Sonardyne Global
Headquarters
T. +44 (0) 1252 872288
F. +44 (0) 1252 876100

www.sonardyne.com

Application Note
Using SMS Telemetry Position Updates

Reference Documents

Ranger 2 and AvTrak 6 user manuals.

Description

The ability to provide an AUV with its real world position with minimal latency (<10s) is extremely important for aiding of inertial navigation systems. It is especially important during descent or ascent when there is no DVL bottom lock available. The AUV will generally have it last known GPS surface position and typically rely on free inertial positioning during the descent until attaining DVL bottom lock at 50 to 100m altitude. The AUV will then require a calibrated seabed reference or receive updates from a surface reference system.

A new feature of Sonardyne's Ranger 2 system when using an AvTrak 6 instrument is to provide navigation update rate telemetry to the AUV of it position when it was last interrogated. By selecting the "telemetry" interrogation method the system sends the position from the last navigation cycle to AvTrak6. On receiving the position information the AvTrak6 responds acoustically and outputs the position telegram on the designated serial port after a pre-determined time. The position of the AUV is calculated from the acoustic response and this is communicated to the AUV on the following cycle. If multiple AUVs are being positioned then a simplistic round robin method is used, hence the update rate is halved assuming similar water depths.

Summary of capabilities

- The position information is exported on a serial port at the AvTrak6.
- The acoustic payload is efficient.
- The AvTrak6 can provide a short acknowledgement rather than a full telemetry response.
- The transceiver address is exported along with the message.
- It allows user information to substitute a position update if sent into the SMS serial port connection (PAN).
- It allows buffered SMS data on the AvTrak6 to be retrieved as part of a telemetry navigation update (Standard Exchange) and send to the SMS/PAN Port on the topside system.

The implementation uses the existing SMS architecture to allow for the position update information to be acoustically sent to the AvTrak 6 and exported serially to the AUV via the designated serial port. To minimise the acoustic payload, but still provide readability BCD encoding has been used (with upper case C and D indicating + and – values). The SMS overhead (payload size, compression flags, transceiver address and destination port) reside primarily in the telemetry header and only a single 16-bit word of the first data block payload is utilised as overhead. In addition, an acknowledgement only mechanism already exists within the SMS framework.

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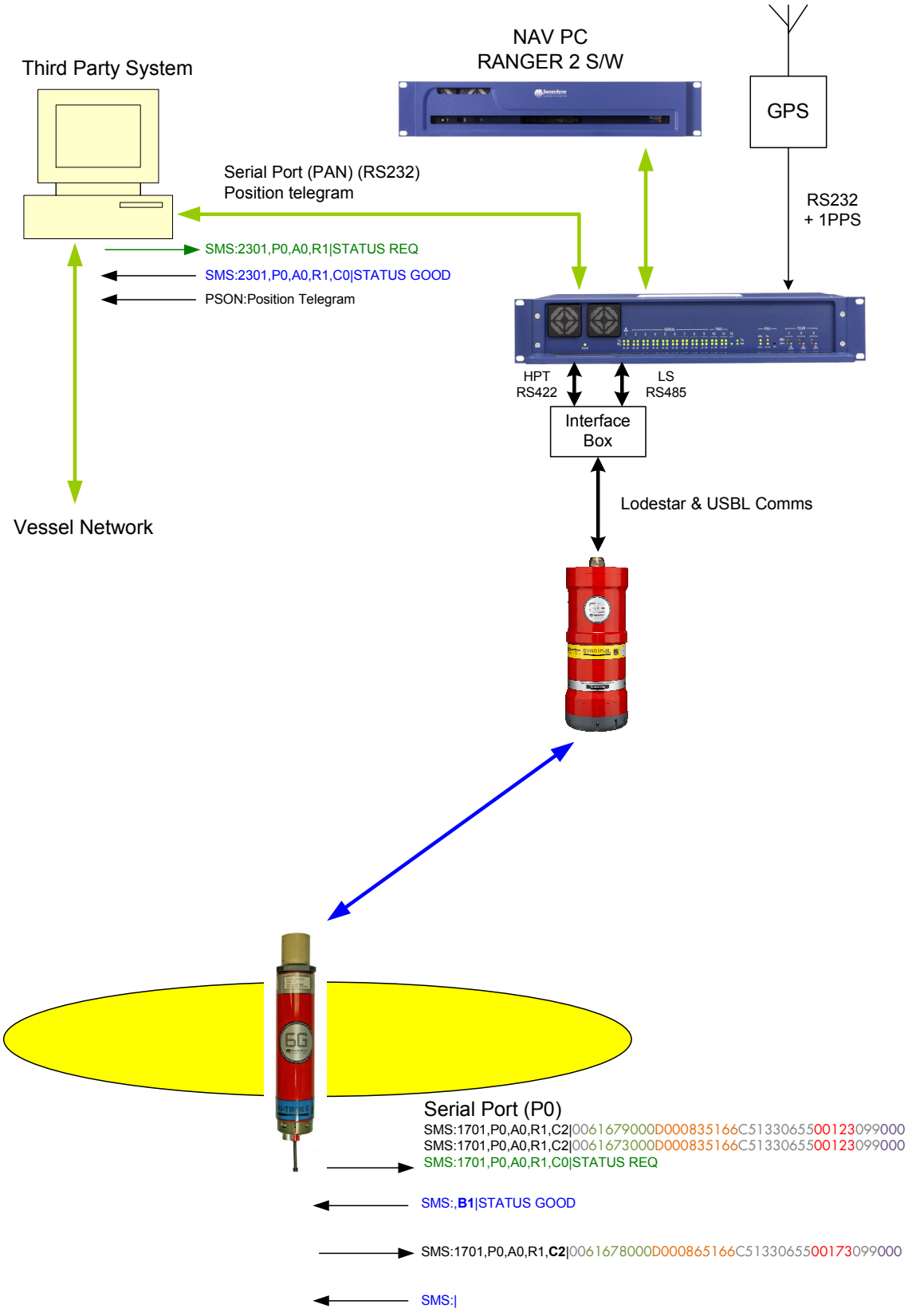
Operational Diagram



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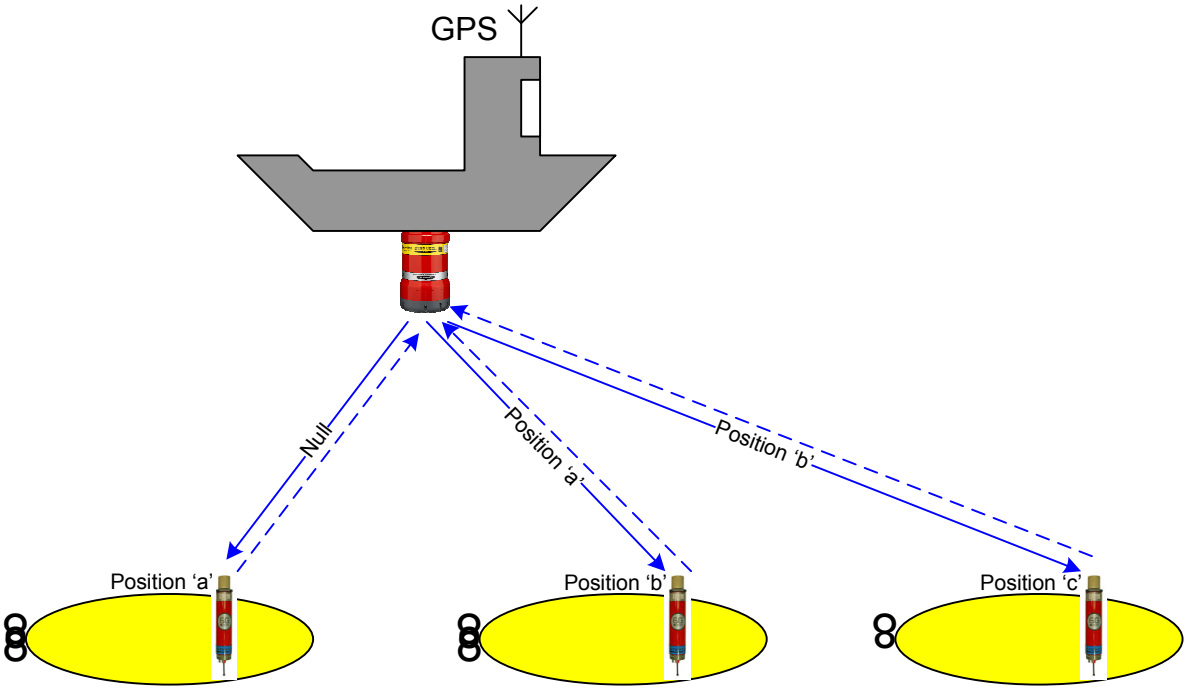
Latent Position Messages

The diagram below shows how the position of the AUV is calculated by the topside system and communicated to the AUV on the following navigation cycle.



SMS Command

The SMS protocol offers a low overhead method for communicating user data between 6G instruments and has been utilised by the Ranger 2 system for communicating the position updates. The table below shows the parameters that can be passed to the SMS command to change the behaviour of the instrument e.g. change the port that the message is delivered on.

Command	**SMS:aaaa**;**W#**,**P#**,A#,R#,C#|*<ASCII-Message>*	
Reply	SMS:aaaa,ACK SMS:aaaa|AUV Status SMS:aaaa,NO_REPLY	*Message acknowledged successfully* *Message received from AUV* *Message acknowledgement not received*
aaaa	Acoustic Address of beacon	
W#	Wakeup	0,1,2,3,4
P#	Serial Port	0,1,2,3,4,5,6,7 (depends on instrument)
A#	Exchange type	A0 = standard exchange, A1 = ACK only
R#	Ranging enabled	R1 = Ranging enabled
C#	Command version	Command **#2** indicates Sonardyne Position update

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BCD Encoding

To make the SMS position telegram human readable it have been coded in BCD with the parameters described and highlighted in the example below.

ID	8	Message ID = 0x0 current message version
TS	32	Timestamp for the position fix encoded as an unsigned integer in ms steps since midnight (UTC)
LON	40	Longitude BCD encoded as a signed integer value in 1e-6 steps ('C' indicates '+', 'D' indicates '-') Covers +/-180.000000 range (0.1 m accuracy at the equator)
LAT	36	Latitude BCD encoded as a signed integer value in 1e-6 steps ('C' indicates '+', 'D' indicates '-') Covers +/-90.000000 range (0.1 m accuracy at the equator)
DEPTH	20	Depth BCD encoded as an unsigned integer value in 0.1 steps – max 9999.9m
SD	12	Unsigned Standard deviation fixed point (lsb=0.1m)
Spare	*12*	*Set to 000*
Total	*160*	*20 Bytes*

Example:

SMS:2304,P0,A0,R1,C2|0061679000D000835166C513306550012309900O

ID	0
TS	61679.000s (17:07:59.000)
LON	-0.835166deg
LAT	+51.330655deg
DEPTH	12.3m
SD	9.9m
Spare	000

Acoustic Telemetry Length

For the proposed payload of 160 bits (160 bits of payload data + 16 bits of SMS header), the acoustic telemetry lengths are as follows:

Telemetry Scheme	Blocks	Length / ms	Byte / Block
TS0 (100bps) not often used	8	2080	3
TS1 (200bps)	4	1120	6 (24)
TS2 (400bps)	2	640	11 (22)
TS3 (900bps) recommended	1	400	23 (23)

The navigation update rate depends on the telemetry scheme, water depth and response payload. If the response is the standard ACK, i.e. nothing in the AvTrak6 buffer then the update rate can be as high as 1Hz at very short range (TS3 telemetry [400ms] + Fixed Turn Around Time (FTAT) [320ms] + Range 100m [66ms] + Topside processing delay [est. 250ms – 500ms]).