 0. Version c is 0. Version d is 0.

Magic Code: This field should be a value of 0xAC0EA767. Livox Viewer will not identify a LVX2 file with an incorrect Magic Code.

Private Header Block

Item	Format	Size
Frame Duration	unsigned int	4 bytes
Device Count	unsigned char	1 byte

Frame Duration: The duration of one frame. The unit of duration is millisecond (ms). Note: This field is only used to inform the user of the frame duration of the current file. In the 2.0.0.0 version of the LVX2 file, this field is 50 and cannot be changed.

Device Count: The count of device info block is variable to suit several devices. This field should be a value of the count of devices.

Devices Info Block

Item	Format	Size
Device Info 0	struct	63 bytes
.....		
Device Info N	struct	63 bytes

⚠ • N = Device Count - 1. Device Count is inside Private Header Block.

Device Info: This is a field that provides information of each device. This field is defined as:

Item	Format	Size	Description
LiDAR SN Code	char[16]	16 bytes	LiDAR broadcast code
Hub SN Code	char[16]	16 bytes	Hub broadcast code. Note that an empty hub SN means there is no hub connecting this LiDAR.
LiDAR_ID	unsigned int	4 byte	LiDAR ID used to identify the device.
LiDAR_Type	unsigned char	1 byte	Reserved field
Device_Type	unsigned char	1 byte	Device Type: 9: Mid-360 10: HAP

Extrinsic Enable	unsigned char	1 byte	0: Extrinsic parameters disabled. Cloud points should be computed without extrinsic parameters. 1: Extrinsic parameters enabled. Cloud points should be computed with extrinsic parameters.
Roll	float	4 bytes	Extrinsic parameters: Roll Angle, Unit: degree
Pitch	float	4 bytes	Extrinsic parameters: Pitch Angle, Unit: degree
Yaw	float	4 bytes	Extrinsic parameters: Yaw Angle, Unit: degree
X	float	4 bytes	Extrinsic parameters: X Translation, Unit: m
Y	float	4 bytes	Extrinsic parameters: Y Translation, Unit: m
Z	float	4 bytes	Extrinsic parameters: Z Translation, Unit: m

⚠ • Users can use LiDAR ID to extract point cloud data of each device from a LVX2 file.

Point Cloud Data Block

Data from the Point Cloud Data Block are composed of frames, and each frame is composed of packages.

Item	Format	Size
Frame 0	struct	N bytes (N = Next Offset – Current Offset)
Frame 1	struct	N bytes
.....		
Frame N	struct	N bytes

Frame is defined as:

Item	Format	Size
Frame Header	struct	24 bytes
Package 0	struct	Depends on current package header.
Package 1	struct	Depends on current package header.
.....		
Package N	struct	Depends on current package header.

Frame Header is defined as:

Item	Format	Size	Description
Current Offset	long long	8 bytes	Absolute offset of the current frame in this file.
Next Offset	long long	8 bytes	Absolute offset of next frame in this file.
Frame Index	long long	8 bytes	Current Frame Index.

Package is defined as SDK protocol normal data:

Item	Format	Size	Description
Version	unsigned char	1 byte	Package protocol version, 0 for the current version
LiDAR ID	unsigned int	4 byte	LiDAR ID used to identify the device.
LiDAR_Type	unsigned char	1 byte	Reserved field
Timestamp Type	unsigned char	1 byte	Refer to Livox SDK2 Communication Protocol for more details. 0x00: if there is no time synchronization, use LiDAR system time. 0x01: gPTP/PTP time synchronization 0x02: GPS time synchronization
Timestamp	unsiged char[8]	8 bytes	Nanosecond of the point package time depends on Timestamp Type.
Udp Counter	unsigned short	2 bytes	The udp counter index inside current udp packet data from Ethernet.
Data Type	unsigned char	1 byte	Point Cloud Coordinate Format: 1: Point Cloud Data1 2: Point Cloud Data2
Length	unsigned int	4 byte	The length of the point cloud data of this package (excluding the package header part and starting length calculation from Point 0 to Point N). For Data Type 0x01, size per point is 14 bytes. For Data Type 0x02, size per point is 8 bytes. Therefore the point count inside this package is Length divided by size per point.
Frame_Counter	unsiged char	1 bytes	Reserved field
Reserve	unsiged char[4]	4 bytes	Reserved bytes
Point 0	struct	depends	Point information, depending on Data Type
Point 1	struct	depends	Point information, depending on Data Type
.....			
Point N	struct	depends	Point information, depending on Data Type

Point is defined as follows:

Data type 0x01 (14 bytes per point)

Item	Format	Size	Description
x	int	4 bytes	X-axis position, unit: mm
y	int	4 bytes	Y-axis position, unit: mm
z	int	4 bytes	Z-axis position, unit: mm
reflectivity	unsigned char	1 byte	Reflectivity
tag	unsigned char	1 byte	Refer to Livox SDK2 Communication Protocol for more details.

Data type 0x02 (8 bytes per point)

Item	Format	Size	Description
x	short	2 bytes	X-axis position, unit: cm
y	short	2 bytes	Y-axis position, unit: cm
z	short	2 bytes	Z-axis position, unit: cm
reflectivity	unsigned char	1 byte	Reflectivity
tag	unsigned char	1 byte	Refer to Livox SDK2 Communication Protocol for more details.

⚠
- The point count inside one package is based on the package length and the size per point. The size per point is based on the point data type (such as Data type 0x01 with 14 bytes per point and Data type 0x02 with 8 bytes per point). For HAP and Mid-360 LiDAR, the point count of each package is 96.
- For data type 0x01, the unit of the x, y, z is mm. For data type 0x02, the unit of the x, y, z is cm.
- For more details about Livox SDK2 Communication Protocol, go to https://github.com/Livox-SDK/Livox-SDK2.