

Claims:

1. A system for measuring a time offset of an acoustic sensor node relative to a reference time, the system comprising:
 - 5 an acoustic communications unit arranged to transmit a first acoustic probe signal to the acoustic sensor node;
a processing resource operably coupled to the acoustic communications unit and arranged to record a transmission time of the first signal, the transmission time being relative to the reference time; wherein
 - 10 the acoustic sensor node is arranged to receive the first signal and to transmit a second acoustic reply signal to the acoustic communications unit after a predetermined time delay, the second signal including time data indicative of a current internal time of the acoustic sensor node during the predetermined time delay; and
 - 15 the acoustic communications unit is arranged to receive the second signal, the processing resource recording a receive time at which the second signal is received, the receive time also being relative to the reference time, and to calculate the combined time of flight of the first and second signals, and using the combined time of flight and the predetermined time delay to calculate the time
 - 20 offset between the current internal time of the sensor node and the reference time.
2. A system as claimed in Claim 1, wherein the acoustic sensor node is arranged on the seabed and/or in the sea.
- 25 3. A system as claimed in Claim 1 or Claim 2, wherein the acoustic communications unit is coupled to or integrally formed with a surface vessel.
4. A system as claimed in any of the preceding claims, wherein the reference time is Coordinated Universal Time (UTC) or International Atomic Time (TAI).
- 30 5. A system as claimed in any of the preceding claims, wherein the sensor node is arranged to record seismic sample data.

6. A system as claimed in any of the preceding claims, further comprising:
a vessel motion compensation unit arranged to compensate, when in use,
for differences in the time of flight between the first signal and the second signal.

5 7. A system as claimed in Claim 6, further comprising:
a location determination system; wherein
the vessel motion compensation unit is arranged to use the location
determination system in order to determine a time compensation value associated
with vessel movement during measurement for application to the time offset.

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8. A system as claimed in Claim 6, wherein the processing resource is
arranged to calculate a first speed of the first signal with respect to a first vector
between a vessel at a first location and the sensor node, a second speed of the
second signal with respect to a second vector between the sensor node and the
15 vessel at a second location.

9. A system as claimed in Claim 6, wherein the motion compensation unit is
arranged to cooperate with a GNSS location determination system and an Attitude
and Heading Reference System.

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10. A system as claimed in any of the preceding claims, wherein the acoustic
communications unit is arranged to transmit a timing correction instruction to the
acoustic sensor node after calculation of the time offset, the sensor node being
arranged to use the time offset in order to update the internal time thereof to the
25 reference time.

11. A subsea seismic survey system comprising:
a plurality of acoustic seismic sensor nodes;
a surface vessel; wherein

30 the surface vessel comprises the acoustic communications unit and the
processing resource of the system as claimed in any one of the preceding claims;
and

the plurality of acoustic sensor nodes comprises the acoustic sensor node of the system as claimed in any one of the preceding claims.

12. A method of measuring a time offset of an acoustic sensor node relative to
5 a reference time, the method comprising:

transmitting a first acoustic probe signal to the acoustic sensor node from an acoustic communications unit;

recording a transmission time of the first signal, the transmission time being relative to the reference time;

10 the acoustic sensor node receiving the first signal and transmitting a second acoustic reply signal to the acoustic communications unit after a predetermined time delay, the second signal including time data indicative of a current internal time of the acoustic sensor node; and

the acoustic communications unit receiving the second signal and recording
15 a receive time at which the second signal is received, the receive time also being relative to the reference time, and calculating the combined time of flight of the first and second signals, and using the combined time of flight and the predetermined time delay to calculate the time offset between the current internal time of the sensor node and the reference time.

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13. A method as claimed in Claim 12, wherein the reference time is Coordinated Universal Time (UTC) or International Atomic Time (TAI).

14. A method as claimed in Claim 12 or Claim 13, wherein the internal time of
25 the acoustic sensor node is represented as a time value or as a count of the number of recorded seismic samples since a start of a seismic survey session.

15. A method as claimed in Claim 12 or Claim 13 or Claim 14, wherein seismic samples data is recorded by the sensor node.

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16. A method as claimed in any of Claims 12 to 15, wherein a vessel motion compensation unit calculates a compensation value for a difference between the time of flight of the first signal and the time of flight of the second signal.

17. A method as claimed in Claim 16, wherein the vessel motion compensation unit cooperates with a location determination system and calculates the time compensation value associated with vessel movement during measurement for application to the time offset.

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18. A method as claimed in Claim 16, further comprising:
calculating a first speed of the first signal with respect to a first vector between a vessel at a first location and the sensor node; and
10 calculating a second speed of the second signal with respect to a second vector between the sensor node and the vessel at a second location.

19. A method as claimed in any of Claims 12 to 18, further comprising:
15 transmitting a timing correction instruction to the acoustic sensor node after calculation of the time offset in order to update the internal time of the acoustic node to the reference time.

20. A method as claimed in any of Claim 12 to 19, wherein prior to the
20 transmission of the first signal, an activation signal is sent to the sensor node from the acoustic communications unit to instruct the sensor node to power up or leave a standby state.

21. A method as claimed in any of Claims 12 to 20, wherein after the sensor
25 node has completed participation in a seismic survey, a deactivation signal is sent to the sensor node from the acoustic communications unit to instruct the sensor node to power down or enter a standby state.

22. A method of performing a subsea seismic survey, the method comprising:
30 measuring seismic information using a plurality of sensor nodes; and
determining the time offset for each sensor node using the method of measuring a time offset as claimed in any one of Claims 12 to 21.

~~23. A system for measuring a time offset substantially as hereinbefore~~

~~described with reference to Figures 1, 3, 4, 5 or 6.~~

~~24. A method of measuring a time offset substantially as hereinbefore
described with reference to Figures 2, 3, 4, 5 or 6.~~