

# Calibrating the Time Drift of a Clock

## Field of Invention

The present invention relates to the field of geophysical surveys in a marine environment with help of nodes. Specifically, the present invention relates to calibrating the time drift of a clock attached to such nodes.

## Claims

1. What is claimed is a method of correcting a SIGNAL ARRIVAL TIME of a SIGNAL, which is received by a NODE with a NODE CLOCK, by a TIME DRIFT of said NODE CLOCK comprising the following steps:
  1. at least one NODE receiving at least one SIGNAL;
  2. said at least one NODE reading at least one SIGNAL ARRIVAL TIME of said at least one SIGNAL from at least one NODE CLOCK;
  3. at least one PINGER emitting at least one PRIMARY PING;
  4. said at least one PINGER reading at least one PRIMARY EMISSION TIME of said at least one PRIMARY PING from at least one PINGER TIMER;
  5. at least one NODE receiving said at least one PRIMARY PING;
  6. said at least one NODE reading at least one PRIMARY ARRIVAL TIME of said at least one PRIMARY PING from said at least one NODE CLOCK;
  7. said at least one NODE emitting at least one SECONDARY PING upon receiving said at least one PRIMARY PING;
  8. said at least one PINGER receiving said at least one SECONDARY PING;
  9. said at least one PINGER reading at least one SECONDARY ARRIVAL TIME of said at least one SECONDARY PING from at least one PINGER TIMER;
  10. determining at least one PING TRAVEL TIME based at least in part on
    1. said at least one PRIMARY EMISSION TIME of said at least one PRIMARY PING and
    2. said at least one SECONDARY ARRIVAL TIME of said at least one SECONDARY PING;
  11. determining at least one TIME DRIFT of said at least one NODE CLOCK based at least in part on at least one set out of
    1. a set comprising
      1. said at least one PRIMARY EMISSION TIME,
      2. said at least one PING TRAVEL TIME, and
      3. said at least one PRIMARY ARRIVAL TIME
    2. and a set comprising
      1. said at least one SECONDARY EMISSION TIME,
      2. said at least one PING TRAVEL TIME, and
      3. said at least one SECONDARY ARRIVAL TIME;
  12. correcting said at least one SIGNAL ARRIVAL TIME by said at least one TIME DRIFT.

2. The method of claim 1. wherein said at least one PINGER TIMER is a time signal broadcast by a satellite.
3. The method of claim 1. wherein said at least one PINGER TIMER is a time signal broadcast by a clock not attached to said PINGER.
4. The method of claim 1. wherein said at least one PINGER TIMER is a time signal provided by a PINGER CLOCK attached to said PINGER.
5. The method of claim 4. wherein said PINGER CLOCK is calibrated at least once before emitting said at least one PRIMARY PING SIGNAL.
6. The method of claim 4. wherein said PINGER CLOCK is calibrated at least once after receiving said at least one SECONDARY PING SIGNAL.
7. The method of claim 4. wherein said at least one PINGER is mounted on at least one underwater vehicle.
8. The method of claim 7. wherein said at least one underwater vehicle is an autonomous underwater vehicle.
9. The method of claim 7. wherein said at least one underwater vehicle is a remotely operated underwater vehicle.
10. The method of claim 1. wherein said at least one NODE receives both said at least one SIGNAL and said at least one PRIMARY PING by means of at least one HYDROPHONE.
11. The method of claim 10. wherein said at least one PRIMARY PING and said at least one SIGNAL are separated by means of frequency filtering.
12. The method of claim 1. wherein said at least one NODE receives both said at least one SIGNAL and said at least one PRIMARY PING by means of at least one GEOPHONE.
13. The method of claim 12. wherein said at least one PRIMARY PING and said at least one SIGNAL are separated by frequency filtering.

1. What is claimed is a system of correcting a SIGNAL ARRIVAL TIME of a SIGNAL, which is received by a NODE with a NODE CLOCK, by a TIME DRIFT of said NODE CLOCK comprising the following devices:

1. at least one PINGER comprising

1. at least one device providing time ("PINGER TIMER"),
2. at least one device capable of emitting at least one PRIMARY PING ("PRIMARY PINGER SOURCE") and reading at least one PRIMARY EMISSION TIME from said at least one PINGER TIMER,

and

3. at least one device capable of receiving at least one SECONDARY PING ("PRIMARY PINGER RECEIVER") and reading at least one SECONDARY ARRIVAL TIME from said at least one PINGER TIMER;

and

2. at least one NODE comprising

1. at least one device providing time ("NODE CLOCK"),
2. at least one device capable of receiving said at least one PRIMARY PING ("SECONDARY PINGER RECEIVER"),

3. at least one device capable of emitting at least one SECONDARY PING (“SECONDARY PINGER SOURCE”),  
and
  4. at least one device (“CONVENTIONAL NODE”) capable of receiving at least one SIGNAL and reading at least one SIGNAL ARRIVAL TIME from said at least one NODE CLOCK.
2. The system of claim 1. wherein at least one device (“PRIMARY PINGER”) comprises both at least one PRIMARY PINGER SOURCE and at least one PRIMARY PINGER RECEIVER.