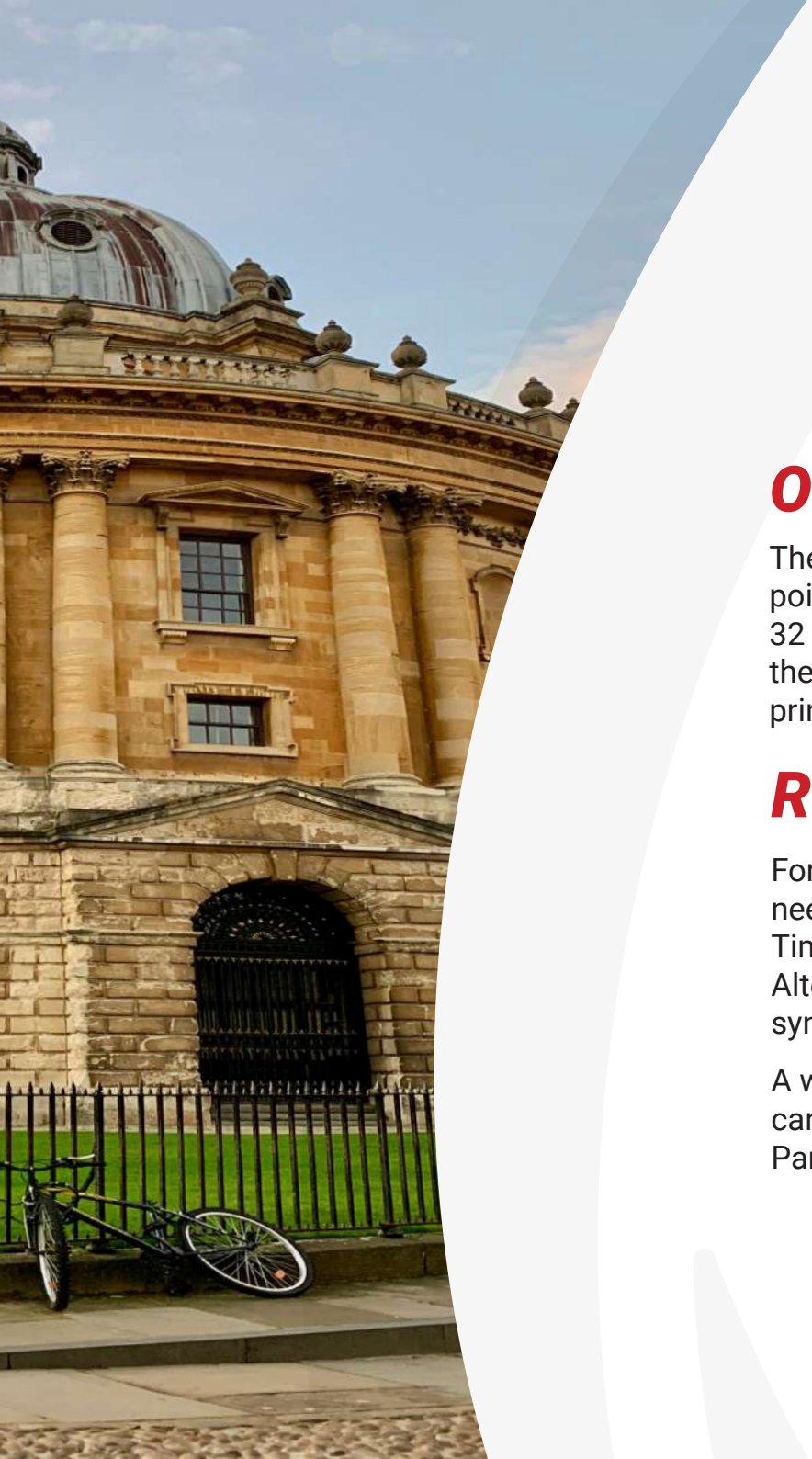


Hesai LiDAR

Hardware integration guide

OXTS Survey





Overview

The Hesai XT is a new all-purpose LiDAR from Hesai that can be used for pointcloud creation in surveying applications or autonomous vehicle aiding. With 32 lasers it is a mid-range LiDAR that boasts high accuracy. This guide will use the integration of a Hesai XT LiDAR with an xNAV650 INS as an example, but the principles are the same for all Hesai sensors and OxTS INS devices.

Requirements

For the LiDAR to function correctly with an Inertial Navigation System (INS), it needs to be receiving timing and synchronisation messages. To do this Precision Time Protocol (PTP) can be used to send these messages over ethernet. Alternatively, NMEA messages can be sent over ethernet or serial RS232 and time synchronisation can be done using pulse per second (PPS) signals.

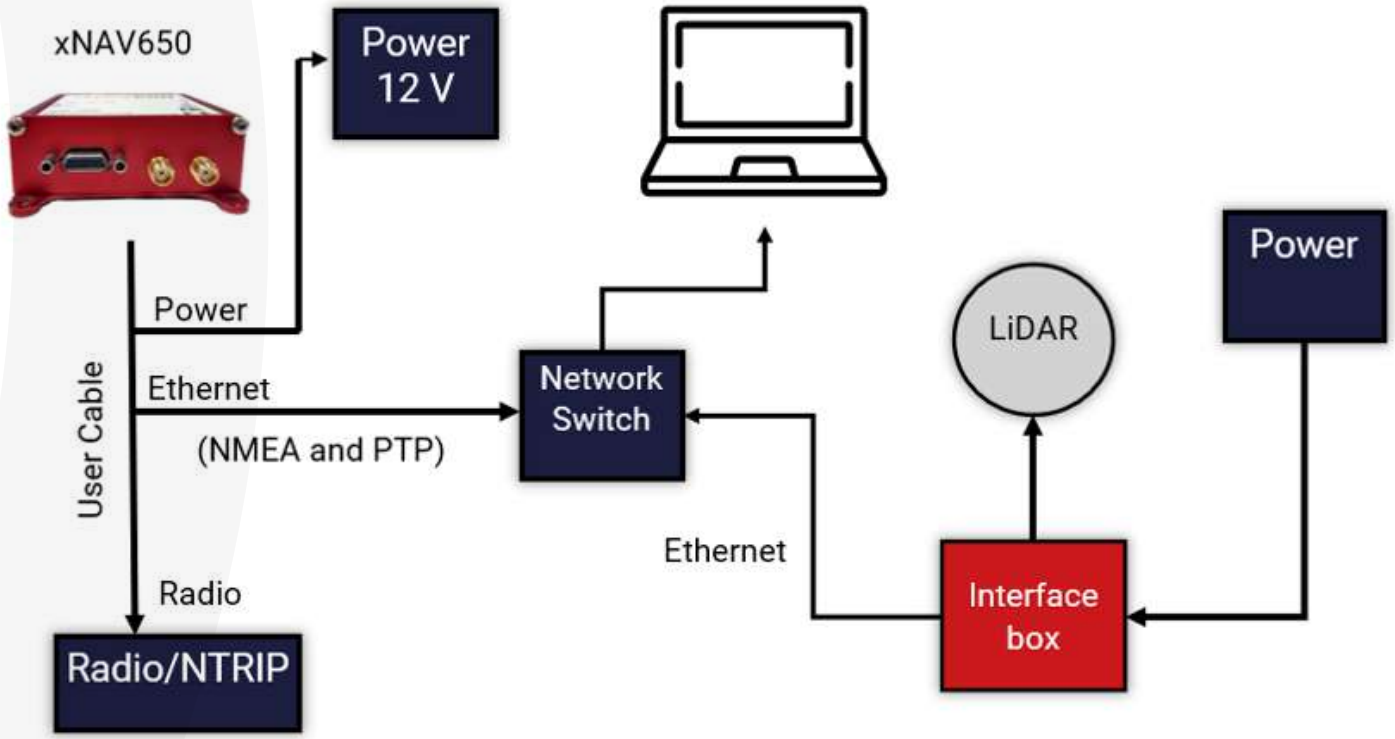
A way to record the data of the LiDAR must also be considered. The data can be streamed to a PC and recorded using software such as WireShark or Pandarview.

Hardware

In order to fulfil the requirements above, a cable must be created to communicate between the two devices. The exact design of the cable will depend on your data capturing requirements. The simplest cable setup will be using PTP messages over ethernet. Wiring diagrams are included in the manuals of our INS devices and the Hesai XT manual to give you all the necessary information.

PTP Setup Diagram

An example setup using PTP:







PPS Setup

Wiring information regarding our INS devices and user cables is available either in our user manuals or on request. The following guide will use information about the xNAV650 user cable which is included at the end of the xNAV650 user manual. Similarly, wiring information is included in the manuals of Hesai's products. NMEA and PPS messages must be sent from the INS to the LiDAR, PPS must be sent over the dedicated wire and NMEA can be sent over serial or over ethernet.

Signal	xNAV650 Cable J1 Pin	xNAV650 Cable Wire Colour	Hesai Wire
RS232 RX	3	Red	(Not needed)
RS232 TX [SENDS NMEA]	4	Orange	Purple, pin 2 [GPS DATA]
Signal ground	11	White/Black	Brown, pin 3 [GND]
PPS [SENDS PPS]	12	White/Brown	Black, pin 1 [GPS PPS]
Signal ground	13	White/Red	Brown, pin 3 [GND]
I/O signal 2	9	Grey	(Not needed)
I/O signal 1	10	White	(Not needed)
Power +	2	Brown	White, pin 4 [VIN]
Power -	1	White/Yellow	Brown, pin 3 [GND]

It is entirely possible to put a connector (eg M12) onto the INS user cable and to match this to a connector placed on the Hesai unit. NMEA, PPS and power can all be sent through this new connection meaning there is no need to use the interface box. Furthermore, if the unit is the XT16 then LiDAR data can be logged directly onto the INS, but if it is a unit with more lasers it will need to have an ethernet breakout to a separate logging device (eg PC). This is particularly useful on UAV applications so that only one power source connection is needed. When space is limited a Y cable can be used to deliver power from a source to both the INS and LiDAR.

To make a single connection and log data onto the INS you will need to match the ethernet output wires of the LiDAR to the ethernet input wires on the INS, in doing this you may want to also have a breakout cable to view data live on a PC.

Additional Notes

/ If you are using both the xNAV and LiDAR through an ethernet switch or into a PC through different ethernet connections, then the connections will have to be put onto the same IP range.

/ These PIN numbers apply to the xNAV650 device. The same principle applies to all OxTS INS devices, however the PIN numbers for the signals will depend on the INS in use due to the different connector types.

/ When working with high data rate LiDAR units it is often necessary to use a gigabit ethernet switch.

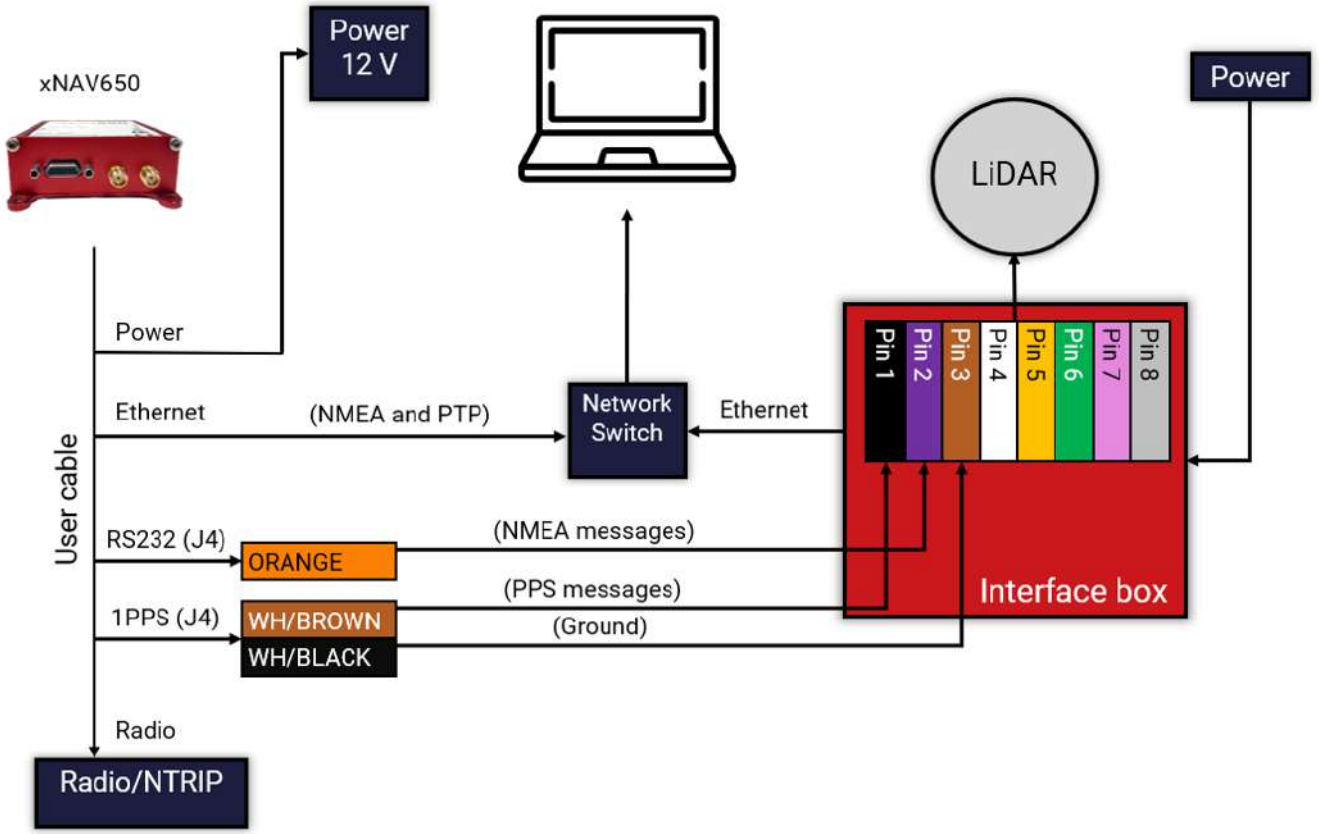
/ Check with Hesai whether removing the interface box will void the warranty. More information can be found in the LiDAR manual.





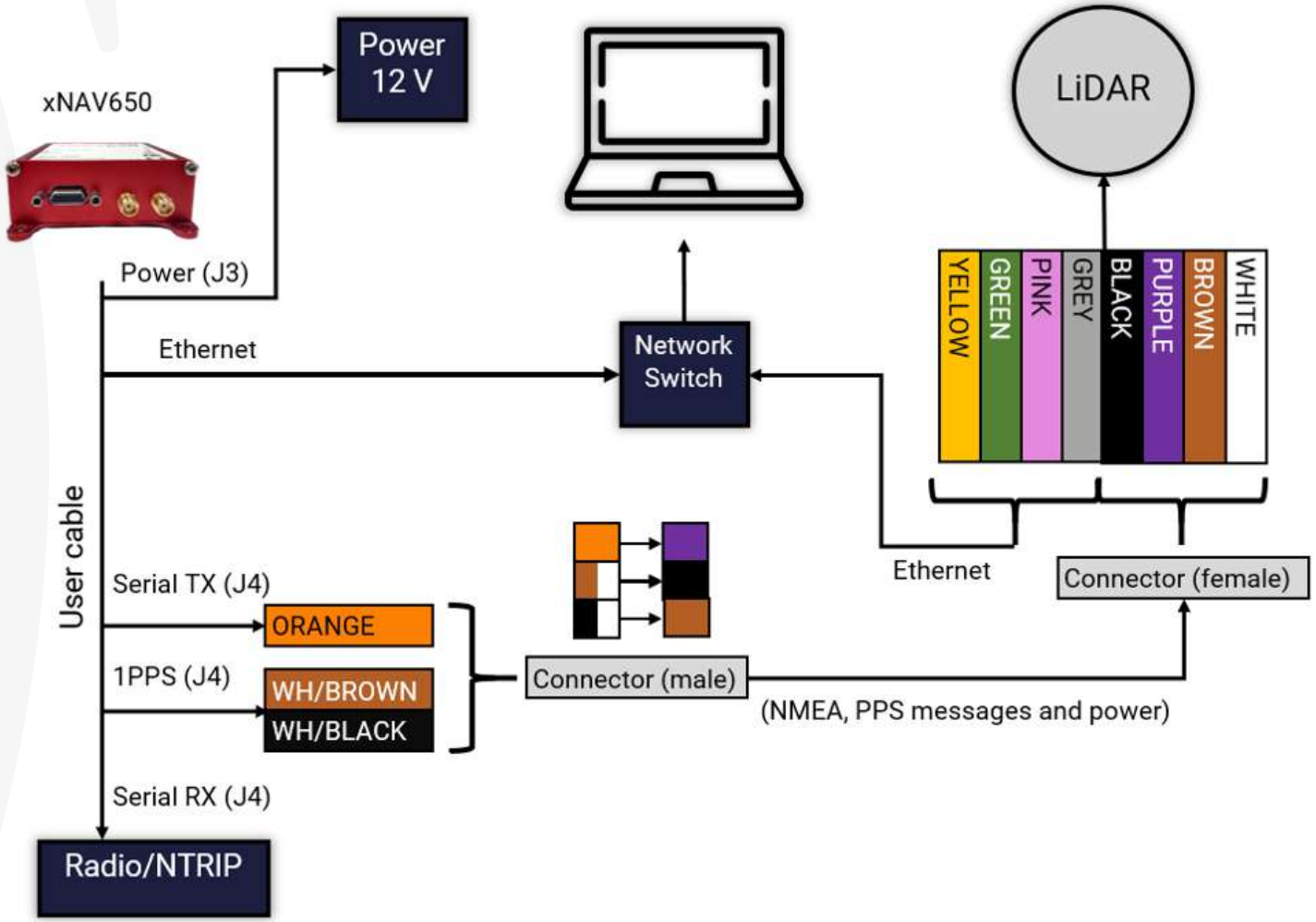
PPS Setup Diagram

PPS and NMEA messages can be sent using a traditional PPS setup using the interface box:

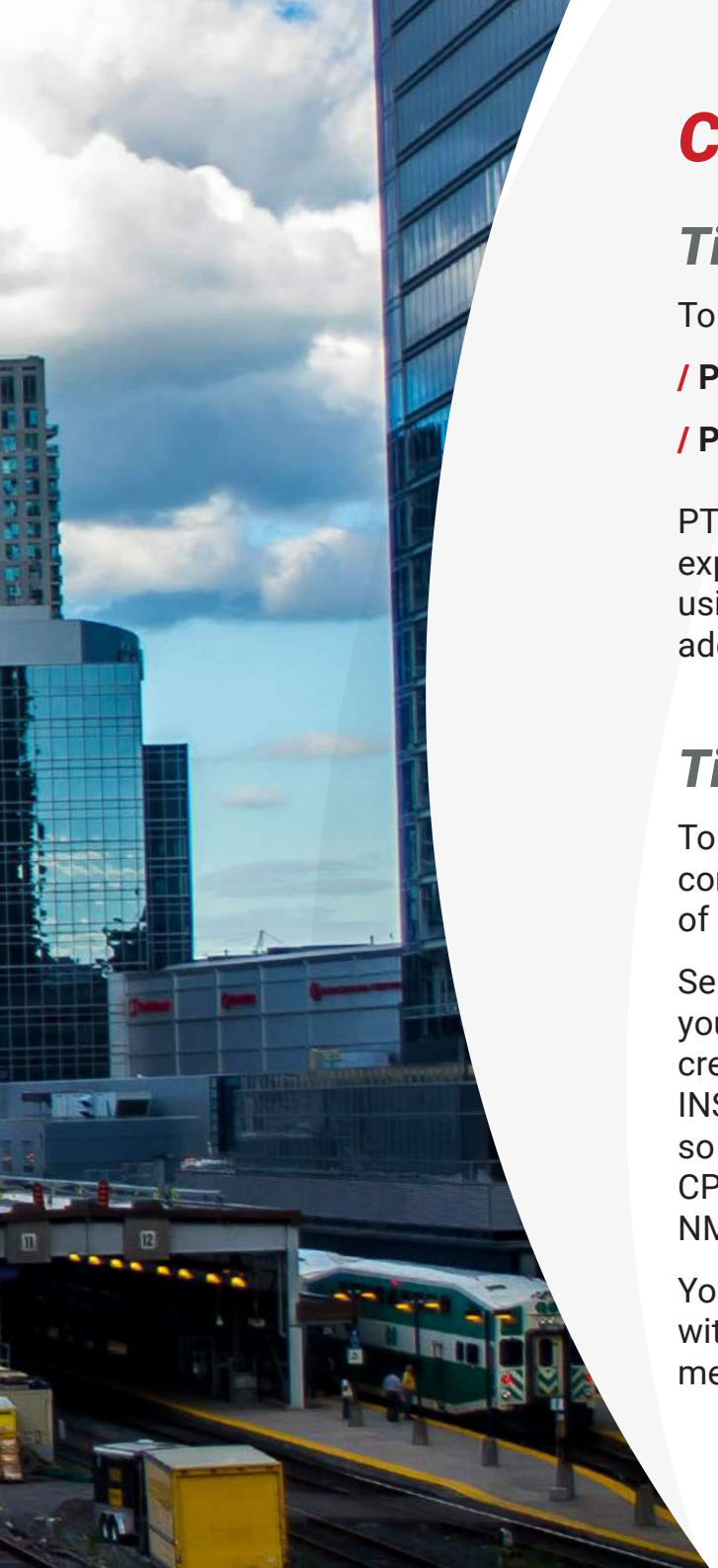


Direct Connection Setup Diagram

PPS and NMEA messages can be sent using a direct connection:







Configuration

Time synchronisation using PTP

To configure PTP we have several support articles available:

/ **PTP quick start guide** - view article

/ **PTP time modes** - view article

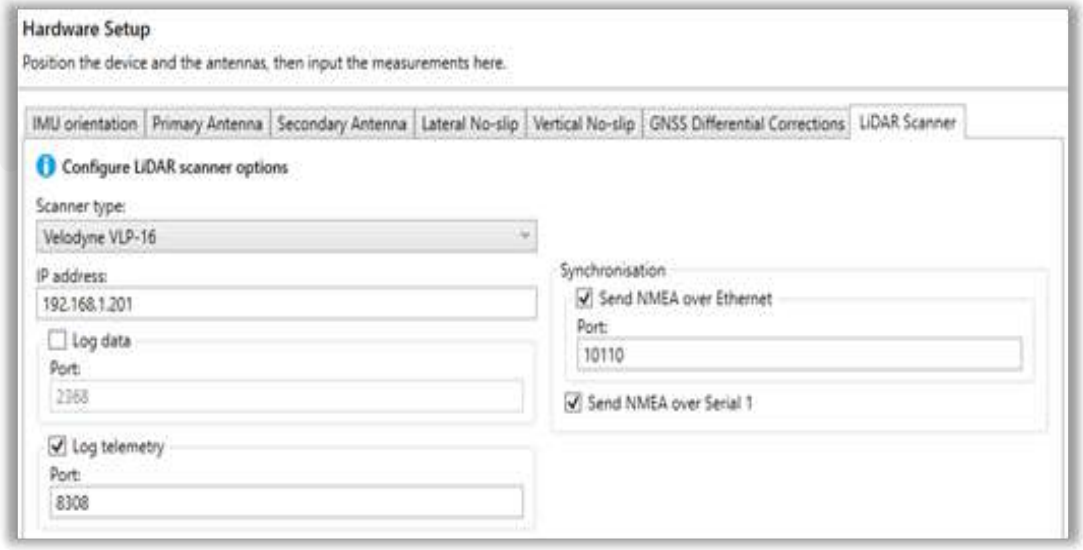
PTP can be configured with different time offsets for different time epochs, the Hesai expects UTC time messages. If you find you have the wrong time epoch and you are using OxTS' LiDAR georeferencing software, OxTS Georeferencer, a command can be added in post-processing to correct the timing.

Time synchronisation using PPS

To configure your INS device to work with the LiDAR you need to ensure that the correct messages are being sent. This can usually be done on the LiDAR Scanner tab of OxTS' complimentary INS device configuration software, NAVconfig.

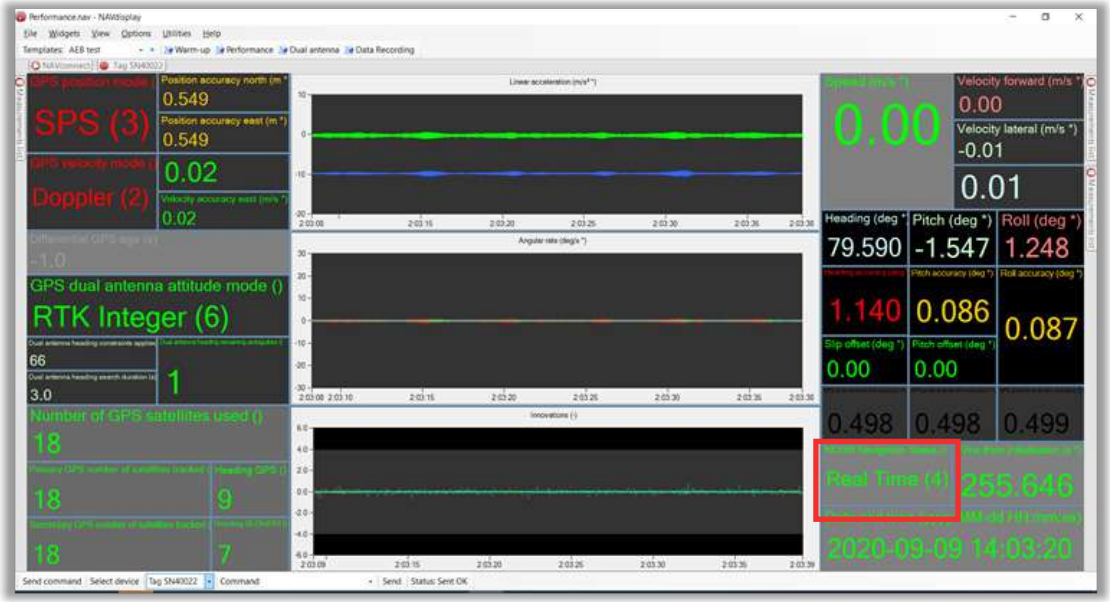
Select Velodyne VLP-16 (regardless of your Hesai LiDAR) from the drop-down menu. If your cable has been created to send NMEA over ethernet, check this box, if it has been created for serial NMEA then check that box. Data logging does not work between the INS and Hesai XT32, but it does work for a 16 laser LiDAR, due to the high data rate so make sure that the two boxes for losing telemetry and data are unchecked or the CPU can be overloaded. The IP address of the LiDAR unit is needed if you are sending NMEA over ethernet but a broadcast address of 255.255.255.0 can also be used.

You do not have to use the LiDAR Scanner tab, these settings can also be applied with further options in the Interfaces section of NAVconfig. A different type of NMEA message from GPRMC can be selected here.



Before you begin collecting data, ensure that you are getting time synchronisation and NMEA messages. You can use the Hesai web interface to do this. Ensure that it does not say ‘free run’ but has chosen ‘tracking’ or ‘locked’. It is likely when using PTP that it says ‘tracking’ instead of ‘locked’ but messages are still being validly received.

Important: The INS must be initialised to send valid NMEA messages.





Post processing

INS data is processed as normal using NAVsuite which is OxTS' complimentary software suite that you can use to configure, monitor and post-process your data.

It is highly recommended that base station corrections are used when processing in NAVsolve, OxTS' powerful post-processing tool, to get a good pointcloud.

OxTS Georeferencer and the boresight calibration solution is compatible with the Hesai LiDAR models listed on our OxTS Georeferencer web page.

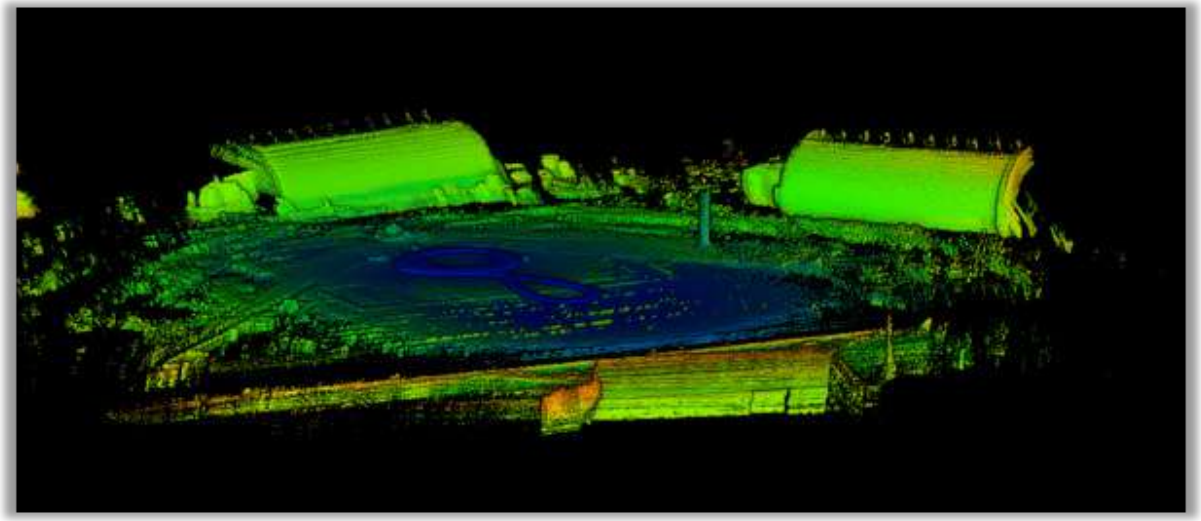
This will allow you to combine your INS data and your LiDAR PCAP or LCOM to georeference a pointcloud.

A guide for using OxTS Georeferencer can be found on the OxTS support site here - view article.

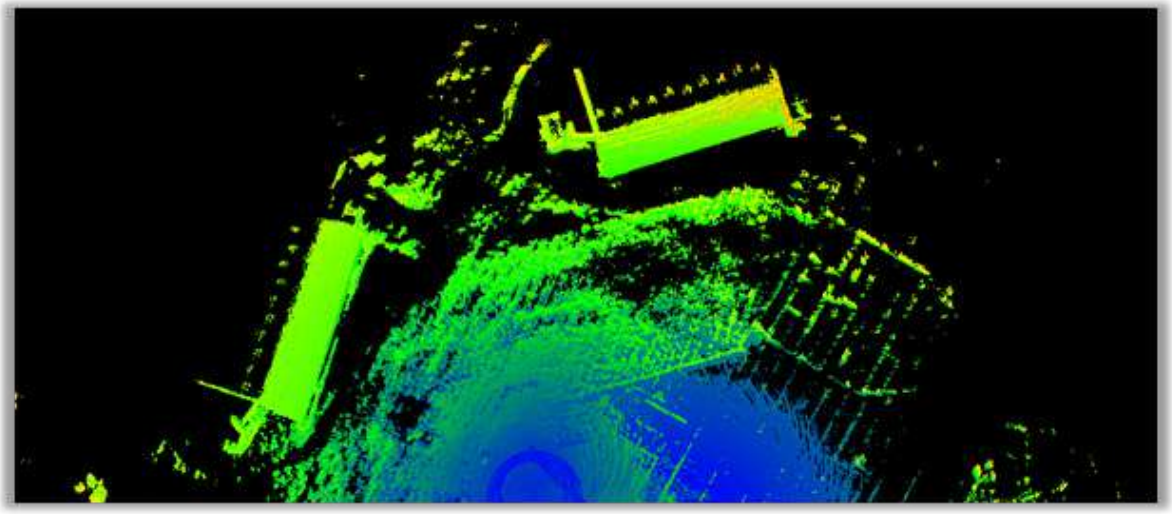
Ensure that you are using the latest version of Hesai firmware to use your LiDAR with OxTS Georeferencer. To get the best results, you should use the correction file that is supplied with, or can be received from, your LiDAR unit. This is a series of angular and timing corrections in a CSV format. This is applied to the georeferencing by selecting the 'Processing Options' on the files tab and browsing for the file in the 'Calibration File' section.

Example data

This airfield hangar pointcloud has been created using a Hesai Pandar 40P LiDAR sensor and an OxTS xNAV650 INS. The data was processed using OxTS Georeferencer.



This is a top-down view of the same hangars. Again this pointcloud was created by combining the data from a Hesai Pandar 40P LiDAR sensor and an OxTS xNAV650 INS.





Need further assistance?

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