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(54) **SYSTEMS AND METHODS FOR HANDLING DISCRETE SENSOR INFORMATION IN A TRANSPORT REFRIGERATION SYSTEM**

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(57) **ABSTRACT**

Systems and methods for handling discrete sensor information in a transport refrigeration system are provided. In one embodiment, a wireless control system for a transport refrigeration system is provided. The wireless control system includes two or more wireless end nodes and a network coordinator. Each of the wireless end nodes is configured to monitor a property of the transport refrigeration system. The network coordinator is configured to manage, command, direct and regulate the behavior of the wireless end nodes. Also, the network coordinator includes a sensor to zone coordinator that is configured to combine sensor data received by the two or more wireless end nodes to control a single transport refrigeration system function of the transport refrigeration system.

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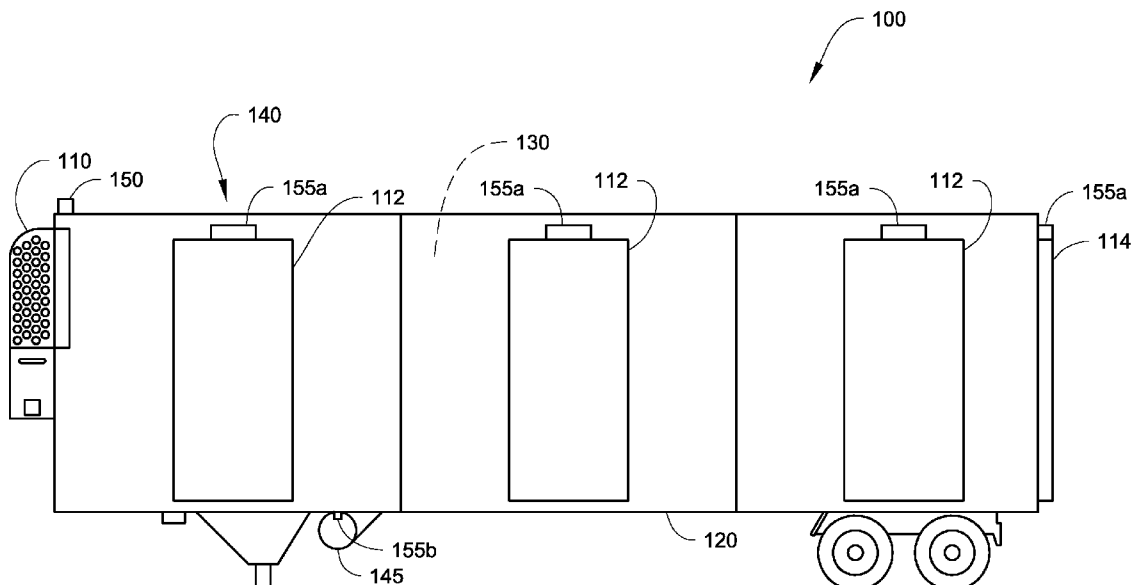


Fig. 1

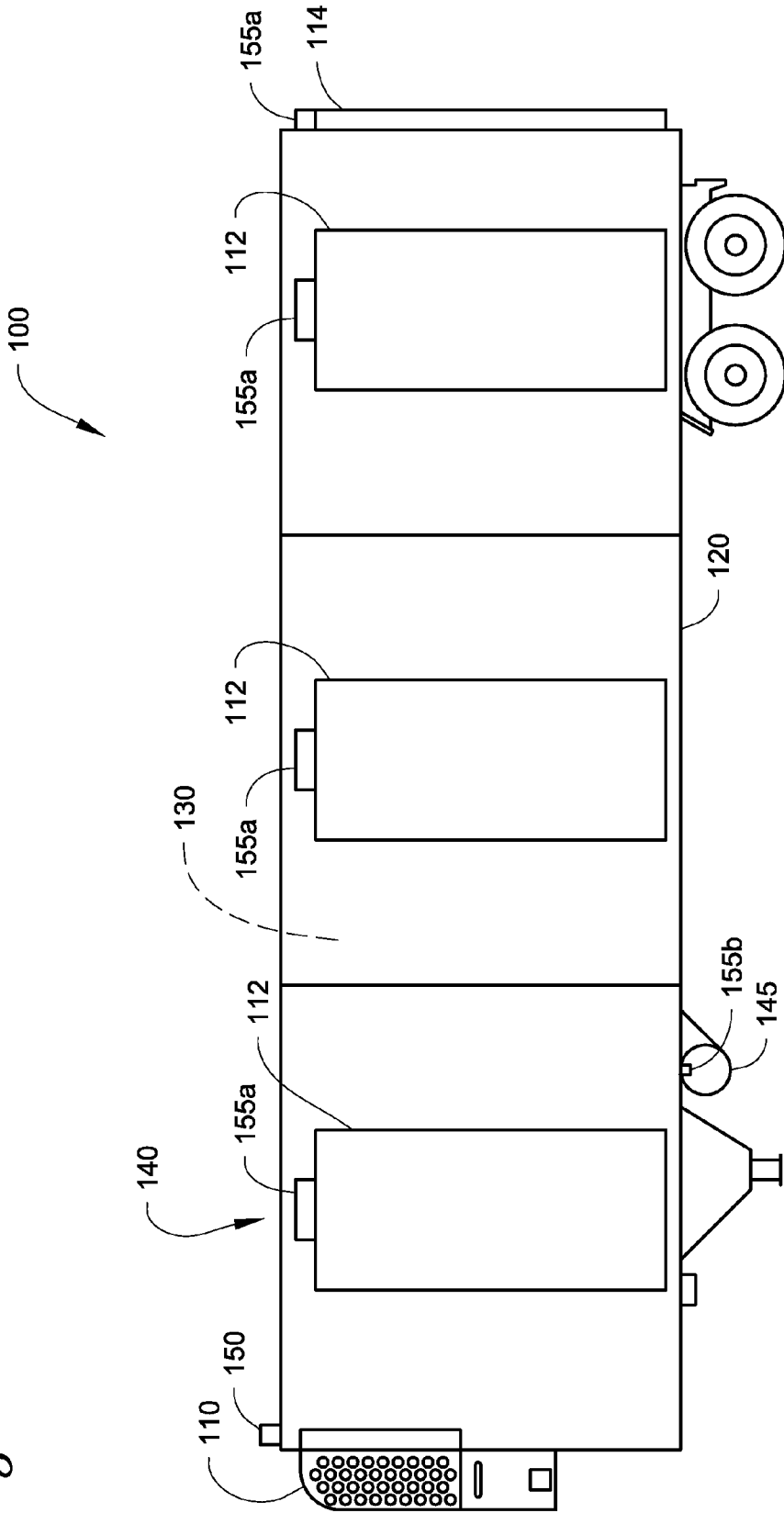
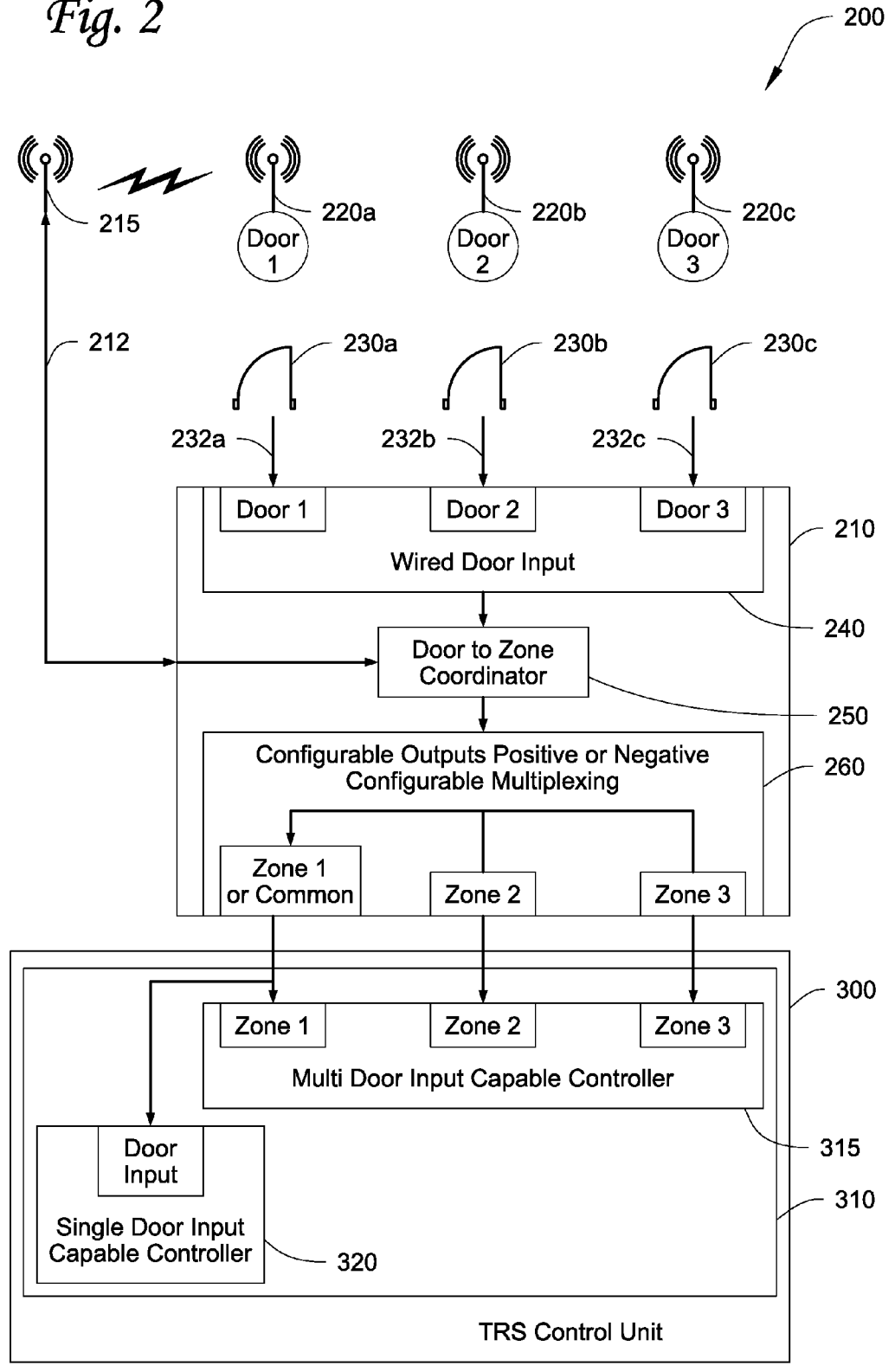


Fig. 2



**SYSTEMS AND METHODS FOR HANDLING DISCRETE SENSOR INFORMATION IN A TRANSPORT REFRIGERATION SYSTEM**

**DETAILED DESCRIPTION**

**FIELD**

[0001] The embodiments disclosed herein relate generally to a transport refrigeration system (“TRS”). More particularly, the embodiments relate to handling discrete sensor information in a transport refrigeration system.

**BACKGROUND**

[0002] Existing transport refrigeration systems are used to cool containers, trailers, and other similar transport units (typically referred to as a “reefer”). Modern reefers may be efficiently stacked for shipment by ship or rail. Typically, when reefers are shipped by truck, a single reefer is placed on a trailer chassis. When cargo in the container includes perishable products (e.g., food product, flowers, etc.), the temperature of the reefer must be controlled to limit loss of the cargo during shipment.

**SUMMARY**

[0003] The embodiments described herein are directed to handling discrete sensor information in a transport refrigeration system.

[0004] In one embodiment, a wireless control system for a transport refrigeration system is provided. The wireless control system includes two or more wireless end nodes and a network coordinator. Each of the wireless end nodes is configured to monitor a property of the transport refrigeration system. The network coordinator is configured to manage, command, direct and regulate the behavior of the wireless end nodes. Also, the network coordinator includes a sensor to zone coordinator that is configured to combine sensor data received by the two or more wireless end nodes to control a single transport refrigeration system function of the transport refrigeration system.

[0005] In another embodiment, a method for handling discrete sensor information in a transport refrigeration system is provided. The method includes receiving a first sensor message from a first wireless end node configured to monitor a first portion of the transport refrigeration system. The method also includes receiving a second sensor message from a second wireless end node configured to monitor a second portion of the transport refrigeration system. Further, the method includes a network coordinator of the wireless communication system combining the first sensor message and the second sensor message and generating coordination message. The method further includes controlling a single transport refrigeration system function of the transport refrigeration system based on the coordination message.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0006] Referring now to the drawings in which like reference numbers represent corresponding parts throughout.

[0007] FIG. 1 illustrates a side view of an embodiment of a transport temperature controlled trailer unit with a transport refrigeration system.

[0008] FIG. 2 illustrates a block diagram of an embodiment of a wireless communication system for in a single zone or a multizone transport refrigeration system.

[0009] The embodiments described herein are directed to handling discrete sensor information in a transport refrigeration system. In particular, the embodiments described herein allow two or more wireless end nodes and/or wired sensor modules to be assigned a single control function of the transport refrigeration system.

[0010] References are made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration of the embodiments in which the methods and systems described herein may be practiced. The term “reefer” generally refers to, for example, a temperature controlled trailer, container, or other type of transport unit, etc. The term “transport refrigeration system” refers to a refrigeration system for controlling the refrigeration of an internal space of the reefer. The term “wireless communication system” refers to a communication system that is configured to transmit data via a wireless connection and a wired connection over a short distance in a mobile environment, such as, for example, between different points of a reefer that is in transport. The term “wireless end node” refers to an electronic device that is an endpoint of a wireless communication system and is capable of monitoring a property of a transport refrigeration system and transmitting data transmissions to and receiving data transmissions from a network coordinator of the wireless communication system. The term “wired sensor module” refers to an electronic sensor device that is connected via a wired connection to the wireless network coordinator and is capable of monitoring a property of a transport refrigeration system and transmitting data transmissions to and receiving data transmissions from a wireless network coordinator of the wireless communication system. The term “network coordinator” refers to an electronic device that is configured to manage, command, direct and regulate the behavior of one or more wireless end nodes and optionally one or more wired sensor modules of the wireless communication system. The term “TRS control unit” refers to an electronic device that is configured to manage, command, direct and regulate the behavior of one or more TRS refrigeration components (e.g., an evaporator, a blower, a heat exchanger, etc.), a TRS engine, a TRS main power source, a network coordinator backup power source (if included in the network coordinator), a TRS fuel tank, etc.

[0011] FIG. 1 illustrates a side view of a transport temperature controlled trailer unit 100 with a transport refrigeration system 110. The trailer unit 100 is installed on a frame 120 and has a plurality of side doors 112 and a rear door 114. The transport refrigeration system 110 is installed on a side wall of the trailer unit 100. The transport refrigeration system 110 is configured to transfer heat between an internal space 130 and the outside environment. In some embodiments, the transport refrigeration system 110 is a multizone system in which different zones or areas of the internal space 130 are controlled to meet different refrigeration requirements based on the cargo stored in the particular zone.

[0012] It will be appreciated that the embodiments described herein are not limited to trucks and trailer units. The embodiments described herein may be used in any other suitable temperature controlled apparatuses such as a ship board container, an air cargo cabin, an over the road truck cabin, etc. The refrigeration system may be a vapor-compressor type refrigeration system, or any other suitable refrigeration systems that can use refrigerant, cold plate technology, etc.

[0013] The transport refrigeration system 110 includes a wireless communication system 140 and a fuel tank 145. The wireless communication system 140 includes a network coordinator (not shown), an antenna 150, and a plurality of wireless end nodes 155. As shown in FIG. 1, the wireless end nodes 155 include a door sensor 155a for each of the side doors 112 and the rear door 114, and a fuel tank level sensor 155b for the fuel tank 145. In some embodiments, the wireless end nodes 155 can also include other types of sensors such as, for example, an air space temperature sensor, a humidity sensor, a cargo temperature center, etc. Also, the wireless end nodes 155 are sealed to prevent failure due to water ingress, extreme temperatures, UV exposure, exposure to oil/solvents, etc. The wireless communication system 140 is configured to communicate information regarding the transport temperature controlled trailer unit 100 to a controller unit (not shown) of the transport refrigeration system 110 for controlling the refrigeration of the internal space 130. In some embodiments, the wireless communication system 140 also includes one or more wired sensor modules (not shown) that are connected to the network coordinator via a wired connection. The wired sensor modules, like the wireless end modules 155 can include, for example, a door sensor, a fuel tank sensor, an air space temperature sensor, a humidity sensor, a cargo temperature center, etc.

[0014] Referring to FIG. 2, a block diagram of one embodiment of a wireless communication system 200 for use in a single zone or a multizone transport refrigeration system according to one embodiment is described. The wireless communication system 200 includes a network coordinator 210, an antenna 215, a plurality of wireless end nodes 220a-c, and a plurality of wired sensor modules 230a-c. The network coordinator 210 is also connected to a TRS control unit 300 of the multizone transport refrigeration system.

[0015] The wireless communication system 200 can be a wireless personal area network (“WPAN”) that uses a ZigBee communication protocol. In other embodiments, other types of communication protocols can be used such as, for example, Bluetooth or any other type of wireless communication protocol that allows for accurate transmission of data between different points of a reefer during transport.

[0016] The network coordinator 210 is configured to transmit data to and receive data from each of the plurality of wireless end nodes 220a-c via the antenna 215 using a short distance wireless communication protocol such as, for example ZigBee, Bluetooth, etc. The network coordinator 210 is also configured to transmit data to and receive data from each of the plurality of wired sensor modules 230a-c via a wired connection 232a-c.

[0017] The antenna 215 is a weatherproof antenna that is configured to be installed outside of the control box and is connected to the network coordinator 210 via a wired communication link 212 such as, for example, a coaxial cable. In some embodiments, the antenna 215 can be configured to be installed inside the control box with the network coordinator 210.

[0018] Each of the plurality of wireless end nodes 220a-c is configured to transmit and receive information with the network coordinator 210 using a short distance wireless communication protocol such as, for example ZigBee, Bluetooth, etc. In some embodiments, one or more of the wireless end nodes 220a-c are weatherproof by using a sealed housing (not shown) to prevent failure due to water ingress, extreme temperatures, UV exposure, exposure to oil/solvents, etc.

[0019] In this embodiment, each of the plurality of wireless end nodes 220a-c is a door sensor to a separate door of a reefer. Each of the wireless end nodes 220a-c is configured to transmit a data signal to the network coordinator 210 when a door of the transport refrigeration system being monitored by the wireless end node 220 is opened or closed.

[0020] In other embodiments, the plurality of wireless end nodes 220 can be, for example, a fuel tank temperature sensor, an air space temperature sensor, a humidity sensor, a cargo temperature center, etc. When the wireless end node 220 is a fuel tank temperature sensor, the wireless end node 220 is configured to transmit a data signal to the network coordinator 210 indicating the temperature of a fuel tank of a transport refrigeration system. When the wireless end node 220 is an air space temperature sensor, the wireless end node 220 is configured to transmit a data signal to the network coordinator 210 indicating the temperature of an internal space of a reefer. When the wireless end node 220 is a humidity sensor, the wireless end node 220 is configured to transmit a data signal to the network coordinator 210 indicating the humidity of an internal space of a reefer. When the wireless end node 220 is a cargo temperature sensor, the wireless end node 220 is configured to transmit a data signal to the network coordinator 210 indicating the temperature of cargo stored in the reefer.

[0021] Each of the plurality of wired sensor modules 230a-c is configured to transmit and receive information with the network coordinator 210 via a wired connection 232a-c. In some embodiments, one or more of the wired sensor modules 230a-c are weatherproof by using a sealed housing (not shown) to prevent failure due to water ingress, extreme temperatures, UV exposure, exposure to oil/solvents, etc.

[0022] In this embodiment, each of the plurality of wired sensor modules 230a-c is a door sensor to a separate door of a reefer. Each of the wired sensor modules 230a-c is configured to transmit a data signal to the network coordinator 210 when a door of the transport refrigeration system being monitored by the wired sensor module 230 is opened or closed. As shown in FIG. 2, one of the wireless end nodes 220a-c and one of the wired sensor modules 230a-c are configured to monitor each of the doors of the reefer. In other embodiments, both a wired sensor module and a wireless end node are not required to monitor a portion of the reefer. Also, in some embodiments, the wireless communication system may not include any wired sensor modules.

[0023] In this embodiment, the network coordinator 210 is a WPAN module that is configured to be installed in a control box (not shown) of a transport refrigeration system. The network coordinator 210 includes a wired sensor module interface 240, a door to zone coordinator 250, and a configurable output command interface 260. The wired sensor module interface 240 sends data to and receives data from the wired sensor modules 230a-c via a wired connection 232a-c. The door to zone coordinator 250 is configured to receive data from the wired sensor module interface 240 and from the wireless end nodes 220a-c via the antenna 215 and configured to coordinate which zone within an internal space of the reefer is to be controlled based on the received data. The configurable output command interface 260 receives coordination data from the door to zone coordinator 250 and sends zone status information to the TRS control unit 300. Accordingly, the network coordinator 210 allows a user to commission multiple wireless end nodes 220a-c and wired sensor modules 230a-c to a single transport refrigeration system control

function. A transport refrigeration control function can include, for example, turning on lights in an internal space of the reefer, log an event through telematics, control refrigeration to a particular zone of the reefer, etc.

[0024] The TRS control unit 300 is configured to manage, command, direct and regulate the behavior of one or more TRS refrigeration components (e.g., an evaporator, a blower, a heat exchanger, etc.) (not shown), a TRS engine (not shown), a TRS main power source (not shown), a network coordinator backup power source (if included in the network coordinator) (not shown), a TRS fuel tank (not shown), etc. The TRS control unit 300 includes a controller 310. When the reefer is a multizone reefer, the controller 310 is capable of operating as a multi zone controller 315 or a single zone controller 320. When the reefer is a single zone reefer or a multizone reefer that is configured such that each of the zones are commonly controlled to meet the same refrigeration requirements, the controller 310 is capable of operating as a single zone controller 320. When operating as a multi zone controller 315, the controller 310 is configured to receive zone status information from the configurable output command interface 250 and control refrigeration of a specific zone of the multizone reefer based on the received zone status information. When operating as a single zone controller 320, the controller 310 is configured to receive zone status information from the configurable output command interface 250 and control refrigeration of the single or common zone of the reefer. In some embodiments, to operate as a multi zone controller 315, the controller 310 enables the use of an expansion module to handle multiple zones of the reefer.

[0025] As discussed above, the wireless communication system 200 can commission multiple wireless end nodes 220a-c and wired sensor modules 230a-c to a single transport refrigeration system control function. For example, in one embodiment, the wireless communication system 200 can be provided in a multizone reefer in which Door 1 provides access to Zone 1 of the reefer, Door 2 provides access to Zone 2 of the reefer and Door 3 provides access to Zone 3 of the reefer. As shown in FIG. 2, both the wireless end node 220a and the wired sensor module 230a monitor the status of Door 1. Similarly, both the wireless end node 220b and the wired sensor module 230b monitor the status of Door 2, and both the wireless end node 220c and the wired sensor module 230c monitor the status of Door 3.

[0026] The door to zone coordinator 250 can be configured such that if either the wireless end node 220a or the wired sensor module 230a detect that Door 1 has been opened, coordination data is generated and sent to the configurable output command interface 260, which generates zone status data for the TRS control unit 300 to shut off the evaporator in Zone 1 of the multizone reefer. Also, the door to zone coordinator 250 can be configured such that the wireless end node 220a and the wired sensor module 230a must both detect that Door 1 has been closed in order for the door to zone coordinator 250 to generate coordination data for the configurable output command interface 260 to generate zone status data for the TRS control unit 300 to turn on the evaporator in Zone 1 of the multizone reefer.

[0027] In another example, if both Door 1 and Door 2 access Zone 1 of the reefer and Door 3 accesses Zone 2 of the reefer, the door to zone coordinator 250 can be configured such that if either the wireless end node 220a, the wireless end node 220b, the wired sensor module 220a or the wired sensor module 230b detect that Door 1 has been opened, coordina-

tion data is generated and sent to the configurable output command interface 260, which generates zone status data for the TRS control unit 300 to shut off the evaporator in Zone 1 of the multizone reefer. Also, the door to zone coordinator 250 can be configured such that the wireless end node 220a, b and the wired sensor modules 230a, b must all detect that Door 1 has been closed in order for the door to zone coordinator 250 to generate coordination data for the configurable output command interface 260 to generate zone status data for the TRS control unit 300 to turn on the evaporator in Zone 1 of the multizone reefer. In yet another example, if the wireless communication system 200 is provided in a single zone reefer such that Door 1, Door 2 and Door 3 all access Zone 1 or a Common Zone of the reefer. Here, the door to zone coordinator 250 can be configured such that if any of the wireless end nodes 220a-c or the wired sensor modules 220a-c detect that Door 1, Door 2 or Door 3 has been opened, coordination data is generated and sent to the configurable output command interface 260, which generates zone status data for the TRS control unit 300 to shut off the evaporator in Zone 1 or the Common Zone of the single zone reefer. Also, the door to zone coordinator 250 can be configured such that the all of the wireless end nodes 220a-c and the wired sensor modules 230a-c must detect that Doors 1-3 are closed in order for the door to zone coordinator 250 to generate coordination data for the configurable output command interface 260 to generate zone status data for the TRS control unit 300 to turn on the evaporator in Zone 1 or the Common Zone of the single zone reefer.

[0028] Thus, the network coordinator 210 can provide logic to control the refrigeration of multiple zones in a multizone reefer or a single zone in a single zone reefer by assigning multiple wireless end nodes 220 and/or wired sensor modules 230 to a single transport refrigeration system control function. In one embodiment, the network coordinator 210 can assign up to 32 wireless end nodes 220 and wired sensor modules 230 modules to a single transport refrigeration system control function.

#### Aspects:

[0029] It is noted that any of aspects 1-11 below can be combined with any of aspects 12-20.

[0030] 1. A wireless control system for a transport refrigeration system of a reefer comprising:

[0031] two or more wireless end nodes, each of the two or more wireless end nodes configured to monitor a property of the transport refrigeration system;

[0032] a network coordinator configured to manage, command, direct and regulate the behavior of the two or more wireless end nodes,

[0033] wherein each of the two or more wireless end nodes are configured to send sensor data to the network coordinator, and

[0034] wherein the wherein the network coordinator includes a sensor to zone coordinator that is configured to combine sensor data received by the two or more wireless end nodes to control a transport refrigeration system function of the transport refrigeration system.

[0035] 2. The wireless control system of aspect 1, wherein each of the two or more wireless end nodes is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

[0036] 3. The wireless control system of aspects 1-2, further comprising one or more wired sensor modules config-

ured to monitor a property of the transport refrigeration system and to transmit and receive information with the network coordinator.

**[0037]** 4. The wireless control system of aspect 3, wherein each of the one or more wired sensor modules is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

**[0038]** 5. The wireless control system of aspects 1-4, wherein the network coordinator communicates with the two or more wireless end nodes via a Zigbee communication protocol.

**[0039]** 6. The wireless control system of aspects 1-5, wherein the transport refrigeration system function includes at least one of turning on lights in an internal space of the reefer, logging an event through telematics, and controlling refrigeration to a particular zone of the reefer.

**[0040]** 7. The wireless communication system of aspects 1-6, wherein the sensor to zone coordinator is a door to zone coordinator.

**[0041]** 8. The wireless communication system of aspects 1-7, wherein the reefer is a multi-zone reefer including two or more zones and the sensor to zone coordinator is configured to control the transport refrigeration system function of the transport refrigeration system for one of the two or more zones based on data received from the two or more wireless end nodes.

**[0042]** 9. The wireless communication system of aspects 1-7, wherein the reefer is a single zone reefer and the sensor to zone coordinator is configured to control the transport refrigeration system function of the transport refrigeration system based on data received from the two or more wireless end nodes.

**[0043]** 10. The wireless communication system of aspects 1-9, further comprising a transport refrigeration system control unit connected to the network coordinator,

**[0044]** wherein the sensor to zone coordinator is configured to generate coordination data based on the combined sensor data received by the two or more wireless end nodes, and

**[0045]** wherein the transport refrigeration system control unit is configured receive the coordination data from the sensor to zone coordinator and configured to control the transport refrigeration system function of the transport refrigeration system based on the coordination data.

**[0046]** 11. The wireless communication system of aspect 3, wherein a first wireless end node of the two or more wireless end nodes is a door sensor for a door of the reefer, the wired sensor modules is a door sensor for the door of the reefer,

**[0047]** wherein when the first wireless end node and the wired sensor module detect that the door of the reefer is closed, the sensor to zone coordinator generates coordination data to instruct a transport refrigeration system control unit to turn on an evaporator of the reefer.

**[0048]** 12. A method for handling discrete sensor information in a transport refrigeration system of a reefer comprising:

**[0049]** receiving a first sensor message from a first wireless end node configured to monitor a first portion of the transport refrigeration system;

**[0050]** receiving a second sensor message from a second wireless end node configured to monitor a second portion of the transport refrigeration system;

**[0051]** a network coordinator of the wireless communication system combining the first sensor message and the second sensor message and generating a coordination message;

**[0052]** controlling a transport refrigeration system function of the transport refrigeration system based on the coordination message.

**[0053]** 13. The method of aspect 12, wherein each of the first wireless end node and the second wireless end node is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

**[0054]** 14. The method of aspects 12-13, further comprising receiving a wired sensor message from a wired sensor module configured to monitor a property of the transport refrigeration system.

**[0055]** 15. The method of aspect 14, wherein the wired sensor module is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

**[0056]** 16. The method of aspects 12-15, further comprising the network coordinator communicating with the first wireless end node and the second wireless end node via a Zigbee communication protocol.

**[0057]** 17. The method of aspects 12-16, wherein the transport refrigeration system function includes at least one of turning on lights in an internal space of the reefer, logging an event through telematics, and controlling refrigeration to a particular zone of the reefer.

**[0058]** 18. The method of aspects 12-17, further comprising: when the reefer is a multi-zone reefer, the sensor to zone coordinator controlling the transport refrigeration system function for one two or more zones of the reefer based on the coordination message.

**[0059]** 19. The method of aspects 12-17, further comprising:

**[0060]** when the reefer is a single zone reefer, the sensor to zone coordinator controlling the transport refrigeration system function of the transport refrigeration system based on the coordination message.

**[0061]** 20. The method of aspects 12-19, further comprising:

**[0062]** sending the coordination message to a transport refrigeration system control unit; and

**[0063]** controlling, via the transport refrigeration system control unit, the transport refrigeration system function of the transport refrigeration system based on the coordination message.

**[0064]** With regard to the foregoing description, it is to be understood that changes may be made in detail, especially in matters of the construction materials employed and the shape, size and arrangement of the parts without departing from the scope of the present invention. It is intended that the specification and depicted embodiment to be considered exemplary only, with a true scope and spirit of the invention being indicated by the broad meaning of the claims.

What claimed is:

1. A wireless control system for a transport refrigeration system of a reefer comprising:

two or more wireless end nodes, each of the two or more wireless end nodes configured to monitor a property of the transport refrigeration system;

a network coordinator configured to manage, command, direct and regulate the behavior of the two or more wireless end nodes,

wherein each of the two or more wireless end nodes are configured to send sensor data to the network coordinator, and

wherein the wherein the network coordinator includes a sensor to zone coordinator that is configured to combine sensor data received by the two or more wireless end nodes to control a transport refrigeration system function of the transport refrigeration system.

2. The wireless control system of claim 1, wherein each of the two or more wireless end nodes is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

3. The wireless control system of claim 1, further comprising one or more wired sensor modules configured to monitor a property of the transport refrigeration system and to transmit and receive information with the network coordinator.

4. The wireless control system of claim 3, wherein each of the one or more wired sensor modules is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

5. The wireless control system of claim 1, wherein the network coordinator communicates with the two or more wireless end nodes via a Zigbee communication protocol.

6. The wireless control system of claim 1, wherein the transport refrigeration system function includes at least one of turning on lights in an internal space of the reefer, logging an event through telematics, and controlling refrigeration to a particular zone of the reefer.

7. The wireless communication system of claim 1, wherein the sensor to zone coordinator is a door to zone coordinator.

8. The wireless communication system of claim 1, wherein the reefer is a multi-zone reefer including two or more zones and the sensor to zone coordinator is configured to control the transport refrigeration system function of the transport refrigeration system for one of the two or more zones based on data received from the two or more wireless end nodes.

9. The wireless communication system of claim 1, wherein the reefer is a single zone reefer and the sensor to zone coordinator is configured to control the transport refrigeration system function of the transport refrigeration system based on data received from the two or more wireless end nodes.

10. The wireless communication system of claim 1, further comprising a transport refrigeration system control unit connected to the network coordinator, wherein the sensor to zone coordinator is configured to generate coordination data based on the combined sensor data received by the two or more wireless end nodes, and wherein the transport refrigeration system control unit is configured receive the coordination data from the sensor to zone coordinator and configured to control the transport refrigeration system function of the transport refrigeration system based on the coordination data.

11. The wireless communication system of claim 3, wherein a first wireless end node of the two or more wireless end nodes is a door sensor for a door of the reefer, the wired sensor modules is a door sensor for the door of the reefer, wherein when the first wireless end node and the wired sensor module detect that the door of the reefer is closed, the sensor to zone coordinator generates coordination data to instruct a transport refrigeration system control unit to turn on an evaporator of the reefer.

12. A method for handling discrete sensor information in a transport refrigeration system of a reefer comprising:  
 receiving a first sensor message from a first wireless end node configured to monitor a first portion of the transport refrigeration system;  
 receiving a second sensor message from a second wireless end node configured to monitor a second portion of the transport refrigeration system;  
 a network coordinator of the wireless communication system combining the first sensor message and the second sensor message and generating a coordination message;  
 controlling a transport refrigeration system function of the transport refrigeration system based on the coordination message.

13. The method of claim 12, wherein each of the first wireless end node and the second wireless end node is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

14. The method of claim 12, further comprising receiving a wired sensor message from a wired sensor module configured to monitor a property of the transport refrigeration system.

15. The method of claim 14, wherein the wired sensor module is one of a door sensor, an air space temperature sensor, a humidity sensor, a cargo temperature sensor and a fuel tank level sensor.

16. The method of claim 12, further comprising the network coordinator communicating with the first wireless end node and the second wireless end node via a Zigbee communication protocol.

17. The method of claim 12, wherein the transport refrigeration system function includes at least one of turning on lights in an internal space of the reefer, logging an event through telematics, and controlling refrigeration to a particular zone of the reefer.

18. The method of claim 12, further comprising:  
 when the reefer is a multi-zone reefer, the sensor to zone coordinator controlling the transport refrigeration system function for one two or more zones of the reefer based on the coordination message.

19. The method of claim 12, further comprising:  
 when the reefer is a single zone reefer, the sensor to zone coordinator controlling the transport refrigeration system function of the transport refrigeration system based on the coordination message.

20. The method of claim 12, further comprising:  
 sending the coordination message to a transport refrigeration system control unit; and  
 controlling, via the transport refrigeration system control unit, the transport refrigeration system function of the transport refrigeration system based on the coordination message.

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