

SYSTEM FOR TRACKING OF CONTAINERS

The application provides a system, a device, and a method for tracking of containers. In particular, the application provides a system, device, method for tracking of
5 containers using the Automatic Identification System (AIS).

Many commercial tracking systems comprise a Global Positioning System (GPS) receiver for determining geographical position information and means for communicating this
10 information to a central entity.

In one example, EDC76 system from European Datacomm, which is a satellite communication service provider, provides a tracing and tracking device that utilizes the Iridium satellite network. In another example, a tracker solution is provided by a provider, SPOT that is based on GEOS satellites. Certain products, like the R35-W from
15 Arknave and the PT1000 from PearTrack, also offer tracking using Global System for Mobile communications (GSM)/ General Packet Radio Service (GPRS) wireless networks, where such wireless networks are available. Other products, like Transit Unit from Global Tracking Technologies, use
20 Radio-frequency identification (RFID) communication.

US 20090177394 A1 discloses a method and a system for determining which vessel a container is loaded on using GPS information. Independent location information that is received from the container and the vessel is compared to
30 determine a distance between the vessel and the container. If the distance is within the length of the vessel, the container is considered as being loaded on the vessel.

US 20080186163 discloses a system for tracking the locations of a freight container using a self contained and a portable container tracking device. The container tracking device includes a Global Positioning System (GPS) receiver, an attachment mechanism to secure the tracking device to an interior of a container door, an intrusion detection system, and an alarm. The user can access the position and status information through a website Internet access to a centralized database, through SMS interrogation, or through SMS message updates. The user can load map information, trip alarm conditions, update method, as well as authentication information on a flash drive and then insert it in the tracking device. In the event an alarm condition is broken, an alarm is triggered and an alarm message is sent to the user. The tracking device is located inside the container whilst its antennas are located on the outside. This prevents damage, tampering, and theft of the tracking device.

It is an objective of this application to provide an improved tracking device with lower cost and higher availability of communication time.

The application provides a ship with one or more containers, which is transported by the ship. The ship could be any vessel that transports containers.

Referring to the container, it comprises a container position updating device that in turn comprises a container transceiver unit, a container memory unit, and a container processor unit.

The container transceiver unit is used for receiving one or more nearby ship Automatic Identification System (AIS) messages. The AIS messages comprise nearby ship positional information.

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The container memory unit is used for storing the received AIS messages. The container processor unit is used for determining container positional information using the received nearby ship AIS messages.

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The container transceiver unit is also used for broadcasting the determined container positional information together with container identification information. This is a new set of information. The container transceiver unit uses AIS format for the transmitting the information. This allows easy receiving by ships, since most ships have AIS receivers.

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Referring to the ship, it comprises an AIS device that comprises a ship transceiver unit, a ship memory unit, and a ship processor unit.

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The ship transceiver unit is used for receiving the container positional information and the container identification information from the container transceiver unit. This information can be easily received by most ships that are equipped with AIS receivers.

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The ship memory unit is used for storing the container positional information and the container identification information.

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The ship processor unit is used for incorporating the container positional information and the container identification information into a further AIS message. This allows transmission of container information via the AIS system, which is already existing and thus saving implementation cost.

The ship transceiver unit further broadcasts the further incorporated AIS message to a container tracking entity which may be on another ship, a satellite or a fixed station on land.

The application provides a container tracking entity. The container tracking entity may be on a ship, a satellite, or a fixed station on land. The entity includes an entity receiver, an entity memory unit, and an entity processor unit.

The entity receiver is intended for receiving one or more Automatic Identification System (AIS) messages from one or more ships. The ship AIS messages include container positional information and container identification information.

The entity memory unit is intended for storing the ship AIS messages. The entity processor unit is intended for determining container identification information and container positional information using the AIS messages.

The output unit is intended for outputting the determined container identification information and the determined container positional information to a unit, such as a

printer. The information can be used by a human being for evaluating whether everything is alright.

The application provides a container position updating
5 device. The device comprises a container transceiver unit, a container memory unit, and a container processor unit.

The container transceiver unit is used for receiving one or more nearby ship Automatic Identification System (AIS)
10 messages. The AIS messages include positional information of the nearby ships. The nearby ship can include a ship that is carrying or is transporting the container transceiver unit.

15 The container memory unit is used for storing the received AIS messages. The container processor unit is used for determining container positional information using the nearby ship received AIS messages. The container transceiver unit is also used for broadcasting the container
20 tainer positional information and container identification information to a container tracking entity via one of the ships.

The application provides a method of tracking a container.
25 The method includes a step of broadcasting or transmitting one or more AIS messages that comprises ship positional information by one or more ships. This is characterized in that the ship can be nearby the container. The ship also transports the container but can also be not
30 transporting the container. In other words, the container can receive AIS message from nearby ships and also from the ship that transports the container.

The AIS messages are then received by the container. After this, the container determines its container position using the AIS messages. Following this, the container broadcasts the determined container positional information and container identification information. The information allows other entity to recognize the container and its location.

The ship later receives the container positional information and the container identification information and it then incorporates the container positional information and the container identification information into a further AIS message. The further AIS message is afterward broadcasted by the ship to a container tracking entity.

Later, the container tracking entity determines container identification information and container positional information using the further AIS message. The container tracking entity also outputs the determined container identification information and container positional information to a unit, such as printer or display monitor.

The container position can be determined using more than one AIS message. This can provide for more accurate determination of container position.

The application provides a method of operating a container tracking entity. The method includes a step of receiving an Automatic Identification System (AIS) message from a ship. Container identification information and container positional information is later determined or derived using the AIS message. The determined container identification information and the determined container

positional information is afterward outputted to a unit, such as a printer or display monitor.

The application provides a method of operating a container position updating device. The method includes a step of receiving one or more nearby ship Automatic Identification System (AIS) messages. Container positional information is then determined using the received AIS messages. After this, container positional information and container identification information is broadcasted or is sent for transmitting to a container tracking entity via a ship AIS unit. The information may reach the container tracking entity via multi-hub or several intermediate nodes.

In summary, this application provides a method for container tracking. The method includes a step of determining a position of the container using information from at least one Automatic Identification System (AIS) of a ship that is in the proximity of the container. The AIS information has positional information of the nearby ship. All or most freight ships transmit this AIS information. The method has a benefit of not requiring the container to have any dedicated Global Positioning System (GPS) receiver.

Periodically, the container position information and identification information of the container is transmitted to the ship AIS. The received container information is then packaged or included in a binary message field of an AIS message.

The AIS message also includes complementary information. Detail information from several other containers that are also onboard the ship can also be consolidated and be include in the AIS message with no loss of information.

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The above described application has benefits of significant reduction of operating costs. Moreover, the application has a higher reliability and robustness as compared to other products that require an unobstructed sky for position fix. The position fix derives a position from measuring external reference points.

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It also avoids reception problems that are associated with Iridium-based satellite communication. A container that is placed between container stacks, that is placed in a container stack, or that is even placed inside a hull of the ship would experience difficulty receiving satellite signals. Large operational electrical power is not required by the application unlike other devices.

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Put differently, the application provides a device comprising a tracking unit, which operates without direct reception of the GPS positioning signal. The application then embeds container tracking data in an already available communication channel.

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In the following description, details are provided to describe the embodiments of the application. It shall be apparent to one skilled in the art, however, that the embodiments may be practiced without such details.

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Fig. 1 illustrates an embodiment of a side, a top, and a cross-sectional view of a ship that is loaded with containers,

5 Fig. 2 illustrates an embodiment of an Automatic Identification System (AIS) with extensions for a container tracking device that is on the ship of Fig. 1,

10 Fig. 3 illustrates an embodiment of the container tracking device estimating its position by listening to AIS information of ships that are in its proximity,

Fig. 4 illustrates another embodiment of the Automatic Identification System (AIS) of Fig. 2, and

15 Fig. 5 illustrates an embodiment of a container tracking device.

20 Figs. 1 to 5 have similar parts. The similar parts have same names or same part numbers. The description of the similar parts is hereby incorporated by reference, where appropriate, thereby reducing repetition of text without limiting the disclosure.

25 Fig. 1 depicts different views of an embodiment of a container ship 10.

To utilize space, multiple containers 12 are stacked on a deck 13 of the ship 10 whilst several containers 12 also placed in a hull 15 of the ship 12.

30 Each container 12 comprises a large metal box in which goods are packed. The metal box allows easy lifting and moving of the goods onto the ship 10 and also later easy moving of the goods onto a land transport vehicle.

The ship 10 is intended for travelling on water and can transport the containers 12 to different destinations.

5 Fig. 2 shows an embodiment of an Automatic Identification System (AIS) 20 for the ship of Fig. 1. The AIS 20 has extensions to support container tracking, which can operate transparently or seamlessly with other functions of the AIS 20.

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The AIS 20 has multiple communication channels. The communication channel is used in a time shared manner and generally in a broadcast manner. A ship B 23 has a communication channel 23 with a ship A 24 whilst the ship A 24
15 has a communication channel 26 with an AIS satellite 28 and a communication channel 29 with a fixed navigation structure 31, such as light house. The AIS satellite 28 has a communication channel 33 with a communication satellite 35. The AIS satellite 28, the fixed navigation
20 structure 31, and the communication satellite 35 have communication channels 37, 38, and 39 respectively with a central tracking entity 41. The central tracking entity 41 can include a Vessel Traffic Services (VTS) station.

25 The ship B 22 carries several containers 44 that have communication channels 43 with the ship B 22. Each container 44 has a container tracking device 42 that includes a short-range transceiver.

30 In practice, for most large vessels or ships, the use of the AIS 20 is a compulsory requirement. Several service providers can provide the AIS 20. The different parts of

the AIS 20 receive payloads or information from other AIS parts via their respective communication channels.

In a main usage of the AIS 20, AIS messages are exchanged
5 between the ship A 24 and the ship B 22 to reduce risk of collisions. The AIS message includes ship information, such as position, speed, and navigational status. These messages are exchanged via the Very High Frequency (VHF) range that is limited to within sight of each other. Put
10 differently, a maximum communication distance between the ship A 24 and the ship B 22 is mostly determined by the earth curvature and a height of antenna installation. The ship A 24 can thus exchange information with the ship B 22 when they are within sight of the each other.

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The ship A 24 and B 22 also communicates with the central tracking entity 41 using the AIS messages. The ship A 24 has a GPS receiver for obtaining its positional information via a satellite means.

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The container tracking device 42 communicates or for exchanges information with the ship B 22 as well as with the nearby ship A 24 via the short range transceiver using the AIS message. As most ships already have AIS communication systems, small or no infrastructure changes
25 need to be make for communicating with the container tracking device 42.

In a secondary usage of the AIS 20, the information can
30 then be stored to provide a tracking of the ship A 24 and the ship B 22 as well as tracking of containers 44 are onboard the ship B 22. For non coastal areas, the infor-

mation is often updated only several times a day such that the information can be a few hours old.

One possible way of using the AIS 20 to track the containers 44 is described below.

1. Determination of position

The container tracking device 42 utilizes location information of nearby ships to determine its own position. The container position is determined without use of a dedicated Global Positioning System (GPS) receiver. This is an important feature of this embodiment.

The container tracking device 42 determines its position using AIS information of the nearby ship A 24. The container tracking device 42 receives AIS messages from the nearby ship A 24 via its short range transceiver. The AIS message includes positional information of the nearby ship A 24. Since the container tracking device 42 is near to the ship A 24, the container tracking device 42 can assume that it is at the position of the ship A 24.

To improve accuracy of positional determination, the container tracking device 42 can determine its position using AIS information of several nearby ships, instead of just one nearby ship A 24.

Additionally, speed information and heading or directional information of the nearby ship A 24 can also be combined or included with semantic reasoning or logical reasoning to improve the computation of the present position fix of the container 44. The position fix refers to

a derivation of a position or a location from measuring external reference points. As one example, semantic reasoning can use period of time since receiving a first AIS information signal to determine present position fix of the container 44.

This method can also be complemented by additional information that is provided by vibration, motion and light sensors, which are placed within the container tracking device or placed within the container 44. These sensors can provide additional information, such as movement of the container 44 or opening of the container 44.

AIS messages of two nearby ships can also be used to determine a present position of a container, as shown in Fig. 3. Fig. 3 depicts a ship A 45 and a ship C 47 that are nearby a ship B 46 that carries a container 50. A container tracking device 51 is mounted in the container 50.

The ship A 45, the ship B 46, and the ship C 47 have transceivers 52, 53, and 54 respectively for communicating with each other. The ship B 46 is within a communication range 49 of the ship A 45 and within a communication range 43 of the ship C 47.

In this case, the container tracking device 51 obtains AIS information of the ship A 45 and AIS information of the ship C 47. The AIS information of the ship A 45 has positional information of the ship A 45. Likewise, the AIS information of the ship C 47 has positional information of the ship C 47. From both of the positional infor-

mation, the container tracking device 51 then determines its position.

5 The above described way or method to determine container position has several benefits. It uses already available or existing infrastructure that is trustworthy and that provides a comprehensive system for ship tracking.

The method avoids use of GPS hardware that saves cost.
10 Furthermore, it also avoids limitations of the GPS hardware and is thus more reliable and robust. The GPS hardware requires an unobstructed sky for satellite reception. Moreover, the GPS hardware can be mounted in the container is placed within a stack of containers or be located
15 inside a steel hull of the ship. In these situations, the GPS hardware would experience difficulty in receiving satellite signals.

2. Container-ship communication

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Referring to Fig. 2, the container tracking device 42 can identify the ship B 22 that is carrying the container 45. This identification enables a communication link between the container tracking device 42 and its ship B 22 for
25 transmission of positional information of the container tracking device 42 to the ship B 22.

The carrying or bearing ship B 22 can be identified by comparing a positional tracking record of the container
30 tracking device 42 with the positional information of ships. The tracking record is also called a travelling log. A ship carries the container would have the same positional information over a certain length of time.

The container tracking device 42 then transmits its position and its identification information to an AIS component of the identified carrying ship B 22 using AIS message format. The transmission can use a range-limited AIS transmitter with special identification or use a dedicated onboard communication system.

The above described step can be performed periodically or only when needed to reduce power consumption. The need for performing this step can be identified using conceptual information, like a container cannot be moved unless it is sitting on top or near top of a stack of containers.

This way of establishing container to ship communication has the advantage of no or low operational cost since no external service provider is needed. For containers that are placed inside the hull of the ship, only a simple communication infrastructure can be implemented to enable these containers to communicate with the ship.

The container tracking device 42 can have reduced electrical power consumption if smart sensing, such as sensing of environmental changes, is employed to start up the container tracking device. Since a desired communication range of the container tracking device 42 is limited, its power consumption can also be low.

3. Ship communication

The ship B 22 later receives the container positional information along with container identifier information.

The container positional information and the container identifier information are then packaged or are included in a protocol binary message field of an AIS message of the ship B 22 for sending out. This manner of sending enables a transparent or seamless integration of the container positional information with the other functions or information of the AIS 20.

Complementary information and other detail information from several other containers 44 onboard the ship B 22 can be combined or be consolidated to produce a small data set for sending with no loss of information. Further, the ship can also include auxiliary data for adding value or information to the container tracking information.

Afterward, the ship B 22 sends out the received container positional information and the container identifier information to the central tracking entity 41. Since the binary message can contain a unique receiver address, multi-hub transmission is possible. In other words, one or more hubs can receive the message for transmitting to its destination address. This greatly increases the communication range.

In one example, the fixed navigation structure 31 receives multiple AIS information from different ships A 24. This information is then combined for transmission to the central tracking entity 41. In another example, the AIS satellite 28 receives multiple AIS information from different ships A 24. This information is also combined for transmission to the central tracking entity 41. This combination of information optimizes or improves signal

bandwidth by using one AIS message for multiple containers instead of one AIS message for every container.

The central tracking entity 41 afterward identifies and
5 locates the respective container using the received container positional information and the container identifier information. In other words, the central tracking entity 41 tracks the container 44 using the above said information.

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Fig. 4 shows another embodiment of the AIS of Fig. 2. Fig. 4 includes parts of Fig. 2. The ship B 22 has a communication channel 60 with the AIS satellite 28. The ship B 22 obtains its own positional information via a satellite
15 means.

A method of tracking the container 44 includes the step of the container tracking device 44 communicating with the ship B 22 and of obtaining the positional information
20 of the ship B 22 to determine its container position. The container tracking device 42 then identifies that the ship B 22 is carrying the container 44. It later sends its positional information to the ship B 22 for sending to the central tracking entity 41 for container tracking.

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Fig. 5 shows an embodiment of a container tracking device. Fig. 5 shows the container tracking device 42 of Fig. 2. The tracking device 42 includes a transceiver 65 that is connected to a processing unit 67 via a radio modem 69.
30 The processing unit 67 is connected to a computer memory unit 68.

The tracking device 42 is intended for mounting inside a container for providing tracking information. The transceiver 65 is used for communicating with nearby ships including the ship that is carrying the container, which
5 has the tracking device. The communication uses AIS message of the nearby ship for determining tracking device or container position. The radio modem 69 acts to convert signals between the transceiver 65 and the processing unit 67. The processing unit 67 executes a program that
10 is stored in the computer memory unit. The program directs the processing unit 67 to receive the nearby ship AIS message and to compute the container position.

Although the above description contains much specificity,
15 these should not be construed as limiting the scope of the embodiments but merely providing illustration of the foreseeable embodiments. Especially the above stated advantages of the embodiments should not be construed as limiting the scope of the embodiments but merely to explain possible achievements if the described embodiments
20 are put into practice. Thus, the scope of the embodiments should be determined by the claims and their equivalents, rather than by the examples given.

Reference

	10	ship
	12	container
5	13	deck
	15	hull
	20	Automatic Identification System
	23	ship B
	23	communication channel
10	24	ship A
	26	communication channel
	28	AIS satellite
	29	communication channel
	31	fixed navigation structure
15	33	communication channel
	35	communication satellite
	37	communication channel
	38	communication channel
	39	communication channel
20	41	tracking entity
	43	communication channel
	42	container tracking device
	43	communication range
	44	container
25	45	ship A
	46	ship B
	47	ship C
	48	communication range
	49	communication range
30	50	container
	51	container tracking device
	52	transceiver
	53	transceiver

54 transceiver
60 communication channel
65 transceiver
67 processing unit
5 68 computer memory unit
69 radio modem

Claims

1. A ship with at least one container which is transported by the ship,
- 5 the container comprising a container position updating device that comprises
- a container transceiver unit (65) for receiving at least one Automatic Identification System (AIS) message,
 - 10 - a container memory unit (68) for storing the received at least one AIS message, and
 - a container processor unit (67) for determining container positional information using the received AIS message, wherein the container
 - 15 transceiver unit (65) further broadcasts the determined container positional information together with container identification information
- and
- 20 the ship comprising
- an AIS device that comprises
- a ship transceiver unit for receiving the container positional information and the container identification information,
 - 25 - a ship memory unit for storing the container positional information and the container identification information, and
 - a ship processor unit for incorporating the container positional information and the container identification information into a further AIS message, wherein the ship transceiver
 - 30 unit further broadcasts the further incorporated AIS message.

2. A container tracking entity comprising
an entity receiver for receiving at least one
Automatic Identification System (AIS) message,
5 an entity memory unit for storing the at least
one AIS message, and
an entity processor unit for determining con-
tainer identification information and container po-
sitional information using the at least one AIS mes-
10 sage, and
an output unit for outputting the determined
container identification information and the deter-
mined container positional information.
- 15 3. A container position updating device comprising
a container transceiver unit (65) for receiving
at least one Automatic Identification System (AIS)
message,
a container memory unit (68) for storing the at
20 least one AIS message, and
a container processor unit (67) for determining
container positional information using the received
AIS message, wherein the container transceiver unit
(65) further used for broadcasting the container po-
25 sitional information and container identification
information to a container tracking entity via one
of the at least one ship.
4. A method of tracking a container comprising
30 broadcasting at least one AIS message that com-
prises ship positional information by at least one
ship,

receiving the at least one AIS message by the container,

determining a container position using the at least one AIS message by the container,

5 broadcasting the determined container positional information and container identification information by the container,

10 receiving the container positional information and the container identification information by the ship,

incorporating the container positional information and the container identification information into a further AIS message by the ship,

15 broadcasting the further AIS message by the ship to a container tracking entity,

determining container identification information and container positional information using the further AIS message by the container tracking entity, and

20 outputting the determined container identification information and container positional information.

5. A method of claim 4, wherein
25 the ship is nearby the container.

6. A method of claim 4, wherein
 the ship transports the container.

30 7. A method of one of claims 4 to 6 wherein
 the container position is determined using more than one AIS message.

8. A method of operating a container tracking entity comprising
- receiving an Automatic Identification System (AIS) message from a ship,
- 5 determining container identification information and container positional information using the AIS message, and
- outputting the determined container identification information and the determined container positional information.
- 10
9. A method of operating a container position updating device comprising
- receiving at least one Automatic Identification
- 15 System (AIS) message,
- determining container positional information using the at least one received AIS message, and
- broadcasting the determined container positional information and container identification in-
- 20 formation for transmitting to a container tracking entity via a ship AIS unit.