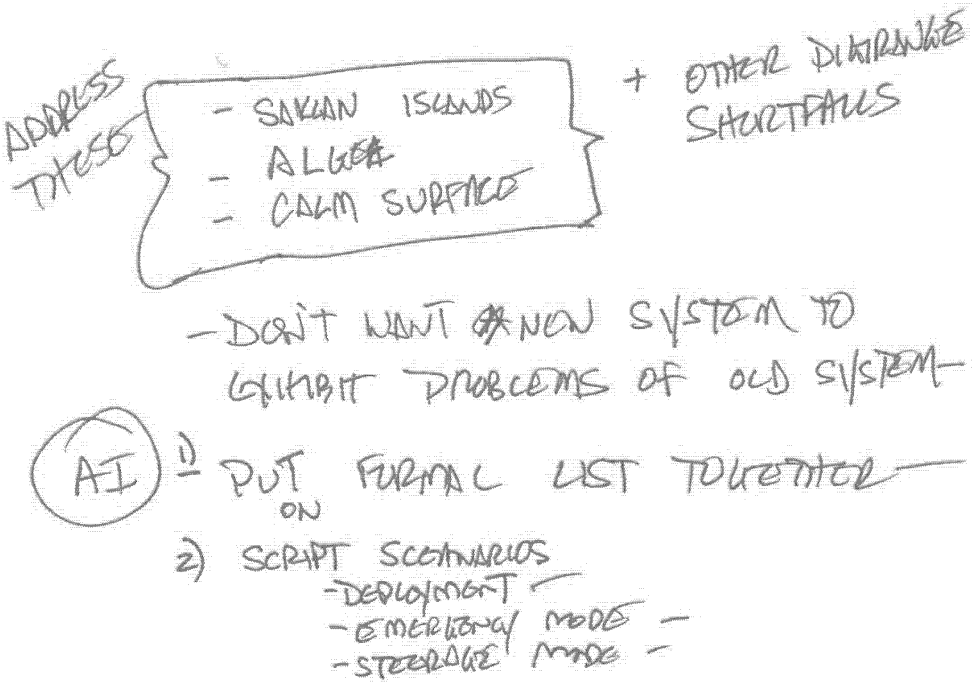
Next Generation Streamer Positioning System
Development Document

Requirement

1) **A streamer control and positioning system capable of meeting the demands of future seismic surveys acquired with Four Dimension (Time Lapse) and High Density (High Streamer count, small streamer separation) survey parameters.**



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IO/Concept Development

In order for the system to function at its optimum IO and Concept system will need to work closely together. It is expected there will be several areas of overlap responsibilities. The following out line some expected areas.

- Who should actually take ownership of the steering? Should it be Concept since they would have the necessary information to determine which streamers or parts thereof need to be steered, or should it be IO who would have to transform the positions as calculated by Concept into commands or instructions to the steering devices.
- Would Concept accept the responsibility for the steering or will they only interpret the navigation and positioning data and translate this into lateral or vertical shifts?
- Although Concept should do all the positioning calculations, should they also be responsible for the dynamic modeling of the cable. In other words should they also take onboard the responsibility for which steering devices need to be addressed in order to achieve a lateral or vertical shift? Without introducing a second interface unit it would make sense for the DMU to issue the commands. The processing of the streamer positions and subsequent commands should be done on an external box that is off the shelf and easily upgraded. Perhaps, run on a spectra machine, communicating with Data server, which would communicate with the DMU.
- To be able to steer the streamers there needs to be a reference to steer against. This reference can either be a preplot line, CDP columns, coverage information, turn-data etc. From the calculated position of the receivers, a position shift to the reference can be calculated. This shift could then be passed to the IO "DMU" (lets call it DMU for the sake of convenience) which would subsequently translates this shift into commands that the streamer devices recognize. In this case, it is the DMU that needs to decide how much steering to exercise to the streamers in order to bring the streamers to the desired location. This would imply that the DMU would need to do the majority of cable modeling. As said above, it may be wise to offload processing to not so specialized off the shelf computers. As even though we are talking off the shelf for the new DMU it will still be considerably more expensive than a top of the range PC.

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1. Functional Requirement

Define current shortcomings of the acoustic positioning system with the aim to avoid known problems.

Functionality for deployment and recovery will need to be reviewed by experienced field staff. Here is one situation where compasses could be needed, although as discussed at the last meeting, it may be possible to have a system generated deployment job, that is intelligent enough to make a workable solution from the deployed units, there would have to be some minimum threshold.

To what extent do we cater for emergency situations? A panic or reset function which in effect nulls or neutralizes any previously issued instructions to the streamer steering devices is required so that during system crashes or other unforeseen circumstances where we are not able to control the system through the main system. This would avoid the streamers to be steered in certain directions without having control over where exactly they are. One idea is to have the ability to control from the tail buoy, via radio. The radio could be low power high frequency (1km workable range), emitted from the adjacent tail buoy. This could also be used in situations where we had telemetry problems. The real issue is to avoid a tangle if we lose on streamer

How do we know how the cables are actually moving the way we instruct it. Response speed of the system needs to be addressed. Feedback from positioning system needs to include parameters that would enable us to visualize this response. Cross- and In-line through water speed parameters spring to mind. This is something that would need extensive mathematical modeling, not to mention sea trials.

Constraints need to be set. There needs to be a set of constraint that prevents the controlling system to issue commands to the steering devices that are physically impossible to achieve. Situations caused by poor or erroneous positioning due to for example poor acoustic performance should not result in unnecessary steering. We must be able to manually over-ride system steering.

Mathematical and Dynamic model of the streamer needs to be studied and decided upon.

System should be capable of working in both 2D and 3D mode. → COMPASSES FOR SINGLE STREAMERS

In reference to situations with a tail current not bad weather, depth keeping and reporting is very important due to frequency response of cable. Increasing the number of reliable depth sensors (not controllers) may make it possible to model cable response real time, making it possible to shoot with cable depth problems.

SOURCE QC $

Source positioning of individual guns should be an option. This should be a requirement if not in the initial system but for future development. Since with more information available and better processing methods, it may be possible in the future to model the gun signature real time. This will allow for greater flexibility on gun separation and spec. + DTG EVERY GUN

Improved determination of the geometrical relation between surface positioning and subsurface positioning such as for example the relation between the RGPS pods on the source float and the Gun-pinger beneath the source. This is where 3D positioning of guns needs to be better.

Multi vessel scenarios need to be defined such as for example a CLO operation. It may be unwise to try and make the system transmitter powerful enough to have one net for 2 streamer vessels in CLO. The lateral 1km from 0,0 point in the old Digicourse system needs to be extended, as it should be a requirement to have a full net in side-by-side streamer vessel operations.

→ THIS IS BECOMING A MORE FREQUENTLY.

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1. **Streamer Depth, Position and Lateral Directivity Control**
   a) System Overview Description.
   - To facilitate efficient deployment and recovery the system must have an absolute minimum number of devices attached externally to the cable. The acoustics need to be reliable in highly dynamic situations such as for example during line-change and during emergency break-offs.
   - Where ever possible "in-line" devices should be targeted. (IE Modules or adapter sections between or within active section).
   - Where possible "In Water" units should be modular such that they will accept heading and/or acoustic sensors as well as perform streamer control.
   - Batteries should not be used as the main power sources for in water equipment, but are acceptable as back up power sources.
   - System communications 'Band Width" to in water devices must not limit the system cycle time.
   - To mitigate risk of equipment damage during periods of equipment or controller failure all units should have a "fail safe" or "neutral" mode.
   - In water units should have a service life of at least 5 years and an MTBF of at least 2 years. Routine maintenance should not be necessary.
   - Operating system should not be OS9. An off the shelf hardware standard, utilizing current easily available technology.
   - Communication protocol from the "In Water" units to the controller must be of a type that does not limit the number of units possible per streamer.
   - Communications protocol from "In Water" units should also be of a type that allows for interfacing into Streamer Data Telemetry strings where necessary.
   - Communications Protocol should also be capable of supporting itself over long distances (nominal maximum of 12 Km is acceptable) at sufficient bandwidth to allow all sensor data to be read with-in a reasonable time period. (Nominal maximum of 5 seconds) — CYCLE TIME —
   - Communications Industry standards such as ATM or Differential RS422 are possible candidates. The Transmission protocol should be digital allowing for error correction, and cleaning of the signal. This again requires a higher bandwidth.
   - It is a requirement to be able to open user interfaces from locations other than the instrument room, such as for example the back-deck or remote vessels. We have several options here. If the interface is via spectra, it can be run via dtn to the other vessels. Iit may be slightly more difficult to get a fully functional PC based interface to a remote vessel, although Terminal server is one option.it should be controllable from any network connected machine.
   - User interface, Nice to be able to have the system controlled from any TCP/IP connected machine on the boat. Reduces the need for unnecessary cybex (KVM switch on a larger scale)
   - The steering functionality should include a number of modes:
     a) even separation mode → APPLIES TO ALL CABLES
     b) separation keeping → DIFFERENT SEPARATION FOR DIFF. CABLES
     c) deployment mode
     d) line change mode
     e) vertical staggering mode
     f) panic mode
     g) templates for user definable modes
     h) coverage mode
     i) steering against preplot or vessel track mode

EMERGENCY MODES

THESE MODES REQUIRE STEERAGE

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Parameters for maximum allowable steering, or force exerted by the units, need to be strictly defined, as this can have a detrimental effect on cable noise. Similar to adjacent wing angle specs in depth keeping.

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