are gaining popularity, but those centralized simulators are not typically modular and do not support edge computing, e.g., processing data nearest the location that sources or uses the data at a panel. These centralized aircraft simulators also typically include proprietary or custom Application Programming Interfaces (APIs), which may not conform to a single standard.

**[0006]** Most conventional training simulators are host-driven, where the simulator's host processor runs a loop containing a large state machine that reads and writes individual bits to drive the various components in an aircraft cockpit simulator panels. That type of simulator has disadvantages. For example, the host computer may require specialized add-in interface cards, increasing complexity, and driver issues. Conventional simulators may also have a high interface wiring density, which increases material and assembly costs and requires a lengthy integration time. The cockpit panels are usually not testable until final assembly, when the interface equipment and connecting wires are in place. There is little modularity and standardization, and since the software code controlling the individual panels is tightly integrated with the host computer, it is vendor-specific and usually highly proprietary. This vendor specificity places constraints on update and replacement options, potentially driving up life-cycle costs significantly.

## Summary

**[0007]** In general, an aircraft cockpit training simulator may include a plurality of aircraft cockpit simulation panels and power over Ethernet (POE) cabling extending therebetween. Each aircraft cockpit simulation panel may comprise at least one simulator user interface device, at least one of an input circuit and an output circuit coupled to the at least one simulator user interface device, a POE interface circuit, and a distributed controller coupled to the at least one of an input circuit and an output circuit and POE interface device configured to asynchronously communicate with other controllers using a publish/subscribe protocol. A host controller may be coupled to the plurality of distributed controllers via the POE cabling and configured to operate the plurality of aircraft cockpit simulation panels in accordance with a host computer model.

The plurality of distributed controllers may also be capable of operating independent of the host computer model.

**[0008]** Each distributed controller may be configured to send a plurality of status messages asynchronously with respect to other distributed controllers. The at least one simulator user interface device may comprise at least one lighting device. The at least one simulator user interface device may comprise at least one power consuming device. The at least one simulator user interface device may comprise at least one of a switch, a lamp, a potentiometer, a joystick, and a display.

**[0009]** The at least one of an input circuit and an output circuit may comprise at least one analog input circuit, and in an example, may comprise at least one analog output circuit. The at least one of an input circuit and an output circuit may comprise at least one digital input circuit, and in yet another example, may comprise at least one digital output circuit.

**[0010]** Each panel may comprise at least one connector, and wherein the at least one of an input circuit and an output circuit, the POE interface circuit, and the distributed controller are in a form of a line replaceable unit (LRU) coupled to the at least one connector.

**[0010a]** In one aspect, the present disclosure refers to an aircraft cockpit training simulator comprising:a plurality of aircraft cockpit simulation panels and power over Ethernet (POE) cabling extending therebetween; each aircraft cockpit simulation panel comprising at least one simulator user interface device, at least one of an input circuit and an output circuit coupled to the at least one simulator user interface device, a POE interface circuit, and a distributed controller coupled to the at least one of an input circuit and an output circuit and POE interface device configured to asynchronously communicate with other controllers using a publish/subscribe protocol, and a host controller coupled to the plurality of distributed controllers via the POE cabling and configured to operate the plurality of aircraft cockpit simulation panels in accordance with a host computer model;

wherein each aircraft cockpit simulation panel comprises at least one connector; and wherein the at least one of an input circuit and output circuit, the POE interface circuit, and distributed controller are in the form of a line replacement unit (LRU) coupled to the at least one connector, each aircraft cockpit simulation panel being capable of operating independent of all other aircraft cockpit simulation panels and the host computer model run by the host controller and configured to facilitate development and testing of the respective aircraft cockpit simulation panel without reference to the other aircraft cockpit simulation panels and the host controller and host computer model.

**[0010b]** In another aspect, the present disclosure refers to an aircraft cockpit training simulator comprising: a plurality of aircraft cockpit simulation panels and power over Ethernet (POE) cabling extending therebetween; each aircraft cockpit simulation panel comprising at least one simulator user interface device and at least one connector

coupled thereto, and a line replaceable unit (LRU) coupled to the at least one connector comprising at least one of an input circuit and an output circuit coupled to the at least one simulator user interface device, a POE interface circuit, and a distributed controller coupled to the at least one of an input circuit and an output circuit and POE interface circuit configured to asynchronously communicate with other distributed controllers using a publish/subscribe Data Distribution Service (DDS) protocol; and a host controller coupled to the plurality of distributed controllers via the POE cabling and configured to operate the plurality of aircraft cockpit simulation panels in accordance with a host computer model;

each aircraft cockpit simulation panel being capable of operating independent of all other aircraft cockpit simulation panels and the host computer model run by the host controller and configured to facilitate development and testing of the respective aircraft cockpit simulation panel without reference to the other aircraft cockpit simulation panels and the host controller and host computer model.

**[0011]** Another example is directed to a method of making an aircraft cockpit training simulator that may comprise coupling power over Ethernet (POE) cabling among a plurality of aircraft cockpit simulation panels, each aircraft cockpit simulation panel comprising at least one simulator user interface device, at least one of an input circuit and an output circuit coupled to the at least one simulator user interface device, a POE interface circuit, and a distributed controller coupled to the at least one of an input circuit and an output circuit and POE interface device configured to asynchronously communicate with other controllers using a publish/subscribe protocol. The method may also include coupling a host controller to the plurality of distributed controllers via the POE cabling and configured to operate the plurality of aircraft cockpit simulation panels in accordance with a host computer model, and wherein the plurality of distributed controllers are also capable of operating independent of the host computer model.

**[0011b]** In another aspect, the present disclosure refers to a method of making an aircraft cockpit training simulator comprising: coupling power over Ethernet (POE) cabling among a plurality of aircraft cockpit simulation panels, each aircraft cockpit simulation panel comprising at least one simulator user interface device, at least one of an input circuit and an output circuit coupled to the at least one simulator user interface device, a POE interface circuit, and a distributed controller coupled to the at least one of an input circuit and an output circuit and POE interface device configured to asynchronously communicate with other controllers using a publish/subscribe protocol, and coupling a host controller to the plurality of distributed controllers via the POE cabling and configured to operate the plurality of aircraft cockpit simulation panels in accordance with a host computer model;

wherein each aircraft cockpit simulation panel comprises at least one connector; and

wherein the at least one of an input circuit and output circuit, the POE interface circuit, and distributed controller are in the form of a line replacement unit (LRU) coupled to the at least one connector, each aircraft cockpit simulation panel being capable of operating independent of all other aircraft cockpit simulation panels and the host computer model run by the host controller and configured to facilitate development and testing of the respective aircraft cockpit simulation panel without reference to the other aircraft cockpit simulation panels and the host controller and host computer model.