CONTROL PANEL SYSTEM FOR A VEHICLE

BACKGROUND

The present disclosure relates generally to vehicles and, in particular, to aircraft. Still more particularly, the present disclosure relates to control panel systems in aircraft.

In operating an aircraft, human operators may interact with various systems on an aircraft. This interaction is facilitated through the use of different types of control systems. The control systems may include keys, buttons, switches, and other types of controls. Additionally, the control systems also may include lights, displays, and other types of output devices. These control systems may be implemented as control units in which controls and a display screen are grouped together on the panel. With the different functions and locations for control panels in an aircraft, each control panel has a specialized design for a particular function and location of the control panel. Also, the design of the control panel may be based on the system controlled by the control panel.

For example, a control panel in a flight deck may include a display device and switches. In contrast, a control panel used in a cargo bay may have physical switches and lights. In yet another example, a control panel for an in-flight entertainment system in a passenger cabin may have a display in the form of a touch screen.

Also, the control panel may have physical buttons, switches, or other controls that are selected specifically for a particular system being controlled. In a similar fashion, the output devices also are tailored to the specific system managed by the control panel.

For example, a cargo bay may have switches in which each switch performs a particular function with respect to doors and other equipment in the cargo bay. The output devices may be lights with each light indicating the operation of a particular function in the cargo bay. As a result, control panels often are not interchangeable with each other.

Further, these control panels typically have larger numbers of wires, connectors, frames, and other components than desired. As a result, these control

panels require larger amounts of space and have greater amounts of weight than desired for use in aircraft.

In addition, the maintenance effort for control units may be greater than desired. For example, an airline may maintain spare control units for all of the different types of control units used in the airline's aircraft. The number of spare control units may be greater than desired because the control units are not interchangeable with each other in aircraft. Further, with these different types of interfaces for systems on aircraft, increased complexity is present for assembling new aircraft.

Therefore, it would be illustrative to have a method and apparatus that takes into account at least some of the issues discussed above as well as possibly other issues.

SUMMARY

In one illustrative embodiment, a method is presented for managing a programmable control panel for a vehicle. A number of first level control functions is assigned to the programmable control panel for the vehicle. A number of second level control functions is assigned to the programmable control panel based on a health of programmable control panels in the vehicle.

In another illustrative embodiment, an apparatus comprises a programmable control panel configured to be connected to a vehicle. The programmable control panel is configured to receive a number of first level control functions to the programmable control panel for the vehicle and receive a number of second level control functions to the programmable control panel based on a health of programmable control panels in the vehicle.

In still another illustrative embodiment, a vehicle system comprises a plurality of systems and programmable control panels configured to control the plurality of systems. A programmable control panel in the programmable control panels is configured to perform a number of first level control functions to the programmable control panel for a vehicle. The programmable control panel in the programmable control panels is configured to perform a number of second level control functions to the programmable control panel based on a health of the programmable control panels in the vehicle.

The features, functions, and advantages can be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives, and advantages thereof will best be understood by reference to the following detailed description of an illustrative embodiment of the present disclosure when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an illustration of a block diagram of a control environment in accordance with an illustrative embodiment;

Figure 2 is an illustration of a block diagram of a programmable control panel in accordance with an illustrative embodiment;

Figure 3 is an illustration of a block diagram of data flow used in managing a programmable control panel in accordance with an illustrative embodiment;

Figure 4 is an illustration of a block diagram of data flow used in managing a control panel in accordance with an illustrative embodiment;

Figures 5-7 are illustrations of block diagrams of interactions between programmable control panels in accordance with an illustrative embodiment;

Figures 8-11 are illustrations of block diagrams of interactions between programmable control panels in a vehicle in accordance with an illustrative embodiment;

Figure 12 is an illustration of an aircraft in accordance with an illustrative embodiment;

Figure 13 is an illustration of a programmable control panel in accordance with an illustrative embodiment;

Figure 14 is an illustration of a cargo area in an aircraft in accordance with an illustrative embodiment;

Figure 15 is an illustration of a display for a programmable control panel in accordance with an illustrative embodiment;

Figure 16 is another illustration of a display for a programmable control panel in accordance with an illustrative embodiment;

Figure 17 is an illustration of a flowchart of a process for managing a programmable control panel in accordance with an illustrative embodiment;

Figure 18 is an illustration of a flowchart of a process for programming programmable control panels prior to installation on a vehicle in accordance with an illustrative embodiment;

Figure 19 is an illustration of a flowchart of a process for monitoring the health of programmable control panels in accordance with an illustrative embodiment;

Figure 20 is an illustration of a flowchart of a process for identifying the health of programmable control panels in accordance with an illustrative embodiment;

Figure 21 is an illustration of a flowchart of a process for assigning functions to control panels in accordance with an illustrative embodiment;

Figure 22 is an illustration of a data processing system in accordance with an illustrative embodiment;

Figure 23 is an illustration of an aircraft manufacturing and service method in accordance with an illustrative embodiment; and

Figure 24 is an illustration of an aircraft in which an illustrative embodiment may be implemented.

DETAILED DESCRIPTION

The different illustrative embodiments recognize and take into account one or more different considerations. For example, the different illustrative embodiments recognize and take into account that control units may be designed to be interchangeable and provide different functions. The different illustrative embodiments recognize and take into account that data processing systems may be implemented into a control panel. As a result, a control panel may be programmed and used in different locations. In this fashion, control panels may be interchangeable with each other. When control panels are interchangeable, the number of control panels that need to be maintained as spares may be reduced.

The different illustrative embodiments also recognize and take into account that with currently used control panels, the replacement of a control unit may be infeasible during flight or other operations if that control panel is not operating as

desired. The different illustrative embodiments recognize and take into account that a control panel may be designed with a processor unit that runs software. With a processor unit, functions in the control panel may be changed using software changes. This type of control panel is a programmable control panel. As a result, a programmable control panel in one location may be more easily interchangeable with another programmable control panel in another location.

Thus, the different illustrative embodiments provide a method and apparatus for managing control panels in a vehicle. A number of first level control functions are assigned to a control panel in the control panels for a vehicle. A number of second level control functions are assigned to the control panel based on the health of the control panels in the vehicle.

With reference now to the figures and, in particular, with reference to **Figure 1**, an illustration of a block diagram of a control environment is depicted in accordance with an illustrative embodiment. Control environment **100** includes vehicle **102**. Systems **104** are present in vehicle **102**. These systems may include, for example, without limitation, an engine control system, an environmental system, a hydraulic system, an entertainment system, and other suitable types of systems.

Control system **106** controls systems **104** in these illustrative examples. Operator **108** in vehicle **102** may interact with control system **106** to obtain information and input commands to systems **104**.

As depicted, control system **106** includes vehicle network data processing system **110**. Computer system **112** is present in vehicle network data processing system **110** in this illustrative example.

Computer system **112** comprises number of computers **114**. As used herein, a “number”, when used with reference to items, means one or more items. For example, “number of computers **114**” is one or more computers.

Computer system **112** is configured to perform different operations for vehicle **102**. For example, without limitation, computer system **112** may monitor systems **104**, perform autopilot functions, provide navigation information, store software, and provide other suitable functions within vehicle **102**.

Additionally, vehicle network data processing system **110** also includes programmable control panels **116**. Number of computers **114** and programmable control panels **116** may communicate with each other using network **118**. Network **118**

comprises communications links **120**. Communications links **120** may include at least one of wireless communications links **122**, wired communications links **124**, optical fiber communications links **126**, and other suitable types of communications links.

As used herein, the phrase "at least one of", when used with a list of items, means different combinations of one or more of the listed items may be used and only one of each item in the list may be needed. For example, "at least one of item A, item B, and item C" may include, for example, without limitation, item A, or item A and item B. This example also may include item A, item B, and item C, or item B and item C.

In these illustrative examples, programmable control panels **116** are hardware devices that are configured to control systems **104**. Programmable control panels **116** also include software in the illustrative examples.

Programmable control panels **116** all may be of the same size or may have different sizes, depending on the particular implementation. For example, different groups of sizes may be present for different systems.

In these illustrative examples, programmable control panels **116** may be programmed to control particular systems within systems **104**. The programming of programmable control panels **116** is performed using panel manager **128** in the illustrative examples. Panel manager **128** may be implemented using hardware, software, or a combination of the two. In this illustrative example, panel manager **128** is implemented within computer system **112** in vehicle network data processing system **110**.

For example, number of first level control functions **130** are assigned to programmable control panel **132**. Number of second level control functions **134** are assigned to programmable control panel **132** based on health **136** of programmable control panels **116**.

Number of first level control functions **130** may be assigned to programmable control panel **132** based on location **138** of programmable control panel **132** in vehicle **102**. For example, number of first level control functions **130** may control a cargo door and cargo movement systems when programmable control panel **132** is located in a cargo bay. If programmable control panel **132** is located in a passenger cabin, number of first level control functions **130** may control an in-flight entertainment

system, an environmental system, or some other suitable system associated with the passenger cabin.

In this illustrative example, number of first level control functions **130** is a number of primary control functions for programmable control panel **132**. In other words, number of first level control functions **130** is the number of control functions normally provided by programmable control panel **132**. These are functions controlled by the system assigned to programmable control panel **132** in the illustrative examples.

Number of second level control functions **134** is a number of additional control functions that may be provided by programmable control panels **116**. Number of second level control functions **134** may be control functions for one or more other programmable control panels within programmable control panels **116**. With number of second level control functions **134**, programmable control panel **132** may be configured to control additional systems in addition to the system controller using number of first level control functions **130**.

Number of second level control functions **134** may be assigned to programmable control panel **132** when other control panels in programmable control panels **116** are not functioning as desired. Whether a control panel in programmable control panels **116** is functioning as desired is based on identifying health **136** of programmable control panels **116**. Panel manager **128** is configured to assign these functions to programmable control panel **132** as well as other programmable control panels in programmable control panels **116**.

In some illustrative examples, programmable control panels **116** may communicate with each other and assign functions to each other. This communication may take place over network **118** or without network **118**. For example, the communication between programmable control panels **116** may be, for example, in a peer-to-peer form in which communications links **120** are between programmable control panels **116**. In this fashion, each programmable control panel in programmable control panels **116** may receive and forward messages from other programmable control panels.

The illustration of control environment **100** in **Figure 1** is not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be unnecessary. Also, the

blocks are presented to illustrate some functional components. One or more of these blocks may be combined, divided, or combined and divided into different blocks when implemented in an illustrative embodiment.

For example, in some illustrative examples, panel manager **128** may not be in vehicle **102**. For example, when more than one computer is present in computer system **112**, a first portion of computer system **112** may be on vehicle **102**, and a second portion of computer system **112** may be in a location remote to vehicle **102**. With this example, panel manager **128** may be on the second portion of computer system **112** in the remote location. As another example, panel manager **128** may be distributed and may be located on both the first portion of computer system **112** in vehicle **102** and in the second portion of computer system **112** located remotely to vehicle **102**.

In still other illustrative examples, computer system **112** may be omitted from vehicle network data processing system **110**. Instead, panel manager **128** may be located on programmable control panel **132** or another programmable control panel in programmable control panels **116**.

Turning now to **Figure 2**, an illustration of a block diagram of a programmable control panel is depicted in accordance with an illustrative embodiment. Programmable control panel **200** is an example of one implementation for programmable control panel **132** in **Figure 1**.

As depicted, programmable control panel **200** includes housing **202**. Housing **202** is a physical structure configured to hold components in programmable control panel **200**.

Programmable control panel **200** also includes bus system **204**. Bus system **204** is configured to provide communications, power, or a combination of the two to different components within programmable control panel **200**. In this illustrative example, processor unit **206**, storage device **208**, memory **210**, display system **212**, user input system **214**, communications unit **216**, and power supply system **218** are connected to bus system **204**. These components are physical components that are physically associated with housing **202**.

Processor unit **206** is configured to run software **220**. Processor unit **206** may be a number of processors, a multi-processor core, or some other type of processor. In these illustrative examples, storage device **208** is a piece of hardware

capable of storing information. For example, storage device **208** is configured to store software **220**. Software **220** may be run by processor unit **206** from storage device **208** through memory **210**.

Memory **210** may be a volatile or nonvolatile storage device. Memory **210** may serve as temporary storage for information, such as data and software, being run by processor unit **206**.

In these illustrative examples, storage device **208** may be a hard drive, a flash memory, or some other suitable type of storage. Memory **210** may be a random access memory or some other suitable type of device.

In these illustrative examples, display system **212** may comprise number of display devices **222**. A display device in number of display devices **222** may take different forms. For example, a display device may be implemented using liquid crystal display **223**, organic light-emitting diode display **224**, active matrix liquid crystal display (AMLCD) **225**, or any other suitable type of display device. In still other illustrative examples, a display device in number of display devices **222** may be as simple as light **226** or light-emitting diode **228**.

User input system **214** is configured to receive user input from an operator. User input system **214** may comprise number of input devices **230**. Number of input devices **230** may include, for example, at least one of touch screen **232**, number of buttons **234**, trackball **236**, keyboard **238**, microphone **240**, and other suitable types of input devices. Of course, combinations of these and other input devices may be used, depending on the particular implementation. For example, number of buttons **234** may include a capacitive button that may be placed on or associated with touch screen **232.** As another illustrative example, trackball **236** may be present on programmable control panel **200** and may be with touch screen **232.** Other combinations of devices may be used for number of input devices **230,** depending on the particular implementation.

As depicted, communications unit **216** is configured to provide communication between programmable control panel **200** and other data processing devices in vehicle network data processing system **110** in **Figure 1**. In some illustrative examples, communications unit **216** may be configured to provide communication between programmable control panel **200** and other programmable control panels though a peer-to-peer connection between the programmable control panels.

Communications unit **216** may be, for example, at least one of network interface card **242**, wireless adapter **244**, universal serial bus connector **246**, and other suitable types of communication devices.

In these illustrative examples, power supply system **218** is configured to provide power to the different components in programmable control panel **200**. Power supply system **218** may include at least one of power supply **248**, battery **250**, energy harvesting device **252**, and other suitable types of power devices. Power supply **248** may be an alternating current power supply that converts an alternating current into a direct current for use by components in programmable control panel **200**. Battery **250** may provide power as a backup to power supply **248** or may be a main power source within power supply system **218**.

Further, power supply **248** may include multiple types of input power. For example, power supply **248** may include a primary power line with a redundant power line as a backup. As another illustrative example, battery **250** may comprise multiple battery units that may provide power. Further, battery **250** may serve to store excess power that may be generated by energy harvesting device **252.**

Energy harvesting device **252** may be a device that generates energy from the environment around programmable control panel **200**. Energy harvesting device **252** may include a piezoelectric energy harvesting device, an ambient radiation energy harvesting device, a thermal electric generator, and other suitable types of energy harvesting devices.

In these illustrative examples, software **220** may include software for agent **254,** user interface **256**, and number of control functions **258**. Agent **254** is configured to manage number of control functions **258**. Additionally, agent **254** also may be configured to identify the health of programmable control panel **200**. For example, agent **254** may run diagnostic processes to determine whether programmable control panel **200** is operating as desired. User interface **256** may be graphical user interface **260** displayed on number of display devices **222**.

Number of control functions **258** may include number of first level control functions **262** and number of second level control functions **264**. Interaction with these functions may be performed through user interface **256**.

With reference now to **Figure 3**, an illustration of a block diagram of data flow used in managing a programmable control panel is depicted in accordance with an

illustrative embodiment. In this illustrative example, panel manager **128** is located in a facility rather than in vehicle **102** in **Figure 1**.

Panel manager **128** is configured to assign functions to programmable control panel **132**. In this illustrative example, programmable control panel **132** has not been programmed with control functions for a system. In this illustrative example, programmable control panel **132** is programmed prior to installation of programmable control panel **132** in a vehicle.

In these illustrative examples, panel manager **128** receives input **306**. Input **306** may be, for example, without limitation, a user input, a configuration file, a command, or some other suitable form of input.

In response to receiving input **306**, panel manager **128** identifies number of first level control functions **130** from functions **310** in function database **312**. In these illustrative examples, functions **310** in function database **312** are functions for control panels that may be used with different vehicles in the illustrative examples. The selection of number of first level control functions **130** from functions **310** is performed using input **306**.

Input **306** may be a selection of number of first level control functions **130**. In other illustrative examples, input **306** may be an identification of the vehicle and the location in which programmable control panel **132** is to be used.

Panel manager **128** sends software **314** containing number of first level control functions **130** to programmable control panel **132**. In this illustrative example, agent **316** is configured to receive and install software **314** on programmable control panel **132**. Installing software **314** causes number of first level control functions **130** to be present in programmable control panel **132**. In these illustrative examples, agent **316** may be software, hardware, or a combination of the two.

Programmable control panel **132** is now ready for installation in a vehicle. In these illustrative examples, programmable control panel **132** is designated for a particular location in vehicle **102** in which number of first level control functions **130** is to be used to control a system.

Turning now to **Figure 4**, an illustration of a block diagram of data flow used in managing a control panel is depicted in accordance with an illustrative embodiment. In this illustrative example, programmable control panel **132** has not been pre-programmed.

Agent **405** in programmable control panel **132** sends identification information **406** to panel manager **128** after programmable control panel **132** has been installed in vehicle **102** in **Figure 1**. Identification information **406** includes information used by panel manager **128** to assign functions to programmable control panel **132**.

In these illustrative examples, identification information **406** may include at least one of location **408**, identifier **410**, configuration **412**, and other suitable information. Location **408** is a location of programmable control panel **132** in vehicle **102**. One manner in which location **408** may be identified is by the user inputting location **408** into programmable control panel **132**. In another example, location **408** may be identified based on the network port to which programmable control panel **132** is connected.

For example, a number may be associated with or coded within the network port.

In yet another example, location **408** may be identified by panel manager **128** using an Internet protocol address for programmable control panel **132.** The Internet protocol address may be programmed into programmable control panel **132** based on location **408** for programmable control panel **132.** As a result, panel manager **128** may identify location **408** based on the Internet protocol address sent by agent **405** in programmable control panel **132.** In other words, the Internet protocol address may be sent and used to identify location **408** if location **408** is not included in identification information **406** sent by agent **405**.

Identifier **410** may be a unique identifier for programmable control panel **132**. This unique identifier may be used in part to identify functions for programmable control panel **132**. Identifier **410** may be a processor identifier, a media access control (MAC) identifier, or some other suitable type of identifier. Configuration **412** contains information about the configuration of programmable control panel **132**. Configuration **412** may be used to identify particular software that is used by programmable control panel **132** to perform different functions.

In response to receiving identification information **406**, panel manager **128** identifies number of first level control functions **130** for programmable control panel **132**. Number of first level control functions **130** are identified from functions **416** in function database **418**. In this illustrative example, function database **418** is located in a computer system in vehicle **102**. Of course, in other illustrative examples, function

database **418** may be in a remote location and accessed through a wireless communications link.

Panel manager **128** sends software **420** to agent **405.** Software **420** includes number of first level control functions **130** assigned to programmable control panel **132**.

In response to receiving software **420**, agent **405** installs software **420**. Programmable control panel **132** is now configured to provide number of first level control functions **130.**

Additionally, programmable control panel **132** also may be assigned number of second level control functions **134**. Number of second level control functions **134** may be used to control another system assigned to programmable control panel **132**. This type of programming may be performed for other programmable control panels in programmable control panels **422** when the other programmable control panels are installed in vehicle **102**. Programmable control panels **422** are other programmable control panels in programmable control panels **116** in **Figure 1** other than programmable control panel **132**.

In the illustrative examples, panel manager **128** monitors the health of programmable control panel **132** and programmable control panels **422** in programmable control panels **116**.

Depending on the health of programmable control panels **422**, panel manager **128** may assign one or more new functions to programmable control panel **132**. The one or more new functions are number of second level control functions **134**.

For example, if the health for programmable control panel **429** in programmable control panels **422** indicates that programmable control panel **429** in programmable control panels **422** is not operating as desired, panel manager **128** identifies number of second level control functions **134** from functions **416** in function database **418**. Number of second level control functions **134** is number of first level control functions **432** for programmable control panel **429** in the depicted example.

In response to identifying number of second level control functions **134**, panel manager **128** sends software **434** for number of second level control functions **134** to programmable control panel **132**. In response to receiving software **434**, agent **405** installs software **434** to include number of second level control functions **134** on programmable control panel **132**. As a result, programmable control panel **132** is now

configured to provide number of first level control functions **130** and number of second level control functions **134**.

In these illustrative examples, the selection of programmable control panel **132** to provide number of second level control functions **134** is based on location **408** of programmable control panel **132**. The selection also is based on the proximity of location **408** to location **444** for programmable control panel **429**. For example, location **408** of programmable control panel **132** may be within an area in which programmable control panel **429** is located. For example, if both programmable control panel **132** and programmable control panel **429** are located on the same wall in a cargo bay, the location may be considered to be a close enough proximity between the two programmable control panels such that panel manager **128** selects programmable control panel **132** to take over functions normally performed by programmable control panel **429**. As a result, programmable control panel **132** may perform its functions as well as those for programmable control panel **429**.

In these illustrative examples, the health of the programmable control panels may be identified in a number of different ways. For example, diagnostic processes may be performed in programmable control panel **132** and programmable control panel **429**. These diagnostic functions may indicate the health of the programmable control panels.

In another illustrative example, a user may input information to indicate the health of programmable control panel **429.** For example, a user may input a code. As another example, the user's hand may be placed on the display for a period of time, or provide some other suitable user input that may cause the panel to take itself out of service. This type of user input may be used when the user discovers that programmable control panel **429** is not operating as desired. This input may cause programmable control panel **429** to send a message indicating that programmable control panel **429** is not operating as desired.

In another illustrative example, panel manager **128** may use a heartbeat system in which panel manager **128** expects to receive a signal or message from programmable control panels **422** within a selected period of time. If the message is not received from a particular programmable control panel within the selected period of time, then the particular programmable control panel may be considered as not operating as desired.

If the diagnostic functions indicate that a programmable control panel is not operating as desired, the agent on the programmable control panel may send a request for help. This request for help may be considered an indicator or information about the health of the programmable control panel.

Turning now to **Figures 5-7**, illustrations of block diagrams of interactions between programmable control panels are depicted in accordance with an illustrative embodiment. In **Figure 5**, programmable control panels **500**, **502**, and **504** are examples of programmable control panels within programmable control panels **116** in **Figure 1**. As depicted, programmable control panels **500**, **502**, and **504** communicate with each other using network **118**. Alternatively, these programmable control panels may communicate directly with each other through wireless communications links without using network **118**.

In this illustrative example, programmable control panel **500** has function 1, function 2, and function 3 in storage device **510**. Function 1 is a first level control function that is operational. Function 2 and function 3 are stored in storage device **510** as the second level control functions. In this illustrative example, agent **511** is configured to manage the functions in storage device **510**.

Programmable control panel **502** has function 1, function 2, and function 3 in storage device **512**. Agent **513** is also present on programmable control panel **502**.

Function 2 is a first level control function that is currently operating. Function 1 and function 3 are second level control functions in programmable control panel **502**.

Programmable control panel **504** is a new programmable control panel in this illustrative example. No functions are currently stored in storage device **514** in this illustrative example.

Agent **515** is present on programmable control panel **504**. Functions are currently absent in storage device **514** of programmable control panel **504**.

Turning next to **Figure 6**, agent **515** sends identification information **600** to network **118**. In these illustrative examples, identification information **600** may include information about the location of programmable control panel **504**, a configuration of programmable control panel **504**, an identifier for programmable control panel **504**, and/or other suitable information.

In **Figure 7**, agent **511** on programmable control panel **500** sends software **700** to programmable control panel **504** in response to identification information **600** in **Figure 6** being sent to network **118**. Agent **513** on programmable control panel **502** sends software **702** to programmable control panel **504** in response to identification information **600** being sent to network **118**. Software **700** and software **702** are used by agent **515** on programmable control panel **504** to install one or more functions to be provided by programmable control panel **504**.

In **Figure 7**, agent **515** on programmable control panel **504** installs at least one of software **700** and software **702** to configure programmable control panel **504** to provide function 1, function 2, and function 3 in storage device **514**. Function 3 is the first level control function in programmable control panel **504** while function 1 and function 2 are second level control functions. In this manner, programmable control panels **500**, **502**, and **504** may interact with each other to provide assignment of functions to programmable control panel **504** after its installation.

Turning now to **Figures 8-11**, illustrations of block diagrams of interactions between programmable control panels in a vehicle are depicted in accordance with an illustrative embodiment. In **Figure 8**, programmable control panels **800**, **802**, and **804** are examples of programmable control panels in programmable control panels **116** in **Figure 1**.

These programmable control panels communicate with each other in a peer-to-peer fashion in this particular example. This communication is performed through agent **818** on programmable control panel **800**, agent **820** on programmable control panel **802**, and agent **822** on programmable control panel **804**. For example, agent **818** on programmable control panel **800** may send communications to agent **820** on programmable control panel **802**. In turn, agent **820** on programmable control panel **802** may perform operations using the communications or may forward the communications to agent **822** on programmable control panel **804**. In a similar fashion, agent **818** on programmable control panel **800** may perform actions based on receiving communications from agent **820** on programmable control panel **802** and may forward the communications received from agent **820** on programmable control panel **802** to network **118** in this illustrative example. These communications then may be received by panel manager **128**.

As depicted, programmable control panel **800** has function 1 in storage device **812**. Function 1 is a primary control function in programmable control panel **800**. Programmable control panel **802** has function 2 in storage device **814**. Function 2 is a primary control function in programmable control panel **802**. Programmable control panel **804** does not have a control function in storage device **816**. Storage device **816,** however, should have a control function. In this illustrative example, storage device **816** is not operating as desired. As a result, no control functions are provided by programmable control panel **804**.

More specifically, storage device **816** has failed in this particular example. In this illustrative example, the failure of storage device **816** may be identified by agent **822** running diagnostic routines to identify the health of different components on programmable control panel **804**.

In **Figure 9**, agent **822** on programmable control panel **804** sends help request **900** to agent **820** on programmable control panel **802** in response to detecting a failure of storage device **816**.

Agent **820** on programmable control panel **802** sends help request **900** to agent **818** on programmable control panel **800**. In turn, agent **818** sends help request **900** to aircraft network **118**. Panel manager **128** may receive help request **900** from agent **818**.

In response to receiving help request **900**, panel manager **128** assigns one or more new functions to programmable control panel **800** and programmable control panel **802**. In particular, a new second level control function is selected for programmable control panel **800** and programmable control panel **802**. In this illustrative example, the second level function is function 3, which was performed by programmable control panel **804**.

In **Figure 10**, panel manager **128** sends function 3 in software **1000** and software **1002** back to programmable control panel **800** and programmable control panel **802**, respectively. Upon receiving software **1000**, in **Figure 11**, agent **818** on programmable control panel **800** installs software **1000** in response to receiving software **1000**. The installation of software **1000** adds function 3 as a second level control function in programmable control panel **800**.

In a similar fashion, agent **820** on programmable control panel **802** installs software **1002** such that programmable control panel **802** provides function 2 and

function 3. Function 3 is a second level control function, while function 2 is a first level control function in programmable control panel **802**.

As a result, both programmable control panel **800** and programmable control panel **802** now include function 3 as a second level control function. In this manner, programmable control panel **800** and programmable control panel **802** may perform function 3 because programmable control panel **804** is unable to perform function 3.

The same function may be placed on both of these programmable control panels such that an operator may select one of the programmable control panels to perform function 3. Two panels are selected in this illustrative example in case it is undesirable that an operator be distracted or change the current function being performed by one of programmable control panel **800** or programmable control panel **802**.

The illustrations of the components in **Figures 2-11** are not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be unnecessary. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined, divided, or combined and divided into different blocks when implemented in an illustrative embodiment.

For example, programmable control panel **200** in **Figure 2** may include a global positioning system (GPS) receiver to identify its location within a vehicle. Of course, any type of location system may be used. In another illustrative example, programmable control panel **200** may include a radio frequency tag reader. The radio frequency tag reader may read radio frequency tags that provide information on locations. More specifically, radio frequency identification (RFID) tags may be placed at different locations in the aircraft. The placement may be such that programmable control panel **200** only may read one radio frequency identification tag at a time. Each radio frequency tag may provide programmable control panel **200** with location information about the location of the tag on the aircraft. Thus, when programmable control panel **200** is placed in a location, programmable control panel **200** may obtain information about the location of programmable control panel **200** from reading a radio frequency tag at the location.

As another example, panel managers in addition to panel manager **128** may be present to manage programmable control panels. Further, in some illustrative examples, a complete set of functions for all of the systems in a vehicle may be pre-programmed on programmable control panels **116**. Instead of sending software, commands and configuration files, as well as other information, may be sent to programmable control panels **116** to activate desired control functions for each of the programmable control panels in programmable control panels **116**.

Turning now to **Figure 12**, an illustration of an aircraft is depicted in accordance with an illustrative embodiment. In this illustrative example, aircraft **1200** is an example of one implementation for vehicle **102** in **Figure 1**. Programmable control panels, such as programmable control panels **116**, may be implemented and managed in aircraft **1200**.

In this illustrative example, aircraft **1200** has wing **1202** and wing **1204** attached to body **1206**. Additionally, engine **1208** is mounted on wing **1202**, and engine **1210** is mounted on wing **1204**. Tail section **1212** of body **1206** has horizontal stabilizer **1214**, horizontal stabilizer **1216**, and vertical stabilizer **1218**.

Turning now to **Figure 13**, an illustration of a programmable control panel is depicted in accordance with an illustrative embodiment. Programmable control panel **1300** is an example of a physical implementation for a programmable control panel. Programmable control panel **1300** may be used to implemented programmable control panels **116** in **Figure 1** and programmable control panel **200** in **Figure 2**.

In this illustrative example, programmable control panel **1300** may be mounted on frame **1302**. As illustrated, frame **1302** comprises rails. These rails may provide power, depending on the implementation. Programmable control panel **1300** has data connector **1304** and power connector **1306**. Data connector **1304** may be connected to a network. Power connector **1306** may be connected to a power source. Additionally, decorative bezel **1308** may be placed over programmable control panel **1300** when programmable control panel **1300** is mounted to frame **1302**.

Turning now to **Figure 14**, an illustration of a cargo area in an aircraft is depicted in accordance with an illustrative embodiment. In this illustrative example, cargo area **1400** is an example of a cargo area found in aircraft **1200** in **Figure 12**. As depicted, programmable control panel **1402** and programmable control panel **1404** are present in cargo area **1400.** These two programmable control panels may be

implemented using a programmable control panel, such as programmable control panel **200** shown in block form in **Figure 2** and programmable control panel **1300** shown in physical form in **Figure 13**.

Programmable control panel **1402** is configured to control access to door **1406**. Programmable control panel **1404** is configured to control the movement of cargo movement system **1408**. In this illustrative example, cargo movement system **1408** may comprise rollers that may be turned by motors in cargo area **1400.**

In these illustrative examples, programmable control panel **1402** controls access to door **1406** as a first level control function. In these illustrative examples, if programmable control panel **1404** fails, software for the movement function for cargo movement system **1408** may be downloaded to programmable control panel **1402**. As a result, programmable control panel **1402** may control both access to door **1406** and operation of cargo movement system **1408**. In this example, operation of cargo movement system **1408** may be controlled using programmable control panel **1402** while cargo is loaded.

After flight begins, programmable control panel **1402** may be operated to control access to door **1406** and may become the first level control function. The functions to control these two systems may be selected through different mechanisms on programmable control panel **1402**. For example, tabs may be used to select functions for either system, dual displays for both functions may be presented on programmable control panel **1402** at the same time, or some other type of interface may be used. Of course, other types of mechanisms may be used, depending on the particular implementation.

Turning now to **Figure 15**, an illustration of a display for a programmable control panel is depicted in accordance with an illustrative embodiment. In this illustrative example, display device **1500** is an example of a display on programmable control panel **1402** in **Figure 14**. In this illustrative example, display device **1500** is one example of a display device in display system **212** in **Figure 2**. As depicted, graphical user interface **1501** is displayed on display device **1500**. Graphical user interface **1501** is an example of a graphical user interface for graphical user interface **260** in **Figure 2**.

As depicted, graphical user interface **1501** has door tab **1502** and cargo tab **1504**. Door tab **1502** is presently selected in this illustrative example. With door tab **1502** selected, graphical user interface **1501** shows the status of door **1406** in section

1506. Control **1508** may lock door **1406** in **Figure 14,** while control **1510** unlocks door **1406**.

Turning next to **Figure 16**, another illustration of a display for a programmable control panel is depicted in accordance with an illustrative embodiment. In this illustrative example, cargo tab **1504** has been selected in graphical user interface **1501** displayed on display device **1500** of programmable control panel **1402** in **Figure 14**. With the selection of cargo tab **1504**, graphical user interface **1501** displays controls and information about cargo movement system **1408** in **Figure 14**.

In this example, section **1600** indicates that cargo movement system **1408** is off. Cargo movement system **1408** may be turned on and off through control **1602** and control **1604,** respectively. When cargo movement system **1408** is turned on, the speed of cargo movement system **1408** may be controlled through control **1606** and control **1608**. In this illustrative example, these controls are second level control functions for programmable control panel **1402**.

The illustration of display device **1500** and graphical user interface **1501** in **Figure 15** and **Figure 16** is not meant to limit the manner in which different displays may be configured for programmable control panels. For example, rather than using tabs, function buttons may be included on display device **1500**. Further, although the illustrative examples show different controls on a touch screen for display device **1500**, these controls may be associated with physical buttons in which labels may be displayed on display device **1500** to identify the functions performed by the physical buttons. These physical buttons may be, for example, without limitation, programmable physical buttons.

The different components illustrated in **Figures 12-16** may be combined with components illustrated in block form in **Figures 1-11**, used with components in **Figures 1-11**, or a combination of the two. Additionally, some of the components illustrated in **Figures 12-16** may be illustrative of how components shown in block form in **Figures 1-11** may be implemented as physical objects.

With reference now to **Figure 17**, an illustration of a flowchart of a process for managing a programmable control panel is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 17** may be implemented in panel manager **128** in **Figure 1**.

The process begins by assigning a number of first level control functions to a programmable control panel for a vehicle (operation **1700**). Next, a number of second level control functions are assigned to the programmable control panel based on a health of the programmable control panels in the vehicle (operation **1702**), with the process terminating thereafter.

Turning next to **Figure 18**, an illustration of a flowchart of a process for programming programmable control panels prior to installation on a vehicle is depicted in accordance with an illustrative embodiment. This process may be implemented in panel manager **128** in **Figure 1**.

The process begins by identifying a group of programmable control panels for programming (operation **1800**). The process then selects an unprocessed programmable control panel from the group of programmable control panels (operation **1802**).

Next, the process selects a number of first level control functions for the programmable control panel (operation **1804**). Operation **1804** may be performed through input received by the controller. This input may be user input, a configuration file, or some other information.

With the user input, the process identifies the number of first level control functions from control functions in a database (operation **1806**). The process then sends software for the number of first level control functions to the programmable control panel (operation **1808**). The process then receives a confirmation that the number of first level control functions has been installed on the programmable control panel (operation **1810**).

A determination is made as to whether another programmable control panel is to be programmed (operation **1812**). If another programmable control panel is to be programmed, the process returns to operation **1802**. Otherwise, the process terminates.

Turning now to **Figure 19**, an illustration of a flowchart of a process for monitoring the health of programmable control panels is depicted in accordance with an illustrative embodiment. This process may be implemented in panel manager **128** in **Figure 1**. This process determines whether the programmable control panels are operating as desired. This information may be used to determine whether functions

need to be reassigned from one programmable control panel to another programmable control panel.

The process begins by sending polling requests to the programmable control panels (operation **1900**). The process receives responses to the polling requests (operation **1902**). Next, a determination is made as to whether any of the programmable control panels have failed to respond to the polling request (operation **1904**). If one or more programmable control panels have failed to respond to the polling request, the programmable control panels failing to respond are identified as not operating as desired (operation **1906**). The process then waits for a period of time (operation **1908**) and returns to operation **1900** as described above.

Returning again to operation **1904**, if one or more programmable control panels has not failed to respond, the process terminates.

Turning now to **Figure 20**, an illustration of a flowchart of a process for identifying the health of programmable control panels is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 20** may be implemented in panel manager **128** in **Figure 1**.

In this illustrative example, the process monitors for a help request from the programmable control panels (operation **2000**). A determination is made as to whether a help request has been received (operation **2002**). If a help request has not been received, the process returns to operation **2000**.

With reference again to operation **2002**, if a help request is received, a programmable control panel that is failing to operate as desired is identified from the help request (operation **2004**). The help request may be sent directly from the programmable control panel that is not operating as desired in some cases. In other cases, a programmable control panel may detect that another programmable control panel is not operating as desired and send the help request.

The process then indicates that the programmable control panel is failing to operate as desired (operation **2006**), with the process then returning to operation **2000** as described above.

With reference now to **Figure 21**, an illustration of a flowchart of a process for assigning functions to control panels is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 21** may be implemented in panel manager **128** in **Figure 1**.

The process begins by determining whether a programmable control panel is operating as desired (operation **2100**). If a programmable control panel is operating as desired, the process terminates. If a programmable control panel has been identified as not operating as desired, the process then identifies the location of the failed programmable control panel (operation **2102**).

Thereafter, the process identifies any programmable control panels within a desired proximity of the location for the failed programmable control panel (operation **2104**). Programmable control panels may be identified as being in a desired proximity in a number of different ways. For example, the identification may be based on the location of the programmable control panel relative to the failed programmable control panel. For example, programmable control panels within a desired proximity may be those within the same zone, compartment, or a selected distance from the failed programmable control panel.

After identifying programmable control panels within the desired proximity, a list of the programmable control panels with configuration information is identified (operation **2106**). This list is used to identify a potential programmable control panel to be configured to include a number of functions formed by the programmable control panel that is not operating as desired. This list of programmable control panels may include information about the programmable control panels. The information may be, for example, type of display, processor speed, type of operating speed, type of interface, and other suitable information.

The process then identifies the type of modification to be made (operation **2108**). In these illustrative examples, the modification in operation **2108** is a modification to the manner in which a programmable control panel operates. The modification may include changes to the interface, additional functions, and other suitable modifications to allow the programmable control panel to control a system previously controlled by the programmable control panel that is no longer operating as desired. The modification may be, for example, adding a tab, overriding the current control functions with the control functions for the failed programmable control panel module, providing dual displays for the number of first level control functions and the number of second level control functions, or some other suitable type of modification.

The process then selects a programmable control panel from the list of programmable control panels (operation **2110**). The selection of the programmable

control panel may be performed in a number of different ways. For example, the programmable control panel may be selected as one closest to the failed programmable control panel based on the current functions being provided by the programmable control panels in the list and other suitable factors.

The process determines whether the programmable control panel selected is operational (operation **2112**). If the programmable control panel is not operational, the process removes the programmable control panel from the list (operation **2114**). Thereafter, the process determines whether any programmable control panels are still present in the list (operation **2116**). If one or more additional programmable control panels are not present, the process generates an alert (operation **2118**), with the process terminating thereafter. Otherwise, the process returns to operation **2110** as described above. The alert may be an audio alert, a visual alert, an email message, a maintenance system message, or some other suitable type of alert. Further, the alert may be generated and sent in multiple types of forms, depending on the particular implementation. For example, the alert may be presented in a cockpit or control center. Additionally, the alert may be transmitted to a remote location from the vehicle.

With reference again to operation **2112**, if the selected programmable control panel is functional, the process then identifies a priority for the functions in the selected programmable control panel (operation **2120**). In some cases, the functions in the failed programmable control panel may have a higher priority over the functions in the selected programmable control panel. The functions with the highest priority are the first level control functions, while the other functions are second level control functions in these illustrative examples. Functions with a higher priority may be displayed as a default display with other functions having a lower priority being displayed in response to a selection of a tab.

In these illustrative examples, a function may have a higher priority than others if the function is one that is desirable to have available continuously or when needed. As a result, the function with the higher priority may be given more resources in the control panel than other functions. Further, the priority of functions may change, depending on the phase of flight. For example, a cargo door control may have a higher priority when the aircraft is on the ground rather than when the aircraft is in flight.

Thereafter, a determination is made as to whether the programmable control panel selected from the list provides a function that should not be supplemented

with additional functions (operation **2122**). If the programmable control panel should not be changed, the process then proceeds to operation **2114** as described above. These factors may include whether the selected programmable control panel has safety-related functions, the function relies on a line of sight that may not be present, or other modifications that may reduce the current functionality of the programmable control panel to an undesired level.

If the programmable control panel should be changed, the process then modifies the programmable control panel with the functions from the failed programmable control panel (operation **2124**), with the process terminating thereafter. In operation **2124**, the modification may include, for example, without limitation, adding the number of functions from the failed programmable control panel as a number of second level control functions, replacing the number of control functions with those from the failed programmable control panel, or making the number of control functions from the failed programmable control panel the number of first level control functions with the current number of control functions becoming a number of second level control functions.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible implementations of apparatuses and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent a module, segment, function, and/or a portion of an operation or step. For example, one or more of the blocks may be implemented as program code, in hardware, or a combination of the program code and hardware. When implemented in hardware, the hardware may, for example, take the form of integrated circuits that are manufactured or configured to perform one or more operations in the flowcharts or block diagrams.

In the illustrative examples, the hardware may take the form of a circuit system, an integrated circuit, an application specific integrated circuit (ASIC), a programmable logic device, or some other suitable type of hardware configured to perform a number of operations. With a programmable logic device, the device is configured to perform the number of operations. The device may be reconfigured at a later time or may be permanently configured to perform the number of operations. Examples of programmable logic devices include, for example, a programmable logic array, programmable array logic, a field programmable logic array, a field programmable

gate array, and other suitable hardware devices. Additionally, the processes may be implemented in organic components integrated with inorganic components and/or may be comprised entirely of organic components excluding a human being.

In some alternative implementations of an illustrative embodiment, the function or functions noted in the blocks may occur out of the order noted in the figures. For example, in some cases, two blocks shown in succession may be executed substantially concurrently, or the blocks may sometimes be performed in the reverse order, depending upon the functionality involved. Also, other blocks may be added in addition to the illustrated blocks in a flowchart or block diagram.

Turning now to **Figure 22**, an illustration of a data processing system is depicted in accordance with an illustrative embodiment. Data processing system **2200** may be used to implement one or more computers in computer system **112** in **Figure 1**. In this illustrative example, data processing system **2200** includes communications framework **2202**, which provides communications between processor unit **2204**, memory **2206**, persistent storage **2208**, communications unit **2210**, input/output (I/O) unit **2212**, and display **2214**. In this example, communications framework **2202** may take the form of a bus system.

Processor unit **2204** serves to execute instructions for software that may be loaded into memory **2206**. Processor unit **2204** may be a number of processors, a multi-processor core, or some other type of processor, depending on the particular implementation.

Memory **2206** and persistent storage **2208** are examples of storage devices **2216**. A storage device is any piece of hardware that is capable of storing information, such as, for example, without limitation, data, program code in functional form, and other suitable information either on a temporary basis or a permanent basis. Storage devices **2216** also may be referred to as computer readable storage devices in these illustrative examples. Memory **2206**, in these examples, may be, for example, a random access memory or any other suitable volatile or non-volatile storage device. Persistent storage **2208** may take various forms, depending on the particular implementation.

For example, persistent storage **2208** may contain one or more components or devices. For example, persistent storage **2208** may be a hard drive, a flash memory, a rewritable optical disk, a rewritable magnetic tape, or some

combination of the above. The media used by persistent storage **2208** also may be removable. For example, a removable hard drive may be used for persistent storage **2208**.

Communications unit **2210**, in these illustrative examples, provides for communications with other data processing systems or devices. In these illustrative examples, communications unit **2210** is a network interface card.

Input/output unit **2212** allows for input and output of data with other devices that may be connected to data processing system **2200**. For example, input/output unit **2212** may provide a connection for user input through a keyboard, a mouse, and/or some other suitable input device. Further, input/output unit **2212** may send output to a printer. Display **2214** provides a mechanism to display information to a user.

Instructions for the operating system, applications, and/or programs may be located in storage devices **2216**, which are in communication with processor unit **2204** through communications framework **2202**. The processes of the different embodiments may be performed by processor unit **2204** using computer-implemented instructions, which may be located in a memory, such as memory **2206**.

These instructions are referred to as program code, computer usable program code, or computer readable program code that may be read and executed by a processor in processor unit **2204**. The program code in the different embodiments may be embodied on different physical or computer readable storage media, such as memory **2206** or persistent storage **2208**.

Program code **2218** is located in a functional form on computer readable media **2220** that is selectively removable and may be loaded onto or transferred to data processing system **2200** for execution by processor unit **2204**. Program code **2218** and computer readable media **2220** form computer program product **2222** in these illustrative examples. In one example, computer readable media **2220** may be computer readable storage media **2224** or computer readable signal media **2226**.

In these illustrative examples, computer readable storage media **2224** is a physical or tangible storage device used to store program code **2218** rather than a medium that propagates or transmits program code **2218.**

Alternatively, program code **2218** may be transferred to data processing system **2200** using computer readable signal media **2226**. Computer readable signal

media **2226** may be, for example, a propagated data signal containing program code **2218**. For example, computer readable signal media **2226** may be an electromagnetic signal, an optical signal, and/or any other suitable type of signal. These signals may be transmitted over communications links, such as wireless communications links, optical fiber cable, coaxial cable, a wire, and/or any other suitable type of communications link.

The different components illustrated for data processing system **2200** are not meant to provide physical or architectural limitations to the manner in which different embodiments may be implemented. The different illustrative embodiments may be implemented in a data processing system including components in addition to and/or in place of those illustrated for data processing system **2200**. Other components shown in **Figure 22** can be varied from the illustrative examples shown. The different embodiments may be implemented using any hardware device or system capable of running program code **2218**.

Illustrative embodiments of the present disclosure may be described in the context of aircraft manufacturing and service method **2300** as shown in **Figure 23** and aircraft **2400** as shown in **Figure 24**. Turning first to **Figure 23**, an illustration of an aircraft manufacturing and service method is depicted in accordance with an illustrative embodiment. During pre-production, aircraft manufacturing and service method **2300** may include specification and design **2302** of aircraft **2400** in **Figure 24** and material procurement **2304**.

During production, component and subassembly manufacturing **2306** and system integration **2308** of aircraft **2400** in **Figure 24** takes place. Thereafter, aircraft **2400** in **Figure 24** may go through certification and delivery **2310** in order to be placed in service **2312**. While in service **2312** by a customer, aircraft **2400** in **Figure 24** is scheduled for routine maintenance and service **2314**, which may include modification, reconfiguration, refurbishment, and/or other maintenance or service.

Each of the processes of aircraft manufacturing and service method **2300** may be performed or carried out by a system integrator, a third party, and/or an operator. In these examples, the operator may be a customer. For the purposes of this description, a system integrator may include, without limitation, any number of aircraft manufacturers and major-system subcontractors; a third party may include, without limitation, any number of vendors, subcontractors, and suppliers; and an operator may be an airline, a leasing company, a military entity, a service organization, and so on.

With reference now to **Figure 24**, an illustration of an aircraft is depicted in which an illustrative embodiment may be implemented. In this example, aircraft **2400** is produced by aircraft manufacturing and service method **2300** in **Figure 23** and may include airframe **2402** with plurality of systems **2404** and interior **2406**. Examples of systems **2404** include one or more of propulsion system **2408**, electrical system **2410**, hydraulic system **2412**, and environmental system **2414**. Any number of other systems may be included. Although an aerospace example is shown, different illustrative embodiments may be applied to other industries, such as the automotive industry.

Apparatuses and methods embodied herein may be employed during at least one of the stages of aircraft manufacturing and service method **2300** in **Figure 23**. In one illustrative example, components or subassemblies produced in component and subassembly manufacturing **2306** in **Figure 23** may be fabricated or manufactured in a manner similar to components or subassemblies produced while aircraft **2400** is in service **2312** in **Figure 23**. As yet another example, one or more apparatus embodiments, method embodiments, or a combination thereof may be utilized during production stages, such as component and subassembly manufacturing **2306** and system integration **2308** in **Figure 23**.

In one illustrative example, programmable control panels may be manufactured and programmed during component and subassembly manufacturing **2306**. In other illustrative examples, programmable control panels may be programmed while being installed in aircraft **2400** during system integration **2308**. Programmable control panels in aircraft **2400** may be reprogrammed to include functions from programmable control panels that may not operate as desired during in service **2312**.

One or more apparatus embodiments, method embodiments, or a combination thereof may be utilized while aircraft **2400** is in service **2312** and/or during maintenance and service **2314** in **Figure 23**. For example, programmable control panels in aircraft **2400** may be updated, replaced, reprogrammed, or otherwise serviced during maintenance and service **2314**. The use of a number of the different illustrative embodiments may substantially expedite the assembly of and/or reduce the cost of aircraft **2400**.

The description of the different illustrative embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and

variations will be apparent to those of ordinary skill in the art. For example, one or more illustrative embodiments may be applied to vehicles other than aircraft. Other vehicles may be selected from one of an aircraft, a spacecraft, a surface ship, a submarine, an automobile, a train, a truck, and other suitable types of vehicles.

Further, different illustrative embodiments may provide different advantages as compared to other illustrative embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS:

What is claimed is:

1. A method for managing a programmable control panel (132) for a vehicle (102), the method comprising:

assigning a number of first level control functions (130) to the programmable control panel (132) for the vehicle (102); and

assigning a number of second level control functions (134) to the programmable control panel (132) based on a health (136) of programmable control panels (116) in the vehicle (102).

2. The method of claim 1, wherein assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) comprises:

assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) based on a location (138) of the programmable control panel (132) in the vehicle (102).

3. The method of claim 1, wherein assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) comprises:

assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) prior to the programmable control panel (132) being installed in the vehicle (102).

4. The method of claim 1, wherein assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) comprises:

assigning the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) after the programmable control panel (132) is installed in the vehicle (102).

5. The method of claim 1, wherein assigning the number of second level control functions (134) to the programmable control panel (132) based on the health (136) of the programmable control panels (116) in the vehicle (102) comprises:

responsive to a particular programmable control panel in the programmable control panels (116) failing to operate as desired, identifying an associated number of first level control functions for the particular programmable control panel; and

assigning the associated number of first level control functions to the programmable control panel (132) as the number of second level control functions (134) to the programmable control panel (132).

6. The method of claim 1 further comprising:

displaying a user interface (256) for the number of first level control functions (130) and the number of second level control functions (134) on a display device in the programmable control panel (132).

7. The method of claim 5 further comprising:

selecting the programmable control panel (132) for assignment of the number of second level control functions (134) based on a proximity of the programmable control panel (132) to the particular programmable control panel.

8. The method of claim 1, wherein the programmable control panel (132) has a user input system (214) having at least one of a touch screen (232) and programmable physical buttons.

9. The method of claim 1, wherein the vehicle (102) is selected from one of an aircraft, a spacecraft, a surface ship, a submarine, an automobile, a train, and a truck.

10. An apparatus comprising:

a programmable control panel (132) configured to be connected to a vehicle (102); receive a number of first level control functions (130) to the programmable control panel (132) for the vehicle (102); and receive a number of second level control functions (134) to the programmable control panel (132) based on a health (136) of programmable control panels (116) in the vehicle (102).

11. The apparatus of claim 10, wherein the number of second level control functions

(134) is a number of control functions (258) for another programmable control panel failing to operate as desired.

12. The apparatus of claim 11, wherein the number of first level control functions (130) is a number of current first level control functions performed by the programmable control panel (132) and is for controlling a system in the vehicle (102).

13. The apparatus of claim 11, wherein the programmable control panel (132) comprises:

a user input system (214);

a display system (212);

a communication unit (216);

a storage device (208) configured to store software (220) for the number of first level control functions (130) and the number of second level control functions (134); and

a processor unit (206) configured to run the software (220).

14. The apparatus of claim 13, wherein a touch screen (232) forms the user input system (214) and the display system (212).

15. A vehicle system comprising:

a plurality of systems (104); and

programmable control panels (116) configured to control the plurality of systems (104), wherein a programmable control panel (132) in the programmable control panels (116) is configured to perform a number of first level control functions (130) to the programmable control panel (132) for a vehicle (102); and perform a number of second level control functions (134) to the programmable control panel (132) based on a health (136) of the programmable control panels (116) in the vehicle (102).

16. The vehicle system of claim 15 further comprising:

a panel manager (128) configured to assign the number of first level control functions (130) to the programmable control panel (132) and assign the number of second level control functions (134) to the programmable control panel (132) based on the health (136) of the programmable control panels (116).

17. The vehicle system of claim 16, wherein the panel manager (128) is configured to assign the number of first level control functions (130) to the programmable control panel (132) in the vehicle (102) based on a location (138) of the programmable control panel (132) in the vehicle (102).

18. The vehicle system of claim 16, wherein the panel manager (128) is configured to assign the number of second level control functions (134) to the programmable control panel (132) based on a location (138) of the programmable control panel (132) relative to another programmable control panel failing to operate as desired.

19. The vehicle system of claim 16, wherein in being configured to assign the number of second level control functions (134) to the programmable control panel (132) based on the health (136) of the programmable control panels (116), the panel manager (128) is configured to identify an associated number of first level control functions for a particular programmable control panel in response to the particular programmable control panel in the programmable control panels (116) failing to operate as desired and assign the associated number of first level control functions to the programmable control panel (132) and the number of second level control functions (134) to the programmable control panel (132).

20. The vehicle system of claim 15 further comprising:
the vehicle (102), wherein the vehicle (102) is selected from one of an aircraft, a spacecraft, a surface ship, a submarine, an automobile, a train, and a truck.