1. USBL Device

Revision History			
Revision	Date	Author	Comments
1	September 2, 2014	G Wright	Initial draft
2	October 13, 2021	S Westaway	Issued for Internal Review

1.1 Overview

The Ultra Short Base Line (USBL) device supports input of proprietary messages from USBL systems. It requires that beacons to be tracked be added to the NavView Beacons data (see Acoustics section in User Guide).

1.2 Input

The device supports the input, detection and decode of the following Message Formats:

- **HIPAP Message Options**
  - HPR 400 – Binary message Type 1
  - PSIMSNS – Sensor values and latency
  - PSIMSSB – Cartesian X/Y and/or Polar vessel coordinate system
  - PSIMSSB – Cartesian N/E vessel coordinate system
  - PSIMSSB – UTM coordinate system
  - PSIMSSB – Radians
  - PSSIMLBP – LBL data
  - PSIMHRT – HAIN data
  - PSIMGPS – HiPaP GPS
- **GAPS Message Options**
  - PTSAG – Geographic
  - PTSAY – Cartesian N/E
  - PTSAX – Cartesian X/Y
- **LinkQuest Message Options**
  - LQF – Geographic
  - TP2 – Cartesian X/Y
- **Other**
  - Output – NavView generated PSIMSSB USBL data (Radians, Lat, Lon)
  - Nautronix Ascii – Nautronix SSBL data
  - PSONUSBL – Sonardyne USBL data

1.3 Message Validation

The messages are validated according to the respective message format features.

Proprietary NMEA messages are checked for only NMEA valid characters as the first step of data validation. If any non-compliance is detected, the message is not processed further. If a checksum is present, it is checked, and the message is only

processed further if it passes. If the checksum is not present, the message processing continues as if one was present, and it passed.

Note: Only those messages that are expected are decoded.

1.4 Units

See respective message description.

1.5 Identifiers

In the case of proprietary NMEA messages, the header is comprised of the talker identifier (first two characters) and message type identifier (third to fifth characters). For standard NMEA messages NavView ignores the talker identifier and uses the message type to determine which decode strategy to use.

1.6 Operation

When a message is received it is validated and confirmed to be one that is expected at which point the appropriate decode strategy is used to decode the data and publish the observations. Non-compliance at any stage results in the message to be rejected and not processed.

1.7 Configuration

The configuration of the USBL device uses a wizard to step the user through the required configuration. The following details the steps and options.

1. Launch the configuration wizard by clicking the configuration button (see Device section in User Guide)

Figure 1 IO Devices - Configure Device

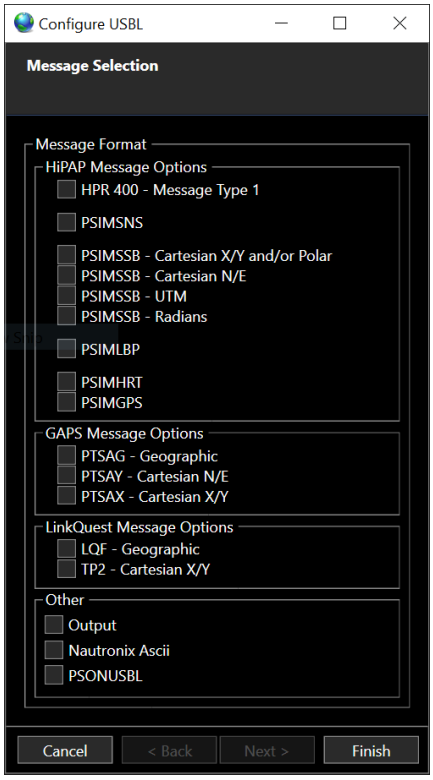

Figure 2 Configure USBL - Message Selection Page

2. **Message Selection Page**: Lists the messages that are supported by the USBL device

Note: Even though the messages can be automatically detected by NavView as they are received, because the message types determine what data will be available and therefore how it can be used by NavView, specifying them allows NavView to be fully configured without requiring actual input. This enables pre-configuration of systems.

1.7.1 HIPAP Configuration

1. Select the HIPAP message option to be used
   - **HPR 400 Message Type 1**
     - Binary data message containing SSBL transponder position data and sensor data related to the position measurement
       - **XY:** Filtered/Unfiltered (raw) transponder position. Horizontal distance from vessel reference point in meters
       - **Z:** Filtered/Unfiltered (raw) transponder vertical distance from vessel reference point in meters
       - **Heading:** Units are degrees, 0° to 360° relative to True north
       - **Pitch:** Units are degrees, positive is bow up
       - **Roll:** Units are degrees, positive is starboard side down

Note: NavView gives the option to select either filtered or infiltered (raw) XYZ (see Figure 3).

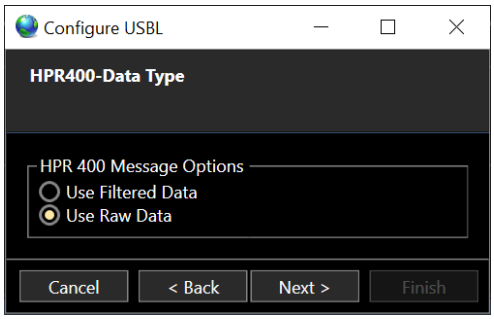

Figure 3 HPR400 Data Type

- **PSIMSNS**
  - Kongsberg proprietary message supporting PSIMSSB and PSIMLBP messages, precedes these messages in output cycle. Provides pitch, roll, heave and heading of the vessel the USBL transducer is mounted and age of data for the current USBL observation epoch.
    - Pitch: Units are degrees, positive is bow up
    - Roll: Units are degrees, positive is starboard side down
    - Heave: Units are meters
    - Heading: Units are degrees, 0° to 360° relative to True north
    - Latency: Units are seconds
    - Published observations: Heading, Attitude, Heave

Note: Select if available, recommend using for latency application.

Note: Kongsberg HiPAP systems always output the PSIMSNS message when configured to output the PSIMSSB and/or PSIMLBP. Other systems outputting the $PSIMSSB message do not, e.g. Sonardyne Ranger.

- **PSIMSSB - Cartesian X/Y and/or Polar**
  Kongsberg proprietary message. Provides XYZ data or range, bearing and Z data relative to the USBL system's reference position and ship's bow
    - **XYZ:** Units are meters, X positive to starboard, Y positive to bow, Z positive down
    - **Bearing:** Units are degrees, 0° to 360° relative to ship's bow
    - **Range:** Units are meters
    - **Published observations:** USBL

Note: Select if PSIMSSB message being output and the **Coordinate system** term in the message is C (Cartesian) and the **Orientation** term is H (vessel head up) or if the **Coordinate system** term is P (polar)

Note: Before using the data, NavView translates it so it is relative to the transducer head location.

Note: NavView USBL calibration corrections are applied to this data.

- **PSIMSSB – Cartesian N/E**
  Kongsberg proprietary message. Provides XYZ data relative to the USBL system's reference position and UTM grid North

- **XYZ:** Units are meters, X North and Y East or X East and Y North depending upon Orientation term in message
- **Published observations:** USBL

Note: Select if PSIMSSB message being output and the **Coordinate system** term in the message is C (Cartesian) and **Orientation** term is N (North) or E (East)

Note: NavView does **not** translate data so it is relative to the transducer head location.

Note: NavView USBL calibration corrections are **not** applied to this data.

- **PSIMSSB – UTM**
  Kongsberg proprietary message. Provides UTM map projection coordinates and depth
  - **Units:** meters, X Northing and Y Easting or X Easting and Y Northing depending upon Orientation term in message
  - **Published observations:** Geographic2D, Elevation

Note: Select if PSIMSSB message being output and the **Coordinate system** term in the message is U (UTM)

- **PSIMSSB – Radians**
  Kongsberg proprietary message. Provides geographic coordinates and depth
  - **Depth:** units are meters
  - **Geographic coordinates:** are in the USBL system presentation datum
  - **Published observations:** Geographic2D, Elevation

Note: Select if PSIMSSB message being output and the **Coordinate system** term in the message is R (Radians)

- **PSIMLBP**
  Kongsberg proprietary message. Provides XYZ data relative to the origin of LBL array and UTM grid North or UTM map projection coordinates depending upon the **Coordinate system** term in message
  - **XYZ:** units are meters
  - **Published observations:** Geographic2D, Elevation

Note: Select if PSIMLBP message being output

- **PSIMHRT**
  Kongsberg proprietary message. Provides geographic coordinates, depth, pitch, roll, yaw and velocities
  - **Depth:** Units are meters
  - **Geographic coordinates:** are in the WGS84 datum
  - **Yaw:** Units are degrees, 0° to 360° relative to local coordinate system north
  - **Pitch:** Units are degrees, positive is bow up
  - **Roll:** Units are degrees, positive is starboard side down
  - **Published observations:** Geographic2D, Elevation, Heading, Attitude

Note: Select if PSIMHRT message being output

2. Click **Next** to continue the wizard, the configuration pages shown, and their order depend upon the messages selected

3. **Beacons Page**

Note: Any beacon being tracked by the USBL system must be present in this list for its data to be used by NavView.

Note: A single instance of this page is presented and addresses all messages.

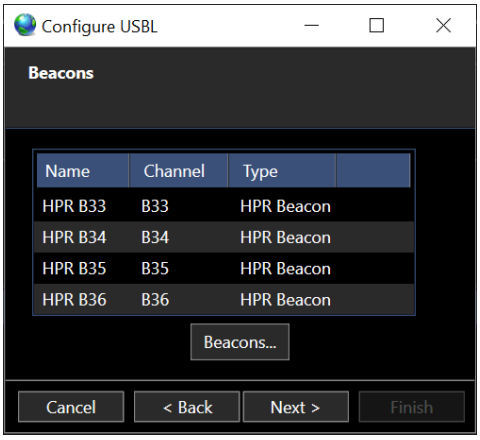

Figure 4 Configure USBL - Beacons Page

I. Check list and determine if the beacons being tracked and used by NavView are present

II. If not, click the **Beacons...** button to open the **Configure Beacons** dialog

III. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button

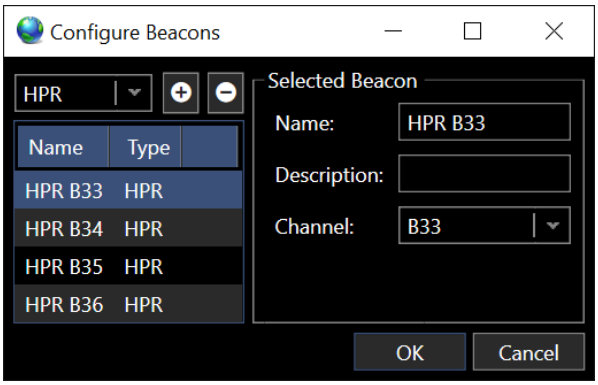

Figure 5 Configure Beacons - Add Beacon

IV. Edit the **Selected Beacon** data

a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use

b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use

c. **Channel**: Enter the ID that the beacon is identified in the respective message

- PSIMSSB Message: Transponder code, e.g. B33

- PSIMLBP Message: Type of item being tracked
    - Ve: Vessel
    - R1: ROV1
    - R2: ROV2
    - R3: ROV3
    - R4: ROV4
    - T1: Transponder 1
    - T2: Transponder 2
    - T3: Transponder 3
    - T4: Transponder 4
- PSIMHRT Message: Name of the HAIN positioning object

V. Click **Okay**

VI. Repeat for all beacons to be tracked

VII. Click **Next**

4. **Time Page**: Presents options to handle the latency of the received messages

Note: A separate Time page is presented for PSIMSSB, PSIMLBP, PSIMHRT and HPR400 messages.

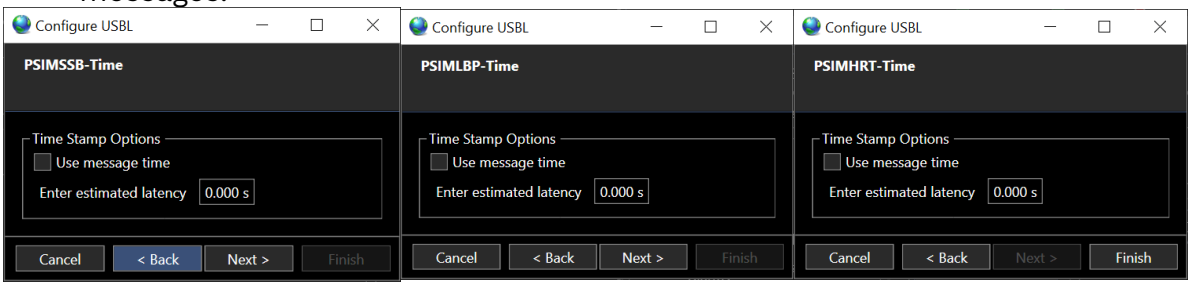

Figure 6 HIPAP – Time Stamp Options Examples

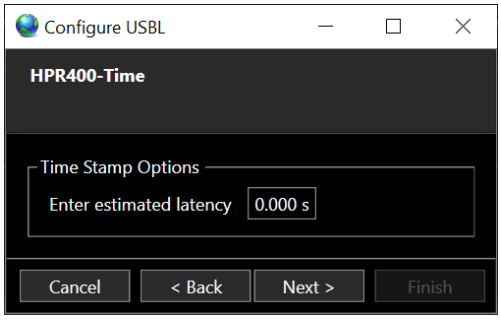

Figure 7 HPR400 Time Example

Note: In the case of the PSIMSSB and PSIMLBP messages, if the PSIMSNS message has been selected, the page will include an option to use the latency term in the PSIMSNS message.

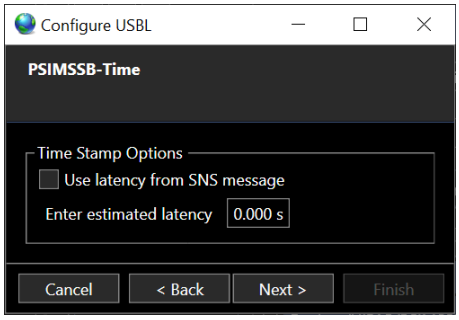

Figure 8 PSIMSNS Message – Time Stamp Options

I. Configure the latency setting
   a. **Use latency from SNS message**: Check this box to use the PSIMSNS message age of data value to deskew the associated data message (PSIMSSB and/or PSIMLBP) receive time to the actual data epoch

Note: This option is only available if the PSIMSNS message is selected as being available and a PSIMSSB and/or PSIMLBP message has been selected.

   b. **Use Message time**: Check this box to use the epoch time included in the message

Note: This option is only available if the PSIMHRT message has been selected.

   c. **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

5. Click **Next**

6. **PSIMSSB Additional Data Page**

   If a transponder is fitted with sensors the values will come as additional information on the message. NavView can decode transponder inclination data using the configuration page shown in Figure 9.

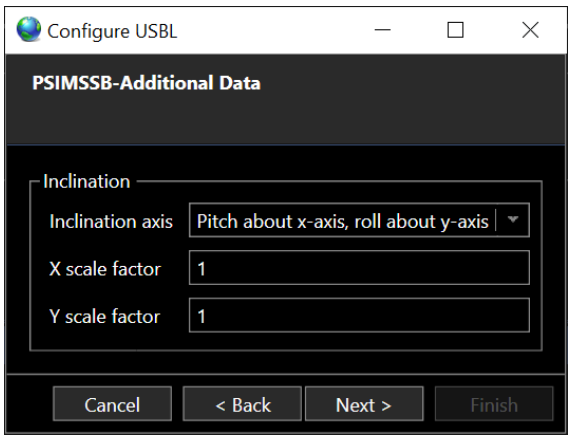

Figure 9 Configure USBL-PSIMSSB Additional Information

- **Inclination axis:** The pitch and roll axis of the transponder axis are assigned from the drop-down
- **X/Y scale factor:** Can be used to change sign convention of the pitch and/or roll data

7. **PSIMSSB Configuration Page**

NavView supports the application of USBL calibration corrections to the USBL XYZ data. These corrections correct the USBL XYZ observations for errors in the physical installation of the hydrophone, i.e. deviation from the vertical (pitch and roll errors) and the alignment with the bow (heading errors). They can also correct for errors in the application of the sound velocity profile (SVP) (scalar error). These corrections must be applied to data as observed at the vessel's USBL transducer. USBL systems are not necessarily configured to output data relative to the transducer. Therefore, for NavView to translate the data received from the USBL system to the transducer, it must know the offsets applied in the USBL system prior to it outputting the data, i.e. the offsets from the USBL reference position to the transducer. For example, USBL systems are typically configured to provide data to a Dynamic Positioning System (DPS) and are configured to output data referenced to the vessel's Centre of Gravity (COG). In this case, the offsets from the COG (reference position) to the transducer must also be entered in NavView.

Note: This page is only applicable to the PSIMSSB Cartesian XY and/or Polar message option therefore only shown if this message type has been selected.

Note: A USBL system being used for surveying will have an attitude sensor input directly to it and therefore the XYZ data output is already corrected to the vertical. Therefore, the translation of the USBL XYZ data to the transducer does not apply attitude data.

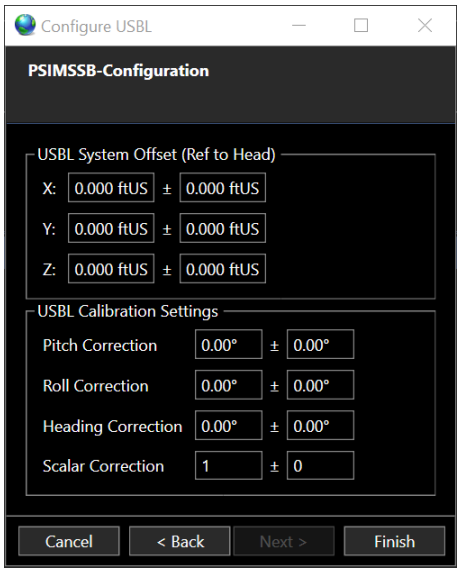

Figure 10 PSIMSSB Offsets/Calibration Configuration Page

I. Enter the **USBL System Offset (Ref to Head)**
   a. **X**: Enter X offset from the reference position to the hydrophone, - to port, + to starboard
   b. **Y**: Enter Y offset from the reference position to the hydrophone, - to the stern, + to the bow
   c. **Z**: Enter Z offset from the reference position to the hydrophone, - down, + up

II. Enter the **USBL Calibration Settings**

Note: The sign convention is for a correction. It is recommended that if the calibration has been performed using the USBL system or the USBL manufacturer's software, the corrections be applied in that system/software. Only apply the calibration correction values determined using NavView here.

III. Click **Next**

8. **Geodesy Page**

Note: This page is applicable to PSIMSSB – UTM, PSIM - Radians and PSIMLBP messages.

Note: A single instance of this page is presented and addresses all the respective messages.

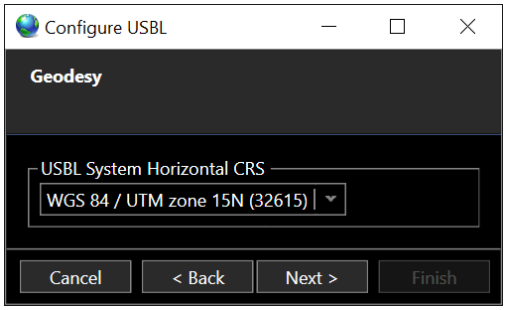

Figure 11 Configure USBL - Geodesy Page

I. From the drop down list select the Horizontal CRS the USBL system is using

II. Click **Next**

9. **PSIMLBP Configuration Page**:

Note: This page is only applicable to the PSIMLBP message.

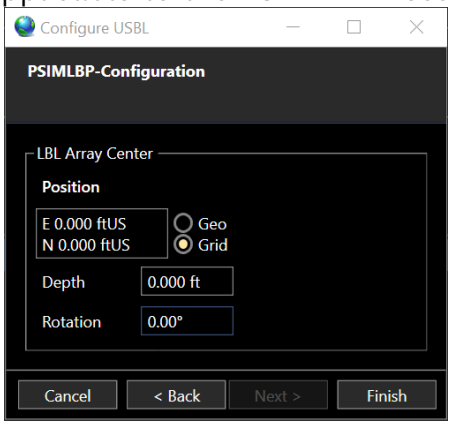

Figure 12 Configure USBL - PSIMLBP Array Center Page

I. Enter the coordinates and depth for the LB array origin

II. Enter the rotation of the array North relative to true North

10. Click **Finish**

1.8 GAPS Configuration

IXSEA Global Acoustic Positioning System, GAPS, is a portable Ultra Short Base Line (USBL) with integrated Inertial Navigation System (INS) and Global Positioning System (GPS). GAPS can provide an

accurate absolute position of a beacon.

NavView can accept three GAPS message options, PTSAG (Geographic), PTSAY (N/E) and PTSAX (X/Y).

1.8.1 PTSAG Configuration

Beacon Absolute Positioning Message (geographical coordinates and depth).

- **Beacon Position:** Latitude/Longitude
- **Beacon Depth:** In meters (+ down)

1. From the **Message Selection** page (see Figure 2) select the PTSAG option
2. Click **Next**
3. **Beacons Page**
    I. Click the **Beacons…** button to open the **Configure Beacons** dialog
    II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button
    III. Edit the **Selected Beacon** data

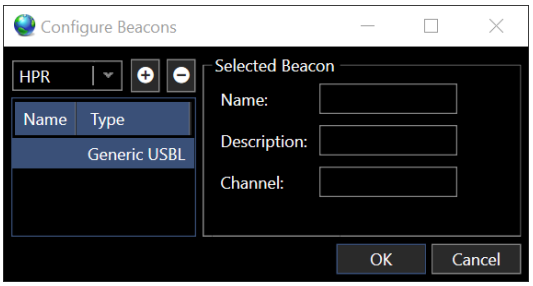

Figure 13 GAPS Configure Beacons

    a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use
    b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use
    c. **Channel**: Enter the ID that the beacon is identified in the respective message

    IV. Click **Okay**
4. Click **Next**
5. **Geodesy Page**
    I. From the drop-down list select the Horizontal CRS the USBL system is using
6. Click **Next**
7. **GAPS Time Configuration**

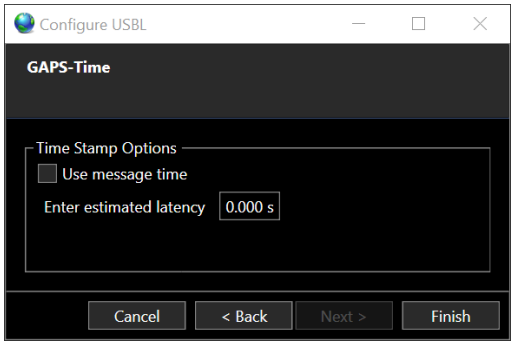

Figure 14 GAPS Time Stamp Options

- **Time Stamp Options**
  - **Use Message time**: Check this box to use the epoch time included in the message
  - **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

8. Click **Finish**

1.8.2 PTSAY Configuration

Beacon Relative Positioning Message relative to GAPS – NORTH orientation (Relative coordinates and depth). The X and Y positions are relative to the GAPS acoustic array.

- **Beacon X:** Positive northwards in meters
- **Beacon Y:** Positive eastwards in meters
- **Beacon Depth:** In meters (+ down)

1. From the **Message Selection** page (see Figure 2) select the PTSAY option
2. Click **Next**
3. **Beacons Page**
   I. Click the **Beacons...** button to open the **Configure Beacons** dialog
   II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button
   III. Edit the **Selected Beacon** data

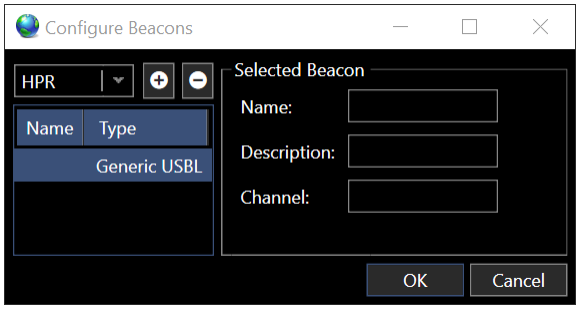

Figure 15 GAPS Configure Beacons

a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use

b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use

c. **Channel**: Enter the ID that the beacon is identified in the respective message

IV. Click **Okay**

4. Click **Next**
5. **GAPS Time Configuration**
   Configure as in item 7, PTSAG configuration
6. Click **Finish**

1.8.3 PTSAX Configuration

Transponder relative Positioning Message relative to the GAPS array – GAPS orientation (Relative coordinates and depth).

- **Beacon X:** (+ forward) in meters
- **Beacon Y:** (+ starboard) in meters
- **Depth:** In meters (+ down)

1. From the **Message Selection** page (see Figure 2) select the PTSAX option
2. Click **Next**
3. **Beacons Page**

   I. Click the **Beacons...** button to open the **Configure Beacons** dialog

   II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button

   III. Edit the **Selected Beacon** data

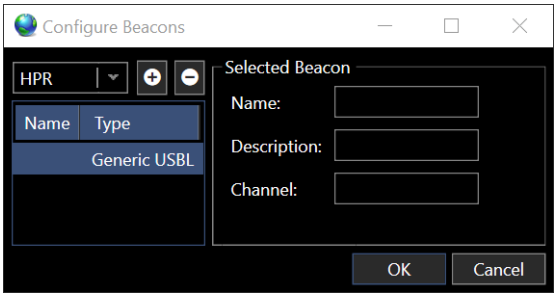

Figure 16 GAPS Configure Beacons

a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use

b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use

c. **Channel**: Enter the ID that the beacon is identified in the respective message

IV. Click **Okay**

4. Click **Next**
5. **GAPS Time Configuration**
   Configure as in item 7, PTSAG configuration
6. Click **Next**
7. **GAPS Configuration Page**
   Configure as in item 7, PSIMSSB Configuration Page

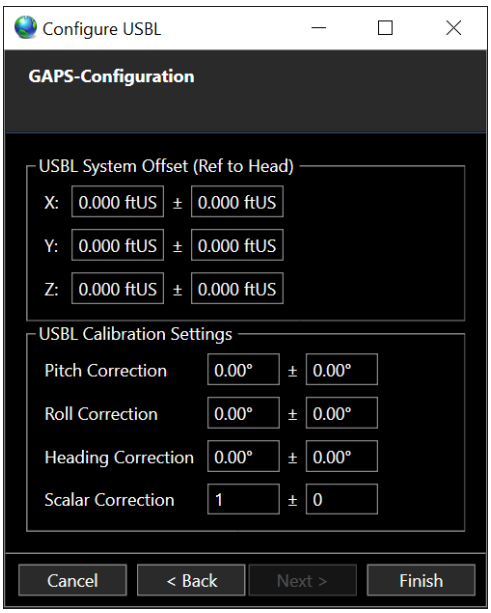

Figure 17 GAPS Offsets/Calibration Configuration Page

8. Click **Finish**

1.9 LinkQuest Message Options

LinkQuest TrackLink USBL acoustic tracking system. NavView can accept two TrackLink message options, LQF (Geographic) and TP2 (X/Y).

1.9.1 LQF Configuration

This interface provides geodetic position of both the ship and transponder.

- **Ship Position:** Latitude/Longitude
- **Beacon Position:** Latitude/Longitude
- **Depth:** In meters (+ down)
- **Ship Heading:** In degrees

1. From the **Message Selection** page (see Figure 2) select the LQF option
2. Click **Next**
3. **Beacons Page**

I. Click the **Beacons…** button to open the **Configure Beacons** dialog

II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the ⊕ button

III. Edit the **Selected Beacon** data

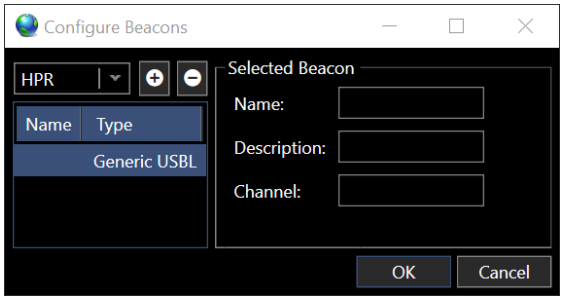

Figure 18 LinkQuest Configure Beacons

a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use

b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use

c. **Channel**: Enter the ID that the beacon is identified in the respective message

IV. Click **Okay**

4. Click **Next**

5. **Geodesy Page**

I. From the drop-down list select the Horizontal CRS the USBL system is using

6. Click **Next**

7. **LQF Time Configuration**

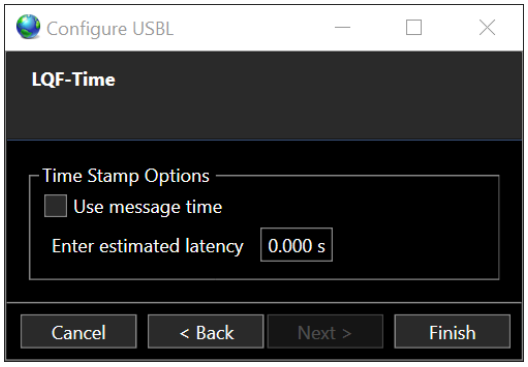

Figure 19 LQF Time Stamp Options

- **Time Stamp Options**
  - **Use Message time**: Check this box to use the epoch time included in the message

- **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

8. Click **Finish**

1.9.2 TP2 Configuration

This interface provides vessel relative XYZ position of a beacon.

- **Beacon X:** (+ve starboard) in meters
- **Beacon Y:** (+ve forward) in meters
- **Beacon Depth:** In meters

1. From the **Message Selection** page (see Figure 2) select the TP2 option
2. Click **Next**
3. **Beacons Page**
   I. Click the **Beacons…** button to open the **Configure Beacons** dialog
   II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button
   III. Edit the **Selected Beacon** data

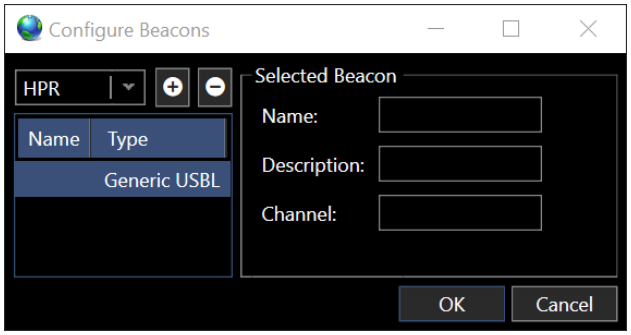

Figure 20 LinkQuest Configure Beacons

   a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use
   b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use
   c. **Channel**: Enter the ID that the beacon is identified in the respective message

   IV. Click **Okay**
4. Click **Next**
5. **TP2 Time Configuration**

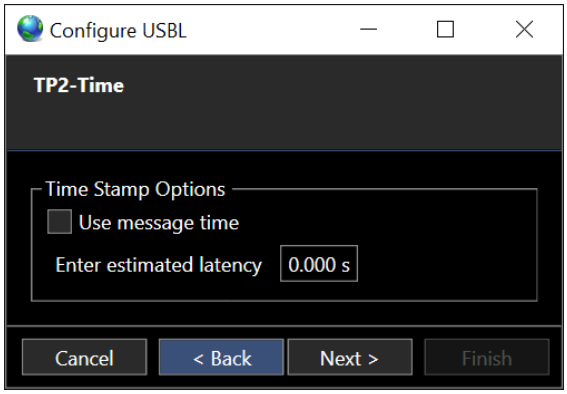

Figure 21 TP2 Time Stamp Options

- **Time Stamp Options**
  - **Use Message time**: Check this box to use the epoch time included in the message
  - **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

6. Click **Next**
7. **TP2 Configuration Page**
   Configure as in item 7, PSIMSSB Configuration Page

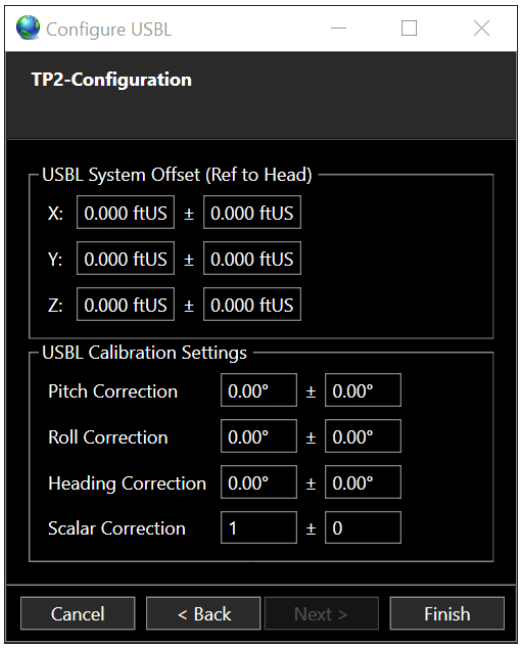

Figure 22 TP2 Offsets/Calibration Configuration Page

8. Click **Finish**

1.10 Other Message Options

NavView can also accept Nautronix Ascii and Sonardyne PSONUSBL messages. NavView can also output a USBL string.

1.10.1 Output Configuration

This option is used if the timestamp from the USBL source is incorrect, NavView can then take in the USBL beacon position and then output the beacon position with a correct time stamp to another system. The only format available for output is the PSIMSSB (PSIMSSB, Radians, Lat, Lon) beacon position.

- **Beacon Position:** Lat/Lon
- **Beacon Elevation:** In meters

1. From the **Message Selection** page (see Figure 2) select the Output option
2. Click **Next**
3. **Output Page**

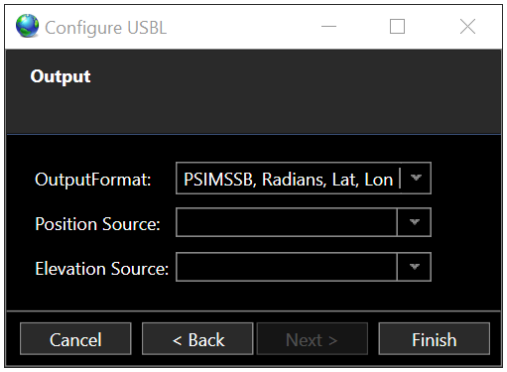

Figure 23 Output – Configure USBL Page

- **Output Format:** PSIMSSB is currently the only format available
- **Position Source:** Select the beacon position source from the drop-down
- **Elevation Source:** Select the beacon elevation source from the drop-down

Note: The output string has a hard coded beacon ID (B01).

4. Click **Finish**

1.10.2 Nautronix Ascii Configuration

This option is used to bring in beacon, vessel relative orientated, position data from a Nautronix SSBL system.

- **Beacon X:** Vessel relative coordinate in meters (+ve starboard)
- **Beacon Y:** Vessel relative coordinate in meters (+ve foreward)
- **Depth:** Vertical distance between vessel's reference point and beacon in meters (+ down)
- **Vessel Pitch:** In degrees
- **Vessel Roll:** In degrees
- **Vessel Heading:** In degrees

1. From the **Message Selection** page (see Figure 2) select the Nautronix Ascii option

2. Click **Next**
3. **Beacons Page**
    I. Click the **Beacons…** button to open the **Configure Beacons** dialog
    II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button
    III. Edit the **Selected Beacon** data

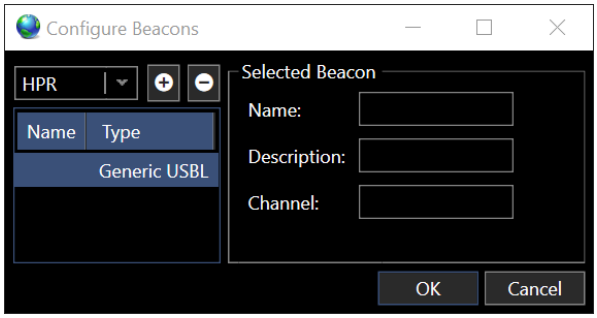

Figure 24 Nautronix Configure Beacons

a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use
b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use
c. **Channel**: Enter the ID that the beacon is identified in the respective message

    IV. Click **Okay**
4. Click **Next**
5. **Nautronix Settings Page**

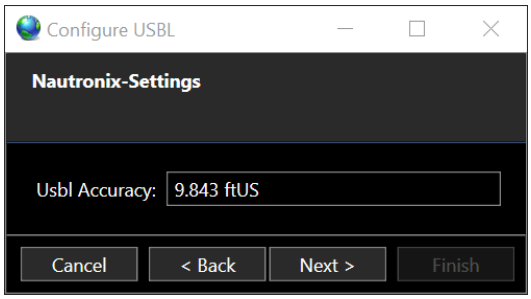

Figure 25 Nautronix Settings - Configure USBL Page

    I. The Nautronix Ascii message does not contain the beacon position accuracy. The expected accuracy is entered here.
6. Click **Next**
7. **Nautronix Offsets Page**
   Configure as in item 7, PSIMSSB Configuration Page

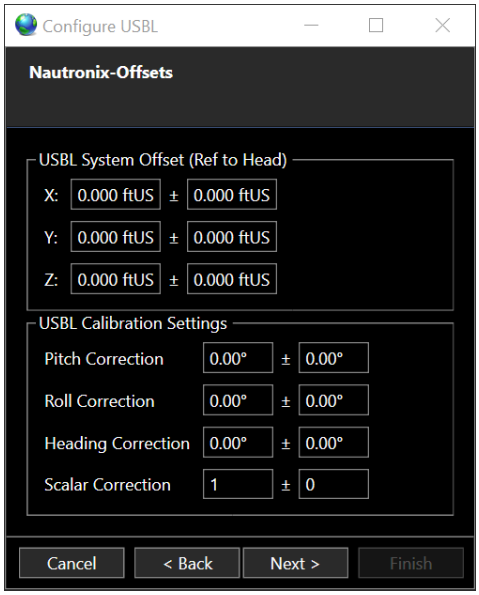

Figure 26 Nautronix Offsets/Calibration Configuration Page

8. Click **Next**
9. **Nautronix Time Configuration**

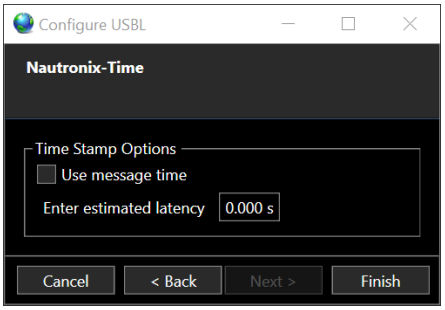

Figure 27 Nautronix Time Stamp Options

- **Time Stamp Options**
  - **Use Message time**: Check this box to use the epoch time included in the message
  - **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

10. Click **Finish**

1.10.3 Sonardyne PSONUSBL Configuration

PSONUSBL is a Sonardyne proprietary USBL message outputting beacon X/Y or N/E vessel relative coordinates, depth and vessel heading pitch, roll.

- **Beacon X:** Vessel relative head up or north up referenced, east coordinate or +ve starboard coordinate in meters

- **Beacon Y:** Vessel relative head up or north up referenced, north coordinate or +ve foreward coordinate in meters
- **Beacon Depth:** In meters (+ve down)
- **Vessel Pitch:** In degrees
- **Vessel Roll:** In degrees
- **Vessel Heading:** In degrees

1. From the **Message Selection** page (see Figure 2) select the PSONUSBL option
2. Click **Next**
3. **Beacons Page**
   I. Click the **Beacons…** button to open the **Configure Beacons** dialog
   II. From the drop-down list, select the beacon type (only beacon types that can be configured for the selected messages are presented) and click the  button
   III. Edit the **Selected Beacon** data

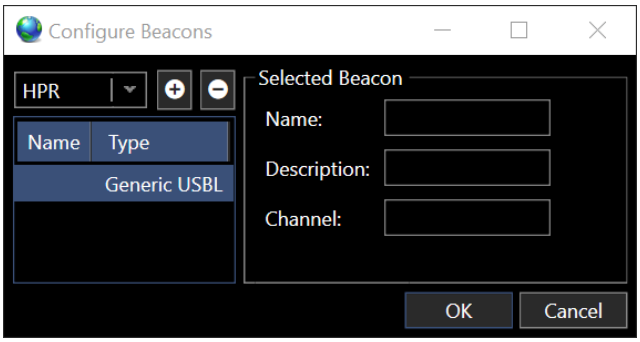

Figure 28 PSONUSBL Configure Beacons

   a. **Name**: Enter a name, this is how this beacon will be identified when beacons are listed for selection for use
   b. **Description (Optional)**: Enter a suitable description for the beacon, e.g. its use
   c. **Channel**: Enter the ID that the beacon is identified in the respective message

   IV. Click **Okay**
4. Click **Next**
5. **PSONUSBL Offsets Page**
   Configure as in item 7, PSIMSSB Configuration Page

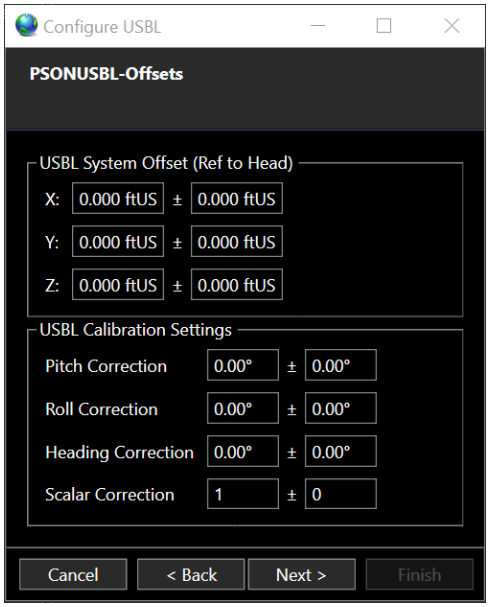

Figure 29 PSONUSBL Offsets/Calibration Configuration Page

6. Click **Next**
7. **PSONUSBL Time Configuration**

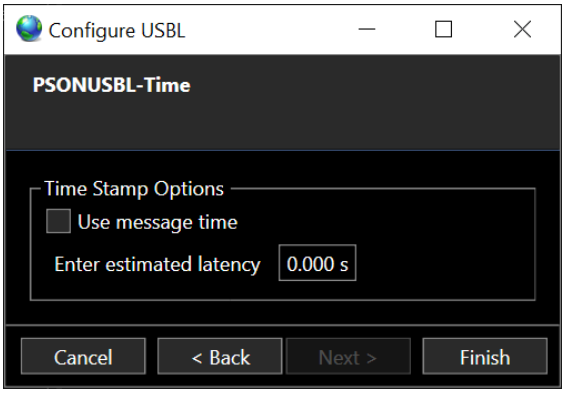

Figure 30 PSONUSBL Time Stamp Options

- **Time Stamp Options**
  - **Use Message time**: Check this box to use the epoch time included in the message
  - **Enter estimated latency**: If the options to use the message time or age of data are not available or selected, the user can enter a latency to apply to deskew the data message receive time to the actual epoch

8. Click **Finish**