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(71) Applicant: **WÄRTSILÄ FINLAND OY** [FI/FI]; Tarhaajantie 2, FI-65380 Vaasa (FI).

(72) Inventors: **NORDLUND, Bjarne**; Tavitie 4, FI-65320 Vaasa (FI). **HELO, Petri**; Kesärannantie 4, FI-65280 Vaasa (FI).

(74) Agent: **LEITZINGER OY**; Tammasaarenkatu 1, FI-00180 Helsinki (FI).

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(54) Title: AN INTEGRATED TRACKING SYSTEM AND METHOD

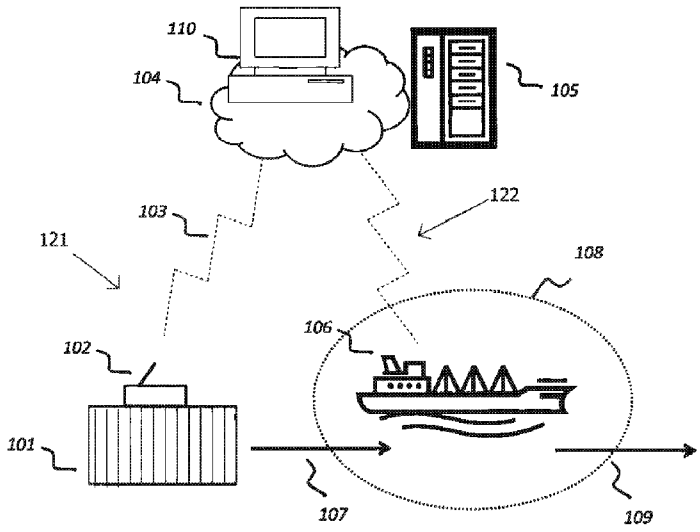

Fig. 3

(57) Abstract: The object of the invention is an integrated tracking system to track transported objects (101) in a transportation system comprising means (102) for providing at least location information of said at least one transported object (101). The integrated tracking system comprises at least one processor unit (110) to form and store a predetermined model of transportation information of said at least one object (101), the predetermined model comprising at least change-over location area (108) information as said transportation information of the at least one transported object, and the integrated tracking system comprises at least two tracking sub-systems (121, 122) comprising the means (102) for providing at least location information of said at least one transported object at least when it arrives to a change-over location area (108). Further, the integrated tracking system comprises at least one processor unit (110) in which is integrated utilization of said at least location information from at least two tracking sub-systems (121, 122) by comparing at least location information from different tracking sub-systems (121, 122) to said predetermined model.

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AN INTEGRATED TRACKING SYSTEM AND METHOD

The field of the invention

The invention relates to a tracking system and a method in transportation.

The state of the art

United Nations Multimodal Convention defines multimodal transport as follows: " 'International multimodal transport' means the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by the multimodal transport operator to a place designated for delivery situated in a different country". An example of multi-modal transportation could include a container being loaded from a trailer truck into a vessel and from the vessel into rail transportation in the destination harbour.

Tracking devices are electronics used for observing object movements and supplying timely ordered sequence of respective location and sensory data to depict the motion of goods. Typically tracking devices comprise of location detecting system, such as satellite based positioning systems e.g. GPS, GLONASS, Gagan or other GPS, microcontroller and radio transmitter/receiver system communicating frequently upstream to provide information for remote computer unit.

Tracking devices are mounted on material handling units such as transport containers. The challenges with currently available systems are two-fold: Firstly, on global transportation routes, the transport containers are placed in locations with limited location system coverage, for instance pallets placed in

metallic sea containers or sea containers placed under the metallic deck of a container ship. In these kind of conditions may exist a so called Faraday shield phenomena causing serious operation problems for example to GPS based tracking. Secondly, in the radio communication to remote computer unit, the monitoring performance of the tracking device status is similarly limited or non-existing.

Vehicles on road and rail, as well as airplanes and seagoing vessel can be equipped with special tracking systems capable of sending location information to external computers. Truck companies have introduced such solutions for fleet management. For sea-going vessels, AIS (Automatic Identification System) provides similar information available in the Internet. Commercial aviation flights can be tracked similarly by using data provided by airplane transponder systems. These specific solutions are using advanced location devices with constant satellite visibility.

The prior art tracking embodiments suffer from lack of successful integration methods between different tracking environments and systems. This causes practical problems especially for an international user because up-to-date and correct tracking information is available only occasionally.

Short description of the invention

The present invention relates to the field of tracking packages and shipments in logistics, more specifically, by use of mobile tracking devices, telecommunication and centralized computers. The object of the invention is to accomplish an integrated tracking system which can successfully utilize up-to date information from different tracking systems. This is achieved by an integrated tracking system to track transported objects in a transportation system comprising means for providing at least location information of said at least

one transported object. The integrated tracking system comprises at least one processor unit to form and store a predetermined model of transportation information of said at least one object, the predetermined model comprising at least change-over location area information as said transportation information of the at least one transported object, and the integrated tracking system comprises at least two tracking sub-systems comprising the means for providing at least location information of said at least one transported object at least when it arrives to a change-over location area, and the integrated tracking system comprises at least one processor unit in which is integrated utilization of said at least location information from at least two tracking sub-systems by comparing at least location information from different tracking sub-systems to said predetermined model.

The focus of the invention is also a method for integrated tracking of transported objects in transportation, in which method is provided at least location information of at least one transported object. In the method is formed and stored a predetermined model of transportation information of said at least one object, the predetermined model comprising change-over location area information as said transportation information of the at least one transported object, and in the method is provided at least location information of said at least one transported object at least when it arrives to a change-over location area between at least two tracking sub-systems, and is integrated utilization of said at least location information from at least two tracking sub-systems by comparing at least location information from different tracking sub-systems to said predetermined model.

The invention is based on integration of different tracking systems by utilizing a predetermined model of transportation information of at least one transported object. The predetermined model comprises change-over location area information for the at least one transported object. The tracking systems comprise means for providing at least location information of said at

least one transported object at least when it arrives to a change-over location area. Integrated utilization of at least location information from at least two tracking systems is performed for example in a central processor unit by comparing at least location information from different tracking systems to said predetermined model.

The benefit of the invention is that an up-to-date and even worldwide tracking information can be made available to the user by utilizing transportation information gained from different kinds of tracking conditions and systems.

Short description of figures

Figure 1 presents a flow chart of method steps for tracking multi-modal transportation tracking by using location tracker roaming.

Figure 2 presents an example of user interface by visualizing object tracking.

Figure 3 presents an architecture of an integrated system for tracking multi-modal transportation by using location tracker roaming.

Detailed description of the invention

The present invention relates to a system and method for tracking different kinds of transported objects, i.e. packages, shipments, transport containers etc. in multi-modal transportation. The system comprises of a server computer, i.e. a processor unit, receiving location and preferably also sensory data from transmitter/receiver tracking devices mounted for example onto transport containers and similar tracking devices mounted into vehicles such as into seagoing vessels. The invention can be applied in different kinds of logistics environments comprising different transportation and storage modes. For example the invention can be successfully utilized in a multimod-

al transportation system, the definition of which is given above in the beginning of the "State of the art" chapter.

The method according to the invention comprises of steps: 1) A server computer stores location coordinates of change-over area, 2) a first tracking device mounted onto the transport container sends location information to the server computer frequently or infrequently, 3) hibernating second tracking device mounted onto the vehicle has arrived inside a defined, i.e. a predetermined change-over location area, 4) the server computer changes monitoring tracking to the second tracking device mounted onto the vehicle located now in the same change-over area as the first tracking device, i.e. the second tracking device cease to hibernate and the first tracking device starts to hibernate, and 5) the server computer changes the tracking focus back to the first tracking device once the vehicle has arrived to a new change-over area.

Despite multi-modal transportation and change-over between tracking devices, the user of server computer is constantly able to track route of the transported object visualized on computer user interface. Also in this embodiment of a system, the user interface may be a web browser based application, or any other application capable to be run on computer.

In figure 1 is presented a flow chart of method steps for tracking multi-modal transportation by using location tracker roaming. The method starts 111 when location information of the first tracking device 102 is received and stored 112 by the server computer, i.e. by the processor unit. The server computer compares 113 the latest stored location information to predetermined change over area. In case the first tracking device 102 is not inside the predetermined change over area, the method is continued in loop by performing next 111. In case the first tracking device 102 has arrived to the

predetermined change-over area, the first tracking device 102 will hibernate 114 and server computer starts receiving and storing 115 location information from the second tracking device 102 mounted into a vessel or a vehicle. This is performed until the second tracking device informs arrival to a new change-over location area, where the server computer changes tracking focus back to step 112, i.e. to the first tracking device.

In figure 2 is presented an example of user interface, which visualizes object tracking. The user interface 117 shows on a computer screen the movement of the tracked object (for example the transport container). For user, the visualized tracking information seem to be constant, when computer automatically combines the received and stored information from the first tracking device 118 inside and outside the change-over area 108 and the received and stored information from the second tracking device 120. Said combination results as a seamless object tracking record as visualized on the computer screen of figure 2.

Preferred embodiments according to the present invention can be described on the basis of the exemplary figure 3. An integrated tracking system tracks transported objects 101 in multimodal transportation system. Transported objects 101 can comprise for example ship engine parts, which are packed into boxes, i.e. into transport containers 101, and the multimodal transportation system comprises for example sea vessel transportation, trailer track transportation and forklift truck transportation on factory areas. The tracking system comprises means 102 for providing location information of said at least one transported object 101. These means 102 are preferably signal transmitting and receiving devices 102, which form and transmit location and/or sensory information in a wireless telecommunication network 103, and also receives for example on/off signals in said network 103. Thus the means 102 comprise at least one antenna and electronics to form location information for example based on GPS technology, at least one transmitter

and at least one receiver, and the means 102 may also comprise measuring technology, sensors etc, to form for example humidity and/or temperature information as said sensory information. For example in a factory environment the means 102 can be implemented with tag technology, which can be integrated with needed electronics and measuring technology. The signal transmitting and receiving devices 102 are preferably mounted to the transported object 101, i.e. to the transport container 101. The signal information transmitted by the means 102 to the telecommunication network 103 is received by at least one processor unit 110 in the integrated tracking system. The processor unit(s) 110 can also transmit for example said on/off signals to the means 102 through the telecommunication network 103. The processor unit(s) 110 comprise transmitter and receiver technology to perform said transmitting and receiving operations. Said telecommunication network 103 can be simply a telecommunication connection between the means 102 and the processor unit(s) 110 via, for example, the antenna of the means 102 and an antenna of the processor unit(s) 110. Said telecommunication network 103 can also be for example global internet network or a local data communication network or said two networks integrated together.

The preferred integrated tracking system comprises at least one processor unit 110 to form and store a predetermined model of transportation information of said transport container 101. The predetermined model comprises change-over location area 108 information as said transportation information of the at least one transport container. The change-over location area 108 locates for example between sea vessel transportation and trailer track transportation, i.e. in a harbour side, and between trailer track transportation and forklift truck transportation on a factory loading and unloading area. Furthermore the predetermined model can comprise a timely planned transportation route information. Said at least one processor unit 110 locates for example in a central computer unit of the integrated tracking system. It is apparent that for example forming of the predetermined model and storing of

the predetermined model can be performed in a same processor unit 110 or in separated processor units 110.

In one preferred embodiment (figure 3) of the invention, the integrated tracking system comprises at least one processor unit 110 to set limit values of the transportation information in the predetermined model. These limit values are for example time limit values of an arrival of the transport container 101 to the change-over location area 108 or of a departure of the transport container 101 from the change-over location area 108. The signal information transmitted by the means 102 to the telecommunication network 103 comprises also time information of the arrival of the transport container 101 to the change-over location area 108 or time information of the departure of the transport container 101 from the change-over location area 108, and said transmitted signal information is received by the processor unit 110 or directly by an alarm processor 123 in the integrated tracking system. The alarm processor 123 can be integrated to the processor unit 110 or locating separately from the processor unit 110 for example in the central computer unit for comparing the provided, i.e. received information from the means 102 to the limit values and for performing an alarm function in the integrated tracking system when the provided information exceeds one or more limit value.

The integrated tracking system comprises at least two tracking sub-systems 121, 122, and each of these tracking subsystems comprises the means 102 for providing at least location information of said at least one transported object at least when it arrives to the change-over location area 108. These tracking sub-systems 121, 122 operate preferably on different geographical areas 118, 120. In one preferred embodiment according to the invention presented in figure 3 the first tracking sub-system 121 operates in land transportation, i.e. in trailer track transportation and in forklift truck transportation and the second tracking sub-system 122 operates in sea vessel transportation. Also there can be a third tracking sub-system operating on factory

areas. The integrated tracking system comprises the processor unit 110 to change tracking of the transported object 101 from a first tracking sub-system 121 to a second tracking sub-system 122 when the transported object arrives to the change-over location area 108 on the basis of the received location area information. In the processor unit 110 is integrated utilization of at least location information from at least two tracking sub-systems 121, 122 by comparing location information and/or other information from different tracking sub-systems 121, 122 to information in the predetermined model. The other information is for example humidity information as a part of said transportation information received from the means 102 telling information on transportation conditions in a sea vessel 106. The other described limit value comparisons, location information comparisons and/or other information comparisons can be performed in a same processor unit 110 or in separated processor units 110, which can utilize any suitable calculation programs, algorithms, data processing and analyzing programs, etc to perform the method steps according to the present invention.

In one preferred embodiment presented in figure 3 the transport container 101 is physically moved 107 in the harbour into the sea vessel 106, which is located inside a preliminary defined change-over area 108. The processor unit 110 acknowledges this location change on the basis of the signal information received from first means 102 mounted to the transport container 101, and the processor unit 110 changes the operation state to transmission from second means 102 mounted to the sea vessel 106. Said second means 102 are used in tracking movements 109 and location 109 of the sea vessel 106, the transport container 101 being transported inside said sea vessel. In this change of operation state the processor unit 110 sends an "off signal" to the first means 102, which hibernate, and the processor unit 110 sends an "on signal" to the second means 102, which start to operate, and the tracking operation is changed from the first tracking sub-system 121 to the second tracking sub-system 122. The described automatic change-over between transport container level information 121 and sea vessel level information

122 can be similarly implemented for example between transport container level information and trailer truck level information.

The described preferred embodiment presented in figure 3 is especially beneficial when transporting outside the coverage area of the prior art tracking devices. This embodiment can be implemented by utilizing a centralized processor unit 110 containing information of the predetermined change-over areas 108 and communication protocols between the processor unit 110 and means 102 for providing at least location information of the transport container or sea vessel or trailer truck, etc. Said communication protocols can be supported for example by mobility management, authentication and authorization procedures to implement the preferred tracking method, i.e. roaming according to the present invention.

The embodiments according to the present invention have several advantages over the prior art. Firstly, for each planned shipment, a consolidated tracking view can be provided despite coverage problems in one or more tracking sub-systems. Secondly, battery lifetime of the tracking device (i.e. means 102) can be extended by hibernating the system based on described change-over operation between the tracking sub-systems. Thirdly, tracking information provided by multiple tracking devices (mounted into a vehicle, onto a transport containers, etc) from different tracking sub-systems can be used to verify information by utilizing comparison methods between the information from different tracking sub-systems.

Although the invention has been presented in reference to the attached figures and specification, the invention is by no means limited to those, as the invention is subject to variations within the scope allowed for by the claims.

Claims

1. An integrated tracking system to track transported objects (101) in a transportation system comprising means (102) for providing at least location information of said at least one transported object (101), **characterized** by, that the integrated tracking system comprises at least one processor unit (110) to form and store a predetermined model of transportation information of said at least one object (101), the predetermined model comprising at least change-over location area (108) information as said transportation information of the at least one transported object, and the integrated tracking system comprises at least two tracking sub-systems (121, 122) comprising the means (102) for providing at least location information of said at least one transported object at least when it arrives to a change-over location area (108), and the integrated tracking system comprises at least one processor unit (110) to change tracking of the transported object (101) from a first tracking sub-system (121) to a second tracking sub-system (122) when the transported object arrives to the change-over location area (108) between the tracking sub-systems (121, 122) on the basis of the provided location area information, and in which processor unit (110) is integrated utilization of said at least location information from at least two tracking sub-systems (121, 122) by comparing at least location information from different tracking sub-systems (121, 122) to information in said predetermined model to verify information by utilizing comparison methods between the provided information from different tracking sub-systems.

2. An integrated tracking system in accordance with claim 1, **characterized** by, that the predetermined model comprises a timely planned transportation route information.

3. An integrated tracking system in accordance with claim 1, **characterized** by, that the integrated tracking system comprises tracking sub-systems (121, 122) operating on different geographical areas (118, 120).

4. An integrated tracking system in accordance with claim 1, **characterized** by, that the tracking subsystems comprise means (102) for providing at least humidity information as a part of said transportation information.

5. An integrated tracking system in accordance with claim 1, **characterized** by, that the integrated tracking system comprises at least one processor unit (110) to set limit values of the transportation information in the predetermined model, and an alarm processor (123) for comparing the provided information to the limit values and for performing an alarm function in the integrated tracking system when the provided information exceeds one or more limit value.

6. A method for integrated tracking of transported objects (101) in transportation, in which method is provided at least location information of at least one transported object (101), **characterized** by, that in the method is formed and stored a predetermined model of transportation information of said at least one object (101), the predetermined model comprising change-over location area (108) information as said transportation information of the at least one transported object, and in the method is provided at least location information of said at least one transported object (101) at least when it arrives to a change-over location area (108) between at least two tracking sub-systems (121, 122), is changed tracking of the transported object (101) from a first tracking sub-system (121) to a second tracking sub-system (122) when the transported object arrives to the change-over location area (108) between the tracking sub-systems (121, 122) on the basis of the provided location area information, and is integrated utilization of said at least location information from at least two tracking sub-systems (121, 122) by comparing at least location information from different tracking sub-systems (121, 122)

to information in said predetermined model, and in the method is verified information by utilizing comparison methods between the provided information from different tracking sub-systems.

7. A method in accordance with claim 6, **characterized** by, that in the method is formed and stored the predetermined model by forming a timely planned transportation route information.

8. A method in accordance with claim 6, **characterized** by, that the tracking sub-systems (121, 122) operate on different geographical areas (118, 120).

9. A method in accordance with claim 6, **characterized** by, that in the method is provided at least humidity information as a part of said transportation information.

10. A method in accordance with claim 6, **characterized** by, that in the method is set limit values of the transportation information in the predetermined model, is compared the provided information to the limit values, and is performed an alarm function when the provided information exceeds one or more limit value.

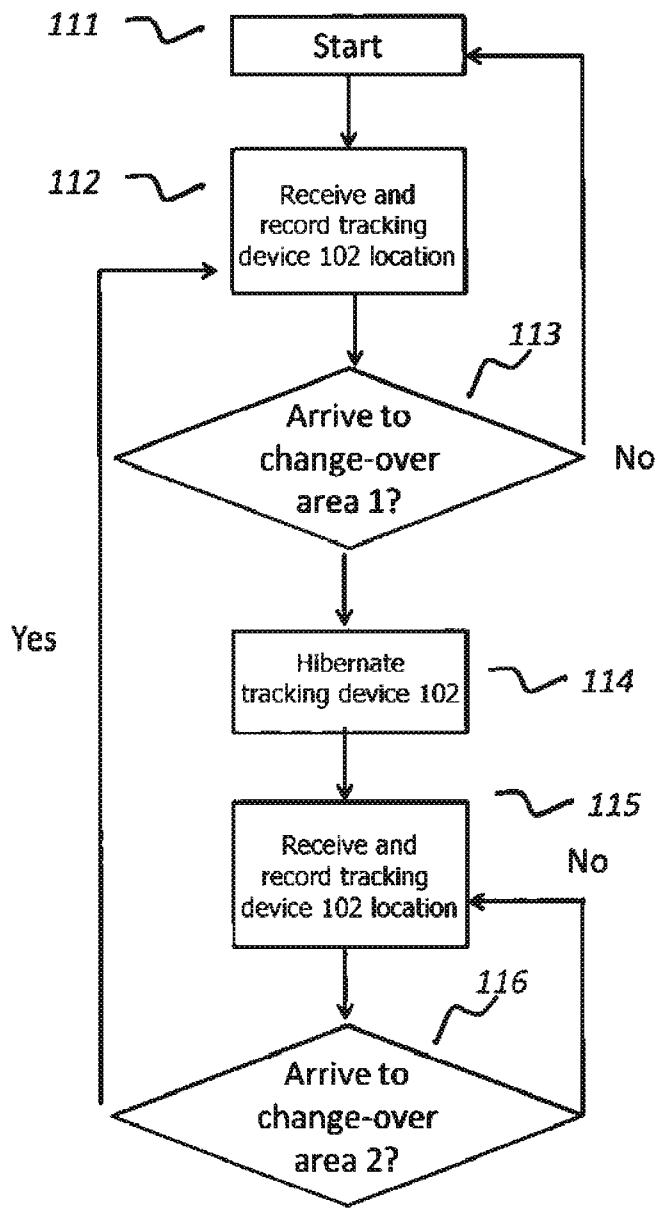
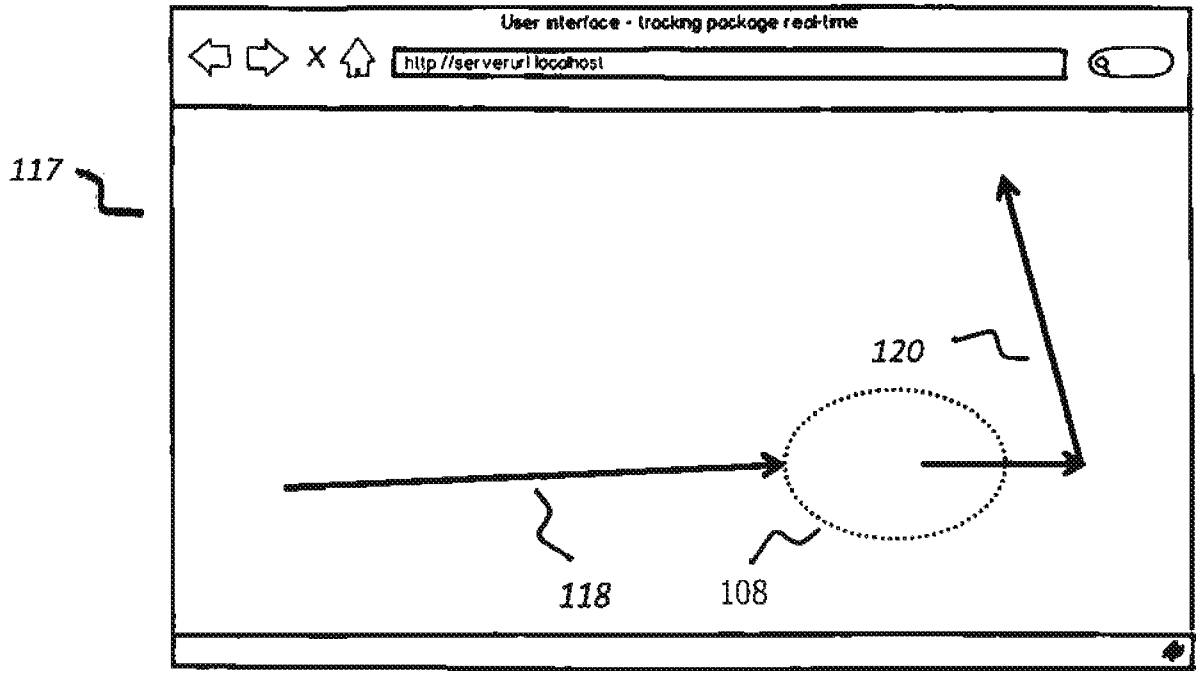

111
Start
112
Receive and record tracking device 102 location
113
Arrive to change-over area 1?
No
Yes
Hibernate tracking device 102
114
115
Receive and record tracking device 102 location
No
116
Arrive to change-over area 2?

Fig. 1


User interface - tracking package real-time
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117
120
118
108

Fig. 2

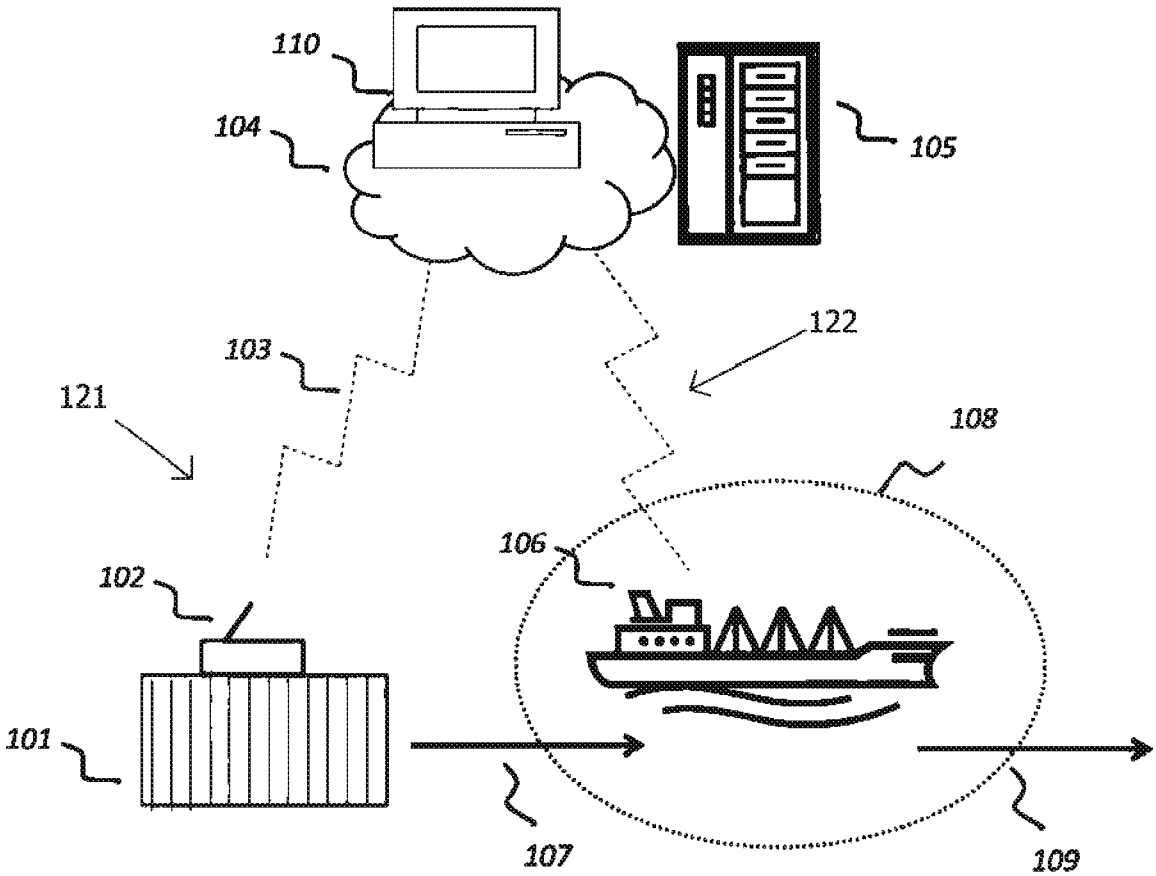

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2013/050632

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/08 G06Q50/30
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/104675 A2 (SKYBITZ INC [US]; BROSIUS JAY [US]) 10 November 2005 (2005-11-10) the whole document	1-10
X	US 2007/216542 A1 (BROSIUS JAY [US] ET AL) 20 September 2007 (2007-09-20) the whole document	1-10
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2013	16/08/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Guenov, Mihail

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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