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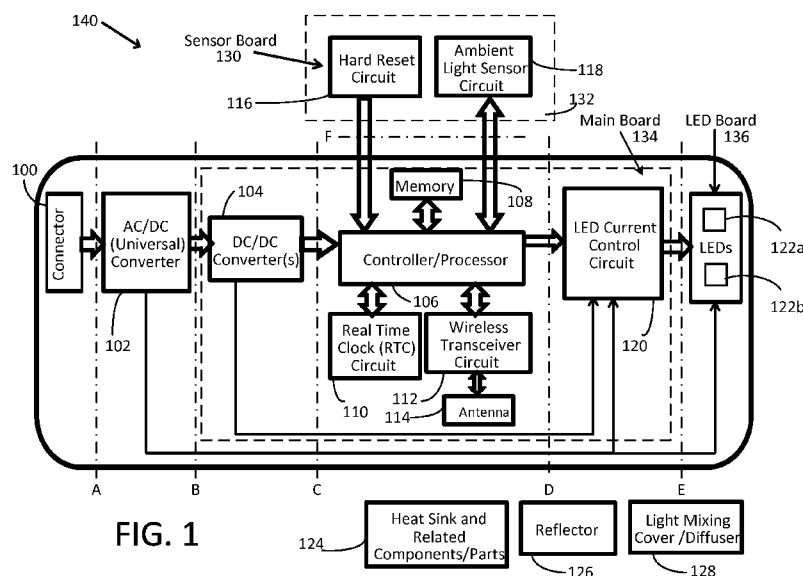


FIG. 1

(57) **Abstract:** A lighting device includes a DC/DC power converter, a controller/processor electrically connected to the DC/DC power converter, a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit. The LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.

WIRELESS LIGHTING CONTROL SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to the field of lighting and, more particularly, to a specialty lighting device and control process for individual or simultaneous adjustment, automation, and programming of an individual or network of such light bulbs through a wireless interface.

BACKGROUND OF THE INVENTION

In response to government mandates, new lighting technologies, such as light emitting diodes (LED) or compact fluorescent lamps (CFL), are entering the market at a rapid pace. However, these bulbs have limitations that make them unattractive to some users. CFLs have dimming limitations, take a few minutes to warm-up, and have problems with their color output. Additionally, CFLs contain mercury, a toxic and regulated substance, which creates issues with disposal. LEDs are currently very expensive in comparison and the high cost has dissuaded many consumers from their purchase.

Current lighting control and automation solutions are limited in their use in rental or temporary situations where the systems high price, required installation, and expertise in set-up are a problem. Further, as mobile computing systems continue to evolve, many people have shown a preference towards using their mobile device as a converged platform to control and execute multiple other tasks. Although a multitude of types of light types and luminaires have been created to help create a mood or environment, most if not all of these solutions only exist in a single state and are limited by the network power line. This has driven the complexity in bulb wattage, fixtures, wall-switches, shades, and other attempts at creating the ability to augment the atmosphere created by a light. If you want to dim one bulb, current solutions generally only allow for a wall-switch dimmer. The ability to address and adjust a single light individually or network of lights simultaneously is currently not possible without extensive installation.

SUMMARY OF THE INVENTION

The present invention provides an easily installed and transferable lighting and home automation solution because special or customized installation is not required. As a result, the present invention is fully portable and can be removed and reused in other locations throughout the long life of the light. In addition, the present invention is programmable and scalable such that the color and brightness of any individual light or a group of lights can be manually or automatically controlled using a wireless interface. A user has the flexibility to personalize the color, atmosphere, and mood of a room to better fit ones preference, time of day, or occasion at hand. Automation and dimming of the lighting devices save more energy than is consumed by the additional components of the lighting device. Moreover, using on/off signals having specified cycle times to produce a blended light reduce the current requirements of the lighting device.

More specifically, the present invention provides a lighting device that includes a DC/DC power converter, a controller/processor electrically connected to the DC/DC power converter, a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit. The LED current control circuit provides an on/off signal having a

cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.

Moreover, the present invention provides a lighting device that includes a flexible strip, an electrical connector affixed to the flexible strip and two or more LEDs affixed to the flexible strip and electrically connected to the electrical connector. In addition, a DC/DC power converter, a controller/processor and a LED current control circuit are remotely located with respect to the flexible strip and electrically connected to the electrical connector via a wire, a cable or a connecting strip. The LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.

Furthermore, the present invention provides a lighting device that includes a housing, a DC/DC power converter, a controller/processor electrically connected to the DC/DC power converter, a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit. The DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the housing, and the two or more LEDs are proximate to or within an aperture of the housing. The LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.

In addition, the present invention provides a lighting system that includes two or more lighting devices. Each lighting device includes a DC/DC power converter, a controller/processor electrically connected to the DC/DC power converter, a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit. The LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time. The controller/processors of the two or more lighting devices communicate with one another using the wireless transceivers and antennas of the two or more lighting devices.

The present invention also provides method for controlling one or more lighting devices by providing the one or more lighting devices, wherein each lighting device includes a DC/DC power converter, a controller/processor electrically connected to the DC/DC power converter, a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit. One or more control signals are sent from the controller/processor to the LED current control circuit corresponding to a blended light having a specified color. An on/off signal having a cycle time is sent from the LED current control circuit to each LED in response to the one or more control signals

such that the two or more LEDs produce the blended light having the specified color based on how long each LED is turned ON and/or OFF during the cycle time.

These and other objects, advantages and features of this invention will be apparent from the following description taken with reference to the accompanying drawing, wherein is shown a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further advantages of the invention may be better understood by referring to the following description in conjunction with the accompanying drawings, in which:

FIGURE 1 is a block diagram of a lighting device in accordance with one embodiment of the present invention;

FIGURE 2 is a circuit diagram of a single LED arm with single LED in accordance with one embodiment of the present invention;

FIGURE 3 is a circuit diagram of a solely LED Drivers scheme in accordance with one embodiment of the present invention;

FIGURE 4 is a timing diagram for the solely LED drivers scheme of FIGURE 3;

FIGURE 5 is a circuit diagram of switches and LED driver scheme in accordance with one embodiment of the present invention;

FIGURE 6 is a timing diagram for the switches and LED driver scheme of FIGURE 5;

FIGURE 7 is a circuit diagram of a multiplexer and a LED driver scheme in accordance with one embodiment of the present invention;

FIGURE 8 is a circuit diagram of current limiting circuit scheme in accordance with one embodiment of the present invention;

FIGURE 9 is a diagram of a mechanical model for a Smartstrip Light in accordance with one embodiment of the present invention;

FIGURE 10 is a block diagram of a Smartstrip light in accordance with one embodiment of the present invention;

FIGURE 11 is a circuit diagram of LEDs groups on LEDs strip in accordance with one embodiment of the present invention;

FIGURES 12A is block diagram of a front view and a rear view of LEDs strip, respectively of a LEDs Strip in accordance with one embodiment of the present invention;

FIGURES 12B is block diagram of a front view and a rear view of Extendible LEDs strip, respectively of a LEDs Strip in accordance with one embodiment of the present invention;

FIGURE 13 is a block diagram of the mechanical and electrical connections for the Smartstrip in accordance with one embodiment of the present invention;

FIGURE 14 is a block diagram of an extendible LEDs Strip in accordance with one embodiment of the present invention;

FIGURE 15 is a block diagram of a LEDs strip extension through parallel connection in accordance with one embodiment of the present invention;

FIGURE 16 is a block diagram of a LEDs strips direct connection in accordance with one embodiment of the present invention;

5 FIGURE 17 is a block diagram of a LEDs Strips connection through wire in accordance with one embodiment of the present invention;

FIGURE 18 is a perspective view of an Intelligent Illuminating Bulb in accordance with one embodiment of the present invention;

10 FIGURE 19 is an exploded perspective view of an Intelligent Illuminating Bulb in accordance with one embodiment of the present invention;

FIGURE 20 is a diagram of a LEDs Board in accordance with one embodiment of the present invention;

FIGURE 21 is a flow chart of a status request/update process for a wireless device or auxiliary device to Intelligent Illuminating Device in accordance with one embodiment of the present invention;

15 FIGURE 22 is a flow chart of a status update process for Intelligent Illuminating Device to Intelligent Illuminating Device in accordance with one embodiment of the present invention;

FIGURE 23 is a flow chart of a communication process from a device to Intelligent Illuminating Device in accordance with one embodiment of the present invention;

FIGURE 24 is a flow chart of a communication process from a device to multiple Intelligent Illuminating Devices in accordance with one embodiment of the present invention;

20 FIGURE 25 is a block diagram of accessing an Intelligent Illuminating Device network through various devices in accordance with one embodiment of the present invention;

FIGURE 26 is a flow chart of a wireless device update date/time process in Intelligent Illuminating Device in accordance with one embodiment of the present invention;

25 FIGURE 27 is a flow chart of an Intelligent Illuminating Device update date/time in Intelligent Illuminating Device in accordance with one embodiment of the present invention;

FIGURE 28 is a flow chart of basic control areas in accordance with one embodiment of the present invention;

FIGURE 29 is a flow chart of a programming process in accordance with one embodiment of the present invention;

30 FIGURE 30 is a flow chart of a process for creating a scene in accordance with one embodiment of the present invention;

FIGURE 31 is a flow chart of a process for executing a scene command in accordance with one embodiment of the present invention;

35 FIGURE 32 is a flow chart of a process for creating a new group or adding to a new group in accordance with one embodiment of the present invention;

FIGURE 33 is a flow chart of a process for sending a group command in accordance with one embodiment of the present invention;

FIGURE 34 is a flow chart of a process for creating or adjusting a light default in accordance with one embodiment of the present invention;

FIGURE 35 is a flow chart of a process for creating or adjust a group default in accordance with one embodiment of the present invention;

5 FIGURE 36 is a flow chart of a power restoration process in accordance with one embodiment of the present invention;

FIGURE 37 is a flow chart of a process for executing a default command through an on/off toggle in accordance with one embodiment of the present invention;

10 FIGURE 38A-F are diagrams of various screens on device application in accordance with one embodiment of the present invention;

FIGURE 39 is a flow chart of a quick set-up process for connected lights in accordance with one embodiment of the present invention;

FIGURE 40 is a flow chart of a quick group process through power restoration in accordance with one embodiment of the present invention;

15 FIGURE 41 is a flow chart of a profile authentication process in accordance with one embodiment of the present invention;

FIGURE 42 is a flow chart of a process for saving settings under a profile in accordance with one embodiment of the present invention;

20 FIGURE 43 is a block diagram of a device to device profile sharing process in accordance with one embodiment of the present invention;

FIGURE 44 is a flow chart of a process for adding an authenticated profile directly through the Intelligent Illuminating Device in accordance with one embodiment of the present invention;

FIGURE 45 is a flow chart of a hard reset process in accordance with one embodiment of the present invention;

25 FIGURE 46 is a flow chart of a soft reset through application in accordance with one embodiment of the present invention;

FIGURE 47 is a flow chart of a process for adding a new Intelligent Illuminating Device into an existing Intelligent Illuminating Device network in accordance with one embodiment of the present invention;

30 FIGURE 48 is a block diagram of another embodiment of II Device system with a wireless energy receiver and transmitter in accordance with one embodiment of the present invention;

FIGURE 49 is a block diagram of a color coding identification process in accordance with one embodiment of the present invention;

FIGURE 50 is a block diagram of sorting based on signal strength in accordance with one embodiment of the present invention;

35 FIGURE 51 is a block diagram of sorting based on status in accordance with one embodiment of the present invention;

FIGURE 52 is a block diagram of sorting based on available Intelligent Illuminating Devices in accordance with one embodiment of the present invention;

FIGURE 53 is a flow chart of an automation programming process in accordance with one embodiment of the present invention; and

FIGURE 54 is a flow chart of a music sync process in accordance with one embodiment of the present invention;

5 FIGURE 55 is a block diagram of showing a potential placement of the photosensor and reset switch on the light mixing cover/diffuser in accordance with one embodiment of the present invention;

FIGURE 56 is a block diagram of an Intelligent Illuminating Device network in accordance with one embodiment of the present invention; and

10 FIGURE 57 is a block diagram of an Intelligent Illuminating Can in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

While the making and using of various embodiments of the present invention are discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts that can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative of specific ways to make and use the invention and do not delimit the scope of the invention.

15 The present invention provides an easily installed and transferable lighting and home automation solution because special or customized installation is not required. As a result, the present invention is fully portable and can be removed and reused in other locations throughout the long life of the light. In addition, the present invention is programmable and scalable such that the color and brightness of any individual light or a group of lights can be manually or automatically controlled using a wireless interface. A user has the flexibility to personalize the color, atmosphere, and mood of a room to better fit ones preference, time of day, or occasion at hand. Automation and dimming of the lighting devices save more energy than is consumed by the additional components of the lighting device. Moreover, using on/off signals having specified cycle times to produce a blended light reduce the current requirements of the lighting device.

25 The present invention, a wireless lighting control system, consists of methods, apparatuses, and associated software (device application) for controlling, programming, and automating one and/or multiple 'Intelligent Illuminating Devices' (II Device) utilizing a wireless communication protocol executed between one or many wireless devices and one or many II Devices (II Device network). The methods and apparatuses presented here would allow one to adjust and control a single or network of II Devices with high flexibility, user control, and intuitive user interaction, with minimal installation or complexity.

30 For the purposes of discussing this invention the following terms will be used to describe the primary aspects of the invention. An II Device is a single wirelessly enabled lighting apparatus. A wireless device is a computing device such as a smartphone, computer, tablet, smartTV, remote, etc. A device application is a user facing software application run on the wireless device. A mesh network is a wireless communication protocol used to connect one or many II Devices and/or one or many wireless devices.

35 An II Device in the context of this invention is a lighting apparatus containing additional electronic circuits and components. In one embodiment, the II Device will produce some measure or effect of luminosity dependent on commands sent wirelessly through a wireless device and associated device application. The II Device can receive wireless communications, take immediate action (in terms of a lighting output) based on the wireless

communication, execute a sequence of actions, and store one or more commands to be executed at a specified time in the future or upon a specified condition being met. In addition, one embodiment of II Device can intelligently relay/transmit wireless communication commands received from a device application (or II Device) to other II Devices within proximity. Similarly, one embodiment of the II Device would confirm receipt of the command through a wireless communication back to the wireless device and device application, possibly relaying the confirmation back through other II Devices. The communication means for to execute these processes can be seen in the mesh network section.

Now referring to FIGURE 1, a block diagram of a lighting device in accordance with one embodiment of the present invention is shown. The lighting device (II Device) 140 might take numerous forms or embodiments in design, but certain components are common to the various designs while others will be used as is necessary for a specific embodiment. These components may or may not be part of II Device 140 and might be arranged in different fashion and with slight alteration to create different intelligent illuminating embodiments. For example, the II Device 140 includes a DC/DC power converter 104, a controller/processor 106 electrically connected to the DC/DC power converter 104, a light emitting diode (LED) current control circuit 120 communicably coupled to the controller/processor 106 and electrically connected to the DC/DC power converter 104, and two or more LEDs 122 electrically connected to the LED current control circuit 120. The LED current control circuit 120 can be a PWM driver, switching or multiplexer circuit, or light emitting diodes (LEDs) driver(s) circuit. The two or more LEDs 122 will include at least a first color LED 122a and a second color LED 122b. Moreover, at least one of the LEDs 122 may include a series of LEDs, a group of LEDs, an array of LEDs, two or more series-connected LEDs, two or more parallel-connected LEDs or a combination thereof. Typically, the first color LED 122a and the second color LED 122b will be selected from a red LED, a green LED, a blue LED, a red LED, a white LED and a tri-color LED.

As will be explained in more detail below, a method for controlling one or more lighting devices 140 includes the steps of providing the one or more lighting devices 140, sending one or more control signals from the controller/processor 106 to the LED current control circuit 120 corresponding to a blended light having a specified color, and sending an on/off signal having a cycle time from the LED current control circuit 120 to each LED 122 in response to the one or more control signals such that the two or more LEDs 122 produce the blended light having the specified color based on how long each LED 122 is turned ON and/or OFF during the cycle time. The LED current control circuit 120 provides an on/off signal having a cycle time to each LED 122 in response to one or more control signals received from the controller/processor 106 such that the two or more LEDs 122 produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time. These on/off signals with specified cycle times to produce a blended light can be used to reduce the current requirements of the II Device 140.

Other embodiments will include additional components. For example, the additional components may include: a power supply connector/fastener 100; an AC/DC power converter 102 electrically connected to the power supply connector/fastener 100 and the DC/DC power converter 104; a real time clock (RTC) circuit 110 communicably coupled to the controller/processor 106; a memory 108 communicably coupled to the controller/processor 106; a wireless transceiver circuit 112 communicably coupled to the controller/processor 106; an antenna 114 communicably coupled to the wireless transceiver circuit 112; a hard reset circuit 116 communicably coupled to the controller/processor 106; an ambient light sensor circuit 118 communicably coupled to the controller/processor 106; a heat sink 124; a reflector 126 disposed behind or around the two or more LEDs 122; and/or a diffuser or lens 128 disposed above the two or more LEDs 122.

The components of the II Device 140 can be modularized to provide easy enhancement, customization, modification and repair of the II Device 140. For example, a main circuit board 134 may include the DC/DC power converter 104, the controller/processor 106, the LED current control circuit 120, the memory 108, the real time clock circuit 110, and the wireless transceiver circuit 112 and antenna 114. A sensor board 130 may include the hard reset circuit 116 and the ambient light sensor circuit 118. A LED board 136 may include the two or more LEDs 122 and additional LED related circuitry (e.g., LED arms).

The connector 100 performs at least one of two functions. One, it can physically connect the II Device 140 to a surface and two provide access to a power source. The connector 100 could fasten to a standard surface, light socket, or electrical socket, or combination of the like. Similarly, the connector 100 could provide a connection to a power source as an Edison base (multiple sizes), Plug in, Bi-pin, or Battery connected connection (including water activated battery), etc. The connector 100 would conduct the electrical current through to the AC to DC converter 102. In some embodiments, such as the Intelligent Illuminating Strip (II Strip or Smartstrip) 900 (FIGURE 9), the fastener and power connection means of the connector 100 might be separated. For example, an electrical plug is connected via a wire to the rest of the Smartstrip and the Smartstrip is fastened in some other manner (such as screws or adhesive) to a surface. In other embodiments, such as the Intelligent Illuminating Bulb (II Bulb) 1800 (FIGURE 18), the connector 100 would be an Edison base or bi-pin for which when the connector is inserted into the appropriate light socket. The connector 100 would provide appropriate contact to extend the AC or DC power source or supply into the body of the II Bulb 1800. In addition, the connector 100 might provide some structural stability in fastening the II Device 140 to a surface.

The AC to DC converter 102 receives power from the connector 100 and outputs the appropriate DC power to the DC/DC converter 104, the LED current controlling 120 circuit, and LED circuit 122. The exact power input might vary depending on country specific standards or power sources, but as a universal converter, the power output will always be DC voltage such as 12VDC or 18VDC or 24VDC. Examples of power inputs include AC power 60V-290V/45-65Hz or (Examples: 230VAC / 50Hz (European / Indian Standard), 110VAC/60Hz (US Standard), or a range of DC power from 12VDC to 1000VDC. The AC to DC converter 102 might be housed within the connector 100 or separate from the connector 100, depending on the specific II Device embodiment.

The DC/DC converter(s) 104 receives a power input from the AC/DC converter 102, it then converts that power to DC power(s) required for driving the internal components/modules of the II Device 140. These components include the controller/processor 106, memory 108, the real time clock (RTC) circuit 110, the wireless transceiver circuit 112, antenna 114, and possibly components within the LED current control circuit 120. It might also supply power to other components, such as the hard reset circuit 116, the ambient light sensor circuit 118, and other potential added circuits. There might be multiple converters dependent on the output DC voltages required by different component requirements. Similarly, the power output would very dependent on the exact component requirements, for example the output might be 5VDC, 3.3VDC, or 1.3VDC.

The controller/processor 106 processes signals received from the memory 108, the real time clock (RTC) circuit 110, and the wireless transceiver circuit 112. It might also process signals from other components, such as the hard reset circuit 116, the ambient light sensor circuit 118, and other potential added circuits. It also takes action and sends commands to the memory 108, the real time clock (RTC) circuit 110, and the wireless transceiver circuit 112. It might also take action and send signals to other components, such as the ambient light sensor circuit 118 and other potential added circuits.

The memory 108 stores data from factory defined settings and from user defined settings. The controller/processor 106 will read/write data in memory 108. Data might include factory-defined settings, such as communication protocols, identification and security protocols, and other data. Data might also include user-defined settings, such as user profiles, default commands, programs, and other data. The memory 108 could be inside the processor 106 and/or external to the processor 106 as a different integrated circuit or chip(s). The controller/processor 106 and memory 108 circuits might take a number of different technical specifications.

The real time clock circuit 110 includes a battery and a date and time clock based RTC. The controller/processor 106 will set the date and time data in the RTC 110 and also read the date and time data from the RTC 110. The RTC 110 could be internal to the controller/processor 106 or it could be an external circuit with respect to the controller/processor 106. The RTC 110 will run on the DC/DC power unless no power is provided, in which case it will run on the battery included within the real time clock circuit 106. The battery could be a rechargeable battery, in which case the DC/DC power when supplied would also charge the rechargeable battery through recharging circuitry. The battery could also be a non-chargeable battery.

The wireless transceiver circuit 112 allows the II Device 140 to communicate with other wireless devices and/or other II Devices. The wireless transceiver circuit 112 includes a transmitter and receiver circuit based on established wireless protocols. These protocols could differ based on different II Device embodiments and changing wireless communication standards. Example wireless protocols include but are not limited to Bluetooth, ZigBee, Wi-Fi, and their related variants. The wireless transceiver circuit 112 will be connected to the controller/processor 106 and the antenna 114.

The antenna 114 captures wireless communication signals and passes them to the wireless transceiver circuit 112 to decode those signals. The antenna 114 could take multiple forms depending on the protocol and signal frequency required. The physical location of the antenna 114 and/or wireless transceiver circuit 112 could be placed in multiple physical locations related to the II Device 140. For example, it might be placed outside of the II Device 140 or inside the II Device 140. Placing it outside, might increase the range of wireless communication for the II Device 140, especially when installed in locations with poor reception. Alternatively, the antenna might be built into the physical structure of the II Device 140 or be part of the main board 134 inside the II Device 140.

In some embodiments, the hard reset circuit 116 of the II Device 140 includes a button or switch mechanism and related circuitry. The button or switch would be connected to the controller/processor 106 either directly on the same board or through a wired connection. When the button or switch is activated, it will send a specific signal to the controller/processor 106 to execute the hard reset program for that II Device 140. The actual button or switch mechanism might be different dependent on the II Device 140 and its application. As example, the reset circuit might be a simple resistant button type switch, it might be a rotational type switch, or it might be a conductive type switch, it might be a compression switch based on pushing in some part of the mechanical structure. The location of the hard reset circuit might be co-located with other external components such as the ambient light sensor, LEDs, diffuser housing, or other II Device components or structural parts. In this sense the physical location with respect to the II Device 140 might vary. The hard reset function in most embodiments will require access to the DC/DC power, and thus the II Device 140 would need to be connected to an active power source. In some embodiments though, the hard reset circuit 116 would have access to a separate power source such as a battery to provide the controller and related circuitry enough power to execute the hard reset command.

In some embodiments, the II Device 140 might have an ambient light sensor circuit 118. The ambient light sensor circuit 118 consists of one or more ambient light sensors (photosensor or similar light detecting component) and supporting circuit. The ambient light sensor(s) in the ambient light sensor circuit 118 detects a level of captured ambient light, converts that level into an analog signal, and sends that data to the controller/processor via an analog to digital (A/D) converter that could be a part of the ambient light sensor circuit 118 or controller/processor 106. The ambient light sensor circuit 118 would consist of one or more ambient light sensors per one or multiple II Devices. In some embodiments the ambient light sensor circuit 118 could be embedded in the II Device 140 itself and in others it might be a separate peripheral device to the wireless lighting control system. Additionally, the placement of the sensor(s) 118 and related circuitry need not be exactly collocated, but possibly separated by a wire.

For example, the light sensor(s) 118 could be placed in multiple locations in relation to the II Device 140: (a) placement of sensor 118 requires external light to reach the light sensor; (b) the sensor(s) 118 could be placed on the exterior of the light, on the housing; (c) the sensor(s) 118 could be at the end of an extension or wire protruding; or (d) the sensor(s) 118 could be part of an external peripheral to the light, connected via wireless communication (e.g., the sensor could be housed with other electronic components such as a processor, communication source (Bluetooth module, Zigbee, Wi-Fi, or other)). There could also be multiple types of II Device sensors used: (a) one which senses a range of overall luminosity; (b) one that senses a combination of red, green and blue components or cyan, yellow, magenta or black components, or hue, saturation and lumens components of the light on it; or (c) in different scenarios the light measured could be in absolute or respective values. The ambient light sensor 118 can be located to detect an ambient light and a light emitted by the II Device 140 such that the controller/processor 106 adjusts one or more of the on/off signals provided to the LEDs 122.

The LED current control circuit 120 executes commands from the controller/processor 106 to control the current passed through the LEDs 122. The LED current control circuit 120 might take different forms dependent on the II Device embodiment as per the following schemes: solely LED drivers scheme (FIG. 3), switches and LED driver scheme (FIG. 5), multiplexer and LED driver scheme (FIG. 7), and current limiting circuit scheme (FIG. 8). In general, the controller/processor 106 sends commands to LED drivers (208 or 318, 320, 322, 324, or 508), switches or multiplexer (500, 502, 504, 506 or 702), which in turn controls the light output by controlling the average current passed through the LEDs 122. The average current would affect the overall luminosity of the II Device 140, such as that at lower average currents passed through the LED driver then the II Device would be dimmer.

For embodiments where multiple LED arms (302, 304, 306, and 308) are present, unique to the presented schemes is a method to maximize the potential current passed through and subsequent luminosity of each LED arm with limited available current from the AC/DC converter 102. This is done by controlling the current passed through by the LED driver (208 or 318, 320, 322, 324, or 508) so that only one LED driver (208 or 318 or 320 or 322 or 324 or 508) can pass through current at a time. This allows each on/off signal to provide a maximum current supplied by the DC/DC power converter to the LED 122. By varying and alternating very short lengths of time that current is passed through different LED arms (302, 304, 306, 308) using LED current control circuit 120, the schemes also allow the multiple LED arms (302, 304, 306, 308) to produce an overall blended light that is capable of various colors, saturation, and brightness. These schemes allow the II Device 140 to provide the highest level of individual luminosity emitted related to one of the LED arms (302, 304, 306, 308), such as white, red, blue, or green, while also allowing for all combinations of color, brightness, and saturation to be achievable.

In other words, the specified color is produced by turning ON the first color LED 122a for a first portion of the cycle time and turning ON the second color LED 122b for a second portion of the cycle time. The two or more LEDs 122 are not turned ON at the same time. The cycle time is preferably short enough such that a user will not notice any flicker, which is usually around 85 Hz (about 12 ms), unless flicker is desired. The on/off signal for the first LED 122a includes two or more pulses during a portion of the cycle time that the first LED 122a is turned ON. Likewise, the on/off signal for the second LED 122b includes two or more pulses during a portion of the cycle time that the second LED 122b is turned ON. The on/off signals can be adjusted to provide a specified color, saturation and brightness or intensity. The specified brightness or intensity can be determined by a duty cycle of the on/off signals.

One potential scheme for the LED current control circuit 120 is the 'solely LED drivers scheme' (FIG. 3). In this scheme the controller/processor 106 would send one or multiple Pulse Width Modulation (PWM) Signals to one or many LED drivers (318, 320, 322, 324) which would control the current flowing through an associated LED arm (302, 304, 306, 308 respectively). There would be the same number of PWM signals (326/400, 328/402, 330/404, 332/406) sent as there would be LED drivers (318, 320, 322, 324) and LED arms (302, 304, 306, 308). The total number of LEDs strings (arms) and LED drivers depend upon the application. LED driver circuit is designed for a particular current level to pass through it, so the LED driver circuit (318, 320, 322, 324) will regulate the flow of current through the respective LED arm (302, 304, 306, 308) to the set current level whenever the controller 106 provides a high level signal to it. PWM consists of high and low signals at a fixed frequency. One could change the duration of high and low signals in a given time frame (defined as time period = 1/frequency). Considering the controller sends one PWM signal to one LED driver to control the average current through one associated LED arm. Varying the duty cycle of the PWM signal changes the average current flowing through the LED driver to the LED arm. The average current affects the overall luminosity of the II Device, such that lowering the average currents passed through the LED driver dims the light produced by the II Device.

LEDs 122 refer to a combination of LEDs or LED arms that are illuminated depending on current passed through from the LED current control circuit 120. The combination of LED arms or LEDs could be of various types and various colors dependent on the II Device embodiment. For example, the LEDs might vary in color such as red, green, blue, and/or white LEDs. The LEDs might also vary in their maximum output luminosity. The combination of illuminations of these LEDs could produce various levels of brightness and/or color.

The heat sink and related components and parts 124 may be required in some embodiments of the II Device 140. The heat sink and related components 124 dissipate the heat generated by the LEDs 122 and LED current control circuit 120. The heat sink 124 could take multiple sizes, shapes, and materials dependent on the II Device embodiment. 'Related components' refers to the housing and outer structure of the II Device 140. These materials and arrangement might of course differ depending on the particular II Device embodiment.

The light reflector 126 is used to amplify or focus the illumination generated by the LEDs 122. The light reflector 126 could be made of different reflective materials and come in different sizes, dependent on the specific variation and application of the II Device 140. The light reflector 126 would be placed behind and/or around the LEDs 122, most likely at an arc so that the illumination of the LEDs 122 is reflected, focused, and amplified through the diffuser 128. The exact placement, angle, and arc of the light reflector 126 would vary dependent on the variation and application of different II Devices.

The diffuser 128 is a part of the II Device 140 that spreads and/or 'mixes' the illumination produced by the LEDs 122. The diffuser 128 could be made of different materials and come in different sizes, dependent on the specific variation and application of the II Device 140. Common material might be glass, plastics, or fiber. The diffuser 128 would be placed over the LEDs 122 so that the illumination passes through the diffuser 128. The exact placement, angle, and arc of the diffuser 128 related to the LEDs 122 would vary dependent on the variation and application of different II Devices.

The II Device 140 might take other common embodiments not fully described in this disclosure, but not limited to the following: (a) an II Device integrated into a lighting fixture (e.g., could be installed fixture with all II Device circuitries built in or non-installed fixture such as a plug in lamp); (b) an II Device integrated into a fan (e.g., could be installed fixture with all II Device circuitries built in); (c) an II Device that is solely battery powered and affixed to a surface; (d) an II Device utilizing OLEDs as LEDs; (e) an II Device integrated into directly into surfaces (walls, tables, and ceilings), clothing, appliances, electronics (Displays, music equipment, etc.), musical instruments (pianos, guitars, etc.) and taking power from some source either internally or externally to that integrated part; or (f) an II Device specifically designed for emergency lighting. Considering the control of the II Device, the invention herein provides processes and methods to wirelessly control and/or program one or many II Devices through one or many wireless devices. These processes and methods shown and described provide maximum utility and range with a given communication protocol and a reliable and efficient system.

As previously mentioned, the II Device 140 could be modular (i.e., different parts of the II Device 140 as separated by a dashed-dot lines A, B, C, D, E and F could be detachable from a manufacturing or consumer standpoint). Certain parts or modules of the II Device 140 could be interchangeable with other types of the same module. As example, consider an II Device 140 that has different connector modules, plug in vs. Edison base, yet the rest of the modules are the same. The modules could be connected together through connectors, that a user could separate or place back together. The modules might also be structurally fixed together so that disassembly is required to disconnect the modules. Additionally, modules within the II Device 140 could be separated physically from each other yet connected electronically in some fashion. There could be different levels of modularity or no modularity at all, depending on the specific II Device embodiment.

Given the standard parts and connections of the II Device 140, there could be numerous potential II Device embodiments with differing arrangements, combinations, or expressions of the components disclosed. Some of these embodiments, characteristics and methods will be described below.

Referring now to FIGURE 2, a circuit diagram of a single LED arm 214 with LED(s) 122 in accordance with one embodiment of the present invention is shown. The LED arm 214 is electrically connected to the power supply 200 and the LED driver 208. The power supply 200 and LED driver 208 are also connected to the ground or negative terminal 206 of the power supply 200. In certain embodiments, the controller/processor 106 might send multiple PWM signals 210 to multiple LED drivers 208 to control the current passed through to multiple LED arms 214. In these cases, the LED current control circuit 120 would allow to similarly change the overall brightness or luminosity of the II Device 140, but also adjust the color and/or saturation of the light emitted from the II Device 140. In this latter case of controlling color and saturation the LED arms 214 would need to be of different colors that could create different colors when mixed at different levels. The LED arm 214 can have warm yellow or other colors/types of LEDs 122.

Now referring to FIGURE 3, a circuit diagram of a solely LED Drivers scheme in accordance with one embodiment of the present invention is shown. For descriptive purposes, consider here four PWM signals (326, 328, 330, 332) sent from the controller 106 annotated as PWM1 326, PWM2 328, PWM3 330 and PWM4 332 and four associated LED drivers annotated as LED Driver1 318, LED Driver2 320, LED Driver3 322 and LED Driver4 324. In addition, consider four LED arms, LED arm1 302 with red LEDs 310, LED arm2 304 with green LEDs 312, LED arm3 306 with blue LEDs 314, and LED arm4 308 with white LEDs 316. Based on established color mixing principals, the variation in the luminosity of these four colors could produce all color combinations. To achieve this variation, the controller 106 could vary and alternate the length of time that the PWM signals (326, 328, 330, 332) are sent to the LED drivers (302, 304, 306, 308). This would create variations in lengths of time when the LED drivers (302, 304, 306, 308) would receive PWM signals (326, 328, 330, 332). The length of time would also allow for a similar control in the overall brightness of the luminosity produced by the II Device 140 in addition to the control provided by variations of the duty cycle of the PWM signal itself.

Similarly, variations in the length of time that the controller 106 would alternatively send each PWM signal (326, 328, 330, 332) to the respective LED driver (318, 320, 322, 324), which would control the current passed through to the respective LED arm (302, 304, 306, 308), would also provide for a combinatory control of the average luminosity produced by each LED arm (302, 304, 306, 308) and thus allow for control of color and saturation of the light produced. The frequency of PWM signals (326, 328, 330, 332) and the rate at which LED drivers (318, 320, 322, 324) receive the PWM signals (326, 328, 330, 332) from controller/processor 106 will be high enough (still within the LEDs' and LED Drivers' technical specifications) so that due to the persistence of vision, consumers would see a constant light output, for example a yellow light instead of fast switching alternate red and green light outputs. The scheme in alternating PWM signals (326, 328, 330, 332) does not allow for simultaneous PWM signals (326, 328, 330, 332) executed by the LED driver (318, 320, 322, 324) at the same time. This maximizes the potential average current passed through LEDs arms (302, 304, 306, 308) and subsequent luminosity of each LED arm (302, 304, 306, 308) considering limited available current from the AC/DC converter 102. It allows for each LED arm (302, 304, 306, 308) to receive the full power provided by the AC/DC converter 102 and regulated by the LED driver (318, 320, 322, 324), such that when it is on all the available current could be sent through to the one LED arm.

To further illustrate these concepts, below is an example of how the solely LED driver scheme might work. Consider, the frequency of PWM signal is 2KHz or total time period for one signal (one high and one low) = $1/2\text{KHz} = 0.5\text{ms}$. Consider the duty cycle of each PWM1 400 and PWM2 402 is the same. The higher the duty cycle, the brighter the overall luminosity would be and vice-versa. Each LED driver (318, 320, 322, 324) is designed for a particular current level, i.e. when LED driver (318 or 320 or 322 or 324) is ON (when they get high signal from the controller 106), the current passing through the LED driver (318, 320, 322, 324) would be the lesser value of either the designed particular current level or the maximum current that power supply 200 can provide. Assume that the luminosity created per unit of average current is the same for both the red LED arm 302 and the green LED arm 304. If in 4ms cycles, the controller turns on the PWM1 and turns off PWM2 every first 2ms and then turns off PWM1 and turns on PWM2 for the next 2ms with PWM3 and PWM4 are off continuously, then, the overall light output would be yellow (mixture of Red and Green color light, each with same luminosity).

Referring now to FIGURE 4, a timing diagram for the solely LED drivers scheme of FIGURE 3 is shown. To produce a type of orange light which consists of 70% red and 30% Green light mixed together, PWM1/LED Driver1 400 should be ON for 70% of the cycle time (here, 70% of 4ms = 2.8ms) and PWM2/LED Driver2 402

should be ON for remaining 30% of the cycle time (here, 30% of 4ms = 1.2ms). Similarly, to produce brighter shade of orange light which may consist of 50% RED, 20% Green and 20% White light together, PWM1/LED Driver1 400 should be ON for 50% of the cycle time (here, 50% of 4ms = 2ms), PWM2/LED Driver2 402 should be ON for 20% of the cycle time (here, 20% of 4ms = 0.8ms), PWM3/LED Driver3 404 should be ON for 0% of the cycle time (here, 0% of 4ms = 0ms), PWM4/LED Driver4 406 should be ON for 20% of the cycle time (here, 20% of 4ms = 0.8ms), and all PWM/LED Drivers (400, 402, 404, 406) should be OFF for the remaining 10% of cycle time (here, 10% of 4ms = 0.4ms).

In a similar way, by varying PWM signal duty cycle for four LEDs Drivers (318, 320, 322, and 324) for a given PWM ON/OFF time cycle (4ms in an example above), II Device 140 could produce any color with different shades. When duty cycle is 100% i.e. 100% ON and 0% OFF, the PWM/LED Driver1 400 and PWM/LED Driver2 402 are ON for 2ms alternately every PWM ON/OFF cycle of 4ms, II Device 140 will produce highest possible (100%) luminosity for the Yellow light. Thus the output luminosity can be varied by varying duty cycle of the PWM signals (326, 328, 330, 332) to LED drivers (318, 320, 322, 324), providing dimming feature to II Device 140.

The algorithm/program in the controller is such that, at a time only one LED Driver (here, 400 or 402 or 404 or 406) is given a PWM signal. This particular scheme is more useful when power supply has limited current output capability. With such algorithm one could achieve maximum luminosity for any color possible. For example, let's assume a power supply is rated at a maximum 15V/1A output and all LEDs have rating of 1A and LED drivers are designed for 1A current. To achieve 100% luminosity output from RED LEDs, one has to pass 1A current through RED LEDs Arm 302 continuously. In this case, LED Driver1 318 only will be given PWM signal for entire 4ms of the PWM cycle and that too at 100% duty cycle. As against in other design if all four LED drivers are designed for 1/4th of the possible supply of current i.e. $1/4 \times 1A = 0.25A$, maximum current will never exceed 0.25A through any LED arm, and will thus limit the output luminosity of that particular LED arm.

The algorithm/Program makes sure that only one LED Driver (318 or 320 or 322 or 324) has its PWM signal ON at a time. To produce colors, program gives turns ON PWM signals to LED drivers (318, 320, 322, 324) in a serial manner i.e. alternately, fast enough so that due to persistence of vision, consumer sees the output light as a single defined color instead of flickering Red, Green, Blue or White lights.

Now referring to FIGURE 5, a circuit diagram of switches (500, 502, 504, and 506) and LED driver 508 scheme in accordance with one embodiment of the present invention is shown. In this scheme, the controller/processor 106 would send a Pulse Width Modulation (PWM) signal to one LED driver 508 which would control the average current flowing through it. In addition, there would be a switch for every LED arm between the LED driver 508 and each LED arm (302, 304, 306, and 308). The controller is connected to each switch (500, 502, 504, and 506) and can send an on/off signal for each. Considering an embodiment with four LED arms (302, 304, 306, 308) and subsequently four switches (500, 502, 504, 506), the controller 106 would send a signal to control Switch1 500, Switch2 502, Switch3 504 and Switch4 506, while also sending a PWM signal to the LED driver 508 to allow current to pass through to the switches (500, 502, 504, 506). Variation in the average current passing through the LED driver 508 controlled by variations in the PWM sent by the controller would increase or decrease the average current passing through to the subsequent LED arms (302, 304, 306, 308), thus controlling the overall brightness of the LEDs. The switches (500, 502, 504, 506) turning on or off, would be able to create different colors and saturation produced by the light. When a switch (500, 502, 504, and 506) gets high signal from the

controller 106, it provides path for current to flow from LEDs in LEDs arms (302, 304, 306, 308) to LED driver 508.

Considering the embodiment contains red, green, blue, and white LED arms (302, 304, 306 and 308 respectively), based on established color mixing principals, the variation in the luminosity of these four colors could produce all color combinations. To achieve this variation, the controller could vary and alternate the length of time that the switches are turned on. This would create variations in lengths of time when the LED driver 508 would pass through current to the LED arms and thus create variations in lengths of time when the LEDs produce light. The length of time would also allow for a similar control in the overall brightness of the luminosity produced by the II Device 140 in addition to the control provided by variations of the duty cycle of the PWM signal 518 itself.

Similarly, variations in the length of time that the controller 106 would alternatively send each switch (500, 502, 504, 506), which would control the current passed through from the LED arms (302, 304, 306, 308) to the LED driver 508, would also provide for a combinatory control of the average luminosity produced by each LED arm (302, 304, 306, 308) and thus allow for control of color and saturation of the light produced. The frequency of switch signals will be high enough (still within the LEDs' (310, 312, 314, 316) and LED Driver's 508 technical specifications) so that due to the persistence of vision, consumers would see a constant light output, for example a yellow light instead of fast switching alternate red and green light outputs.

The scheme in alternating switch signals does not allow for simultaneous switches being on at the same time. This maximizes the potential average current passed through and subsequent luminosity of each LED arm (302, 304, 306, and 308) considering limited available current from the AC/DC converter 102 in the power supply 200. It allows for each LED arm (302 or 304 or 306 or 308) to receive the full power provided by the AC/DC converter 102 and regulated by the LED driver 508, such that when it is on all the available current could be sent through to the one LED arm (302 or 304 or 306 or 308).

To further clarify the scheme, consider the following example. A yellow light with no white light added into it can be produced by the controller turning Switch 1 500 ON and Switch 2 502 OFF and then Switch 1 500 OFF and Switch 2 502 ON continuously at the same frequency, fast enough so that due to the persistence of vision, consumer sees it as a yellow light output instead of alternate Red and Green light output. LED driver 508 circuit can be designed for a particular current level i.e. it will regulate the flow of current through it to the set current level whenever the controller 106 provides a high signal to it. PWM (Pulse Width Modulation) 518 consists of high and low signals at a fixed frequency. One could change the duration of high and low signals in a given particular time (defined as time period = $1/\text{frequency}$).

An example of how this circuitry works will now be described. Assumptions: (1) frequency of PWM 518/608 set is 2KHz, i.e. total time period for one signal (one high and one low) = $1/2\text{KHz} = 0.5\text{ms}$; (2) frequency at which switches (510, 512, 514, 516 / 600, 602, 604, 606) are turned ON and OFF = 250Hz, i.e. total time period for switch to turn ON and OFF = $1/250\text{Hz} = 4\text{ms}$; and (3) LED driver 508 is designed for 1A current, i.e. when any switch (500, 502, 504, 506) and LED driver 508 is ON (when they get high signal from the controller 108) current passing through it is 1A or maximum current that power supply 200 can provide, whichever is less. The user wants a Yellow light output at half the maximum luminosity possible, for which Red 310 and Green 312 LEDs should be illuminated equally by sending same amount of average current through them. Also for half the luminosity, the average current passing through RED LEDs arm 302 and Green LEDs arm 304 should be half the maximum average current possible. This is achievable by turning Switches (510, 512, 514, 516 / 600, 602, 604, 606 / 500,

502, 504, 506) ON/OFF and setting PWM 518/608 as in the timing diagram below. The power supply can provide maximum current of 1A for any LED arm (302, 304, 306, and 308) at a time.

Switching frequency of 250Hz (cycle of 4ms): When Switch1 500 is ON; Switch2 502 is OFF letting current flow through only one arm at a time. Also, time for which Switch1 500 is ON and time for which Switch2 502 is ON are equal, thus producing Yellow light as required. However, to produce a type of orange light which consists of 70% Red and 30% Green light together, SIG1/Switch1 510/600 should be ON for 70% of the cycle time (here, 70% of 4ms = 2.8ms) and SIG2/Switch2 512/602 should be ON for remaining 30% of the cycle time (here, 30% of 4ms = 1.2ms). Similarly, to produce brighter shade of orange light which consists of 50% RED, 20% Green and 20% White light together, SIG1/Switch1 510/600 should be ON for 50% of the cycle time (here, 50% of 4ms = 2ms), SIG2/Switch2 512/602 should be ON for 20% of the cycle time (here, 20% of 4ms = 0.8ms), SIG4/Switch4 516/606 should be ON for 20% of the cycle time (here, 20% of 4ms = 0.8ms), and all switches (510, 512, 514, 516 / 600, 602, 604, 606) are off for the remaining 10% of cycle time (here, 10% of 4mA = 0.4ms). FIGURE 6 is a timing diagram for the switches and LED driver scheme of FIGURE 5.

In a similar way, by varying the switching combinations for a given time cycle, II Device 140 could produce any color with different shades. When duty cycle is 100% i.e. 100% ON and 0% OFF, the LED driver 508 is always ON, thus letting current pass continuously through an LED arm (302, 304, 306, 308) which has its switch ON, in turn providing highest possible luminosity for the color produced. Thus the output luminosity can be varied by varying duty cycle of the PWM signal 518/608 to the LED driver 508, providing dimming feature to II Device 140. The algorithm/program in the controller 106 is such that, at a time only one switch or limited number of switches will be turned ON. Thus, making sure that maximum possible current (mainly set by LED driver 508 circuit) flows through the LED arm of that particular switch at that time. This particular scheme is more useful when power supply has limited current output capability. With such algorithm one could achieve maximum luminosity for any color possible.

For example, let's say a power supply 200 (AC/DC Converter 102) is rated at a maximum 15V/1A output. Let's assume all LEDs have rating of 1A. To achieve 100% luminosity output from RED LEDs arm 302, one has to pass 1A current through RED LEDs arm 302 continuously. In this case, SIG1/Switch1 510/500/600 will be ON continuously and PWM 608 duty cycle to LED driver will be 100% as well. Algorithm/Program makes sure that only one LED arm is ON at a time, and to produce colors other than Red, Green, Blue and White, program turns ON/OFF the respective switches fast enough so that consumer sees the output light as a defined color due to persistence of vision.

Referring now to FIGURE 7, a circuit diagram of a multiplexer 704 and a LED driver 508 scheme in accordance with one embodiment of the present invention is shown. In this scheme, the controller/processor 106 would send a PWM 518 signal to one LED driver 508 which would control the average current flowing through it. In addition, there would be multiplexer 704 between the LED driver 508 and each LED arm (302, 304, 306, and 308). The controller 106 is connected to the multiplexer 704 via two signals. Based on SIG1 700 and SIG2 702 signals, the multiplexer 704 selects an LED arm (302, 304, 306, and 308) to connect to the LED driver 508 at a time producing light with different colors, saturation, and brightness. Variation in the average current passing through the LED driver 508 controlled by variations in the PWM 518 sent by the controller would increase or decrease the average current passing through to the subsequent LED arms, thus controlling the overall brightness of the LEDs.

Considering the embodiment contains red, green, blue, and white LED arms (302, 304, 306 and 308 respectively), based on established color mixing principals, the variation in the luminosity of these four colors could produce all color combinations. To achieve this variation, the controller 106 could vary and alternate the length of time that the multiplexer signals are turned on to let current pass through to each of the respective LED arms (302, 304, 306, and 308). This would create variations in lengths of time when the LED driver 508 would pass through current to the LED arms (302, 304, 306, and 308) and thus create variations in lengths of time when the LEDs produce light. The length of time would also allow for a similar control in the overall brightness of the luminosity produced by the II Device in addition to the control provided by variations of the duty cycle of the PWM signal 518 itself.

Similarly, variations in the length of time that the controller 106 would alternatively send signals to the multiplexer 704, which would control the current passed through from the LED driver 508 to the LED arm (302, 304, 306, 308), would also provide for a combinatory control of the average luminosity produced by each LED arm (302, 304, 306, 308) and thus allow for control of color and saturation of the light produced. The frequency of signals sent to the multiplexer 704 will be high enough (still within the LEDs' and LED Drivers' technical specifications) so that due to the persistence of vision, consumers would see a constant light output, for example a yellow light instead of fast switching alternate red and green light outputs. The scheme in alternating multiplexer signals does not allow for simultaneous signals to allow current to pass to more than one LED arms at the same time. This maximizes the potential average current passed through and subsequent luminosity of each LED arm (302, 304, 306, and 308) considering limited available current from the AC/DC converter 102. It allows for each LED arm (302, 304, 306, 308) to receive the full power provided by the AC/DC converter 102 and regulated by the LED driver 508, such that when it is on all the available current could be sent through to the one LED arm (302, 304, 306 or 308). The timing method is similar to that of the switches and LED drivers scheme (FIG. 6). The multiplexer scheme would vary dependent on the II Device 140 requirements and total number of LED arms.

Now referring to FIGURE 8, a circuit diagram of current limiting circuit scheme in accordance with one embodiment of the present invention is shown. In this scheme, current limiting circuits (800, 802, 804, and 806) control the current passed through to each LED arm (302, 304, 306, and 308). There would be as many current limiting circuits as LED arms that are required for the specific embodiment of the II Device. The controller/processor 106 sends data to the individual current limiting circuit (800, 802, 804, and 806) and defines the current to be passed through to the respective LED arm (302, 304, 306, and 308). A digital potentiometer could be used to form the current limiting circuit (302, 304, 306, and 308). The resistance of potentiometer is proportional to the data given to it by controller/processor 106.

For example, to produce a yellow light consisting of 50% Red and 50% Green light at 100% possible output luminosity, DATA1 808 and DATA2 810 will set the currents through current limiting ckt1 800 and ckt2 802 such that the current splits in half through two arms. For example, if power supply 200 is able to provide 1A current, ckt1 800 and ckt2 802 will be set at 0.5A each. Considering the embodiment contains red, green, blue, and white LED arms (302, 304, 306 and 308 respectively), based on established color mixing principals, the variation in the luminosity of these four colors could produce all color combinations. Setting assigned currents through all circuits (800, 802, 804, and 806), any color, saturation, and brightness within specified limits could be achieved.

Referring now to FIGURES 9 and 10, a mechanical diagram and a block diagram of a Smartstrip Light 900 in accordance with one embodiment of the present invention is shown. There could be numerous versions or like

embodiments, but the general description will be disclosed herein. The Smartstrip 900 consists of the same arrangement and inclusion of all the components of an II Device 140 as previously disclosed.

The Smartstrip 900 includes a flexible strip 912, an electrical connector 908 affixed to the flexible strip 912 and two or more LEDs 122 affixed to the flexible strip 912 and electrically connected to the electrical connector 908. In addition, electrical circuitry 906 (DC/DC power converter 104, controller/processor 106 and LED current control circuit 120) is remotely located with respect to the flexible strip 912 and electrically connected to the electrical connector 908 via a wire, a cable or a connecting strip. The LED current control circuit 120 provides an on/off signal having a cycle time to each LED 122 in response to one or more control signals received from the controller/processor 106 such that the two or more LEDs 122 produce a blended light having a specified color based on how long each LED 122 is turned ON and/or OFF during the cycle time. As shown, the LEDs 122 are formed into LED Groups 1100 that may include a heat sink 124 attached to the flexible strip 912, a reflector 126 disposed behind or around the two or more LEDs 122, and/or a diffuser or lens 128 disposed above the two or more LEDs 122. The LED Groups 1100 are connected in parallel or series or a combination of both by electrical connections 914.

Other embodiments will include additional components. For example, the additional components may include: a power supply connector/fastener 100; an AC/DC power converter 102 electrically connected to the power supply connector/fastener 100 and the DC/DC power converter 104; a real time clock (RTC) circuit 110 communicably coupled to the controller/processor 106; a memory 108 communicably coupled to the controller/processor 106; a wireless transceiver circuit 112 communicably coupled to the controller/processor 106; an antenna 114 communicably coupled to the wireless transceiver circuit 112; a hard reset circuit 116 communicably coupled to the controller/processor 106; and/or an ambient light sensor circuit 118 communicably coupled to the controller/processor 106. These components were previously described in reference to FIGURE 1.

The connector 100 could be one of many connectors that would provide a connection to a power source. This could be an Edison base (multiple sizes), Plug in, Bi-pin, or Battery connected connection. The connector would conduct the electrical current to the AC to DC converter 102 through an AC power cord 902, which is an electrical wire for carrying standard mains power supply.

The AC to DC converter 102 receives power from the connector 100 and outputs the appropriate DC power to the DC/DC converter(s) 104 and the LED current control circuit 120 and LED strip circuit 912. The AC to DC converter 102 might be housed within the connector 100 or separate from the connector 100, depending on the specific Smartstrip embodiment.

The DC/DC converter(s) 104 receives a power input from the AC/DC converter 102 and then converts that power to DC power(s) required for driving the internal components/modules of the Smartstrip 900. These components include the controller/processor 106, memory, the real time clock (RTC) circuit 110, the wireless transceiver circuit 112, antenna 114, and possibly components within the LED current control circuit 120. It might also supply power to components, such as the hard reset circuit 116, the ambient light sensor circuit 118, and other potential added circuitries. There might be multiple converters dependent on the output DC voltages required by different component requirements. Similarly, the power output would very dependent on the exact component requirements, for example the output might be 5VDC, 3.3VDC, or 1.3VDC.

The Controller/processor 106 processes signals received from the memory 108, the real time clock (RTC) circuit 110, and the wireless transceiver circuit 112. It might also process signals from other components, such as

the hard reset circuit 116, the ambient light sensor circuit 118, and other potential added circuitries. It also takes action and sends commands to the memory 108, the real time clock (RTC) circuit 110, and the wireless transceiver circuit 112. It might also take action and send signals to other components, such as the ambient light sensor circuit 118 and other potential added circuitries.

5 The memory 108 stores data from factory defined settings and from user defined settings. The controller/processor 106 will read/write data in memory 108. Data might include factory defined settings such as communication protocols, identification and security protocols, and other data. Data might also include user defined settings such as user profiles, default commands, programs, and other data. The memory 108 could be inside the processor 106 and/or external to the processor 106 as a different IC. The controller/processor 106 and
10 memory 108 circuit might take a number of different technical specifications.

Referring now to FIGURE 11, a circuit diagram of LEDs groups 1100 on a flexible LED strip 912 in accordance with one embodiment of the present invention is shown. Here, LEDs 122 are placed group-wise on a flexible strip 912 with some distance between them. The distance depends upon the requirements of the Smartstrip light requirements. Each LEDs group 1100 might have an individual heat sink and diffuser (to mix colors, in case
15 of different types if colored LEDs in a group). Each LEDs group 1100 has one or many LEDs 122 from each LEDs arm 1102 depending upon the Smartstrip light requirements. These LEDs 122 of a particular arm in each group are electrically connected in a series or parallel combination of LEDs depending upon the requirements of the Smartstrip 900. The LEDs arms 1102 are connected to the positive terminal 1106 and the negative terminal 206 of the AC to DC converter 102. In addition, the number of LEDs groups 1100 would depend upon the requirements of
20 the Smartstrip 900.

Now referring to FIGURES 12A and 12B, block diagrams of a front view and a rear view, respectively of a LEDs Strip 1224 and extendible LEDs strip 1226 in accordance with one embodiment of the present invention are shown. FIGURES 12A and 12B show that LEDs groups 1100 are placed a flexible material 912 with some distance between them and connected together in series, parallel or a combination of both with electrical connections 914.
25 There could be an ambient light sensor circuit 118 on the front of the LEDs strip 1224 and extendible LEDs strip 1226 electrically connected to the electronic circuit 906. Also, there could be a connector 1200 on both the ends of the LEDs strip 1224 and 1226 out of which one 1200a is used to connect to the electronic circuit 906 and the other 1200b could be used to connect to the extendible LEDs strip 1226. There could be PWM and/or switching signals from the controller/processor 106 that are used to drive current control circuit 120 on the regular LEDs strip 1224
30 and are carried to the end connector 1200b of the strip which could eventually be used to drive current control circuit 120 on extendible LEDs strip 1226. In case, of the use of an extendible LEDs strip 1226 in addition to the regular LEDs strip 1224, the power requirement to drive total LEDs will increase. That could be taken care by higher power supply ratings, that is, higher ratings of FIGURES 12A and 12B show that the strips 912 have adhesive(s) or fastener(s) 1222 to fasten the strip on a surface such as ceiling or wall. The strip 912 is made up of a
35 flexible material so that it could be routed as required during the installation at the site of its use. In addition to the LEDs groups 1100 and other potential components as in regular LEDs strip (FIG. 12a), the extendible LEDs strip (FIG. 12b) has its own current control circuit 120 to control average current through LEDs 122 on the strip (FIG. 12b).

Some Smartstrip 900 embodiments and versions might have an ambient light sensor circuit 118. The
40 ambient light sensor circuit 118 may have one or more ambient light sensors (photosensor or similar light detecting

component) and supporting circuitry. The ambient light sensor(s) 118 detects a level of captured ambient light, converts that level into an analog signal, and sends that data to the controller/processor 106 via an analog to digital (A/D) converter. The ambient light sensor circuit 118 would consist of one or more ambient light sensors 118 per one or multiple Smartstrips 900 and/or II Devices 140. In some embodiments the ambient light sensor 118 could be embedded in the Smartstrip electronic circuit 906 board or on LEDs strip and in others it might be a separate peripheral device to the wireless lighting control system. Additionally, the placement of the sensor(s) 118 and related circuitry need not be exactly collocated, but possibly separated by a wire 1206. In addition, some Smartstrip 900 embodiments and versions might have a heat sink(s) 124, a reflector 126 and/or a diffuser 128.

Referring now to FIGURE 13, a block diagram of the mechanical and electrical connections for the Smartstrip 900 in accordance with one embodiment of the present invention is shown. The Smartstrip light 900 has four parts: a connector 100, an AC/DC converter 102, an electronic circuit 906 and LED strip 912. Any two parts could be connected by a flexible wire which would provide flexibility of distance between the two parts, routing of the Smartstrip 900 while placing it on the surface. In addition, any two parts could be connected to each other with mechanically inflexible material; in fact combined parts could look like one part. For example, connector 100, AC/DC converter 102 and electronic circuit 906 parts could be closely connected to each other and could look like one part.

Now referring to FIGURE 14, a block diagram of an extendible LEDs Strip in accordance with one embodiment of the present invention is shown. A LEDs strip 912a can be extended by connecting two or more LEDs strips 912b and 912c. LED strip 912a would have a connector 1400 at its ends which would be used to connect another strip 912b to it. As shown in the figure, LEDs strip 2 912b is connected to LEDs strip 1 912a and LEDs strip 3 912c by a flexible electrical extension 1402, such as an electrical wire, with connectors 1400 on the ends of the LEDs strips 912a, 912b and 912c. These connectors 1400 could be of various types, for example, male connector on the right end of the strip and female connector on the left end of the strip. The connections 1400 include current controlling signals from controller/processor 106 driving lines for LEDs 122 on the strip 912 and LEDs driver signals. In addition, the strip has LEDs current control circuit 120 to control current through LEDs 122 as explained in the II Device section.

Referring now to FIGURE 15, a block diagram of a LEDs strip 912 extension through parallel connection in accordance with one embodiment of the present invention is shown. The extendable LED strip 912 has LED Groups 1504 connected in series with an electrical plug-in connector 1500 via electrical connections 1502 (positive) and 1508 (ground), and an electrical plug-in connector 1506 connected in parallel with the LED Groups 1504 via electrical connections 1502 (positive) and 1508 (ground). Electrical plug-in connectors 1500, 1506 are on the both ends of the extendable LED strip 912. On one end of the LED strip 912, there would be an intake connector 1500 and on the opposite end of the LED strip 912 an outtake 1506 connector. The intake connector 1500 would plug into the outtake connector 1506 of the previous LED strip 912 (either a regular or extendable LED strip) that would ultimately be connected in sequence to a regular LED strip and the rest of the Smartstrip components and power source.

In addition to FIGURE 15, now referring to FIGURES 16 and 17, block diagrams of a LEDs strips 912 direct connection in accordance with one embodiment of the present invention is shown. The intake connector 1500 would have multiple electrical connections passing internally to the strip 912. There would be electrical connections 1502 to extend power through to the LEDs groups 1100 in series. There would also be electrical

connections 1502 that would extend the power through to the other outtake electrical plug-in connector 1506 on the opposite side of the LEDs strip 912. When this outtake electrical plug-in connector 1506 is not in turn connected to another intake electrical plug-in connector 1500 of another strip, the connection will terminate in the outtake connector 1506. The electrical connections 1502 would include ground connection 1508 and current controlling signals such as PWM and switching signals from the controller/processor 106 for both the connection to the LEDs current control circuit 120, LEDs groups 1100 in series, and the connection to the outtake connector 1506. Additional LED strips could be connected in the same fashion. This number of LED strips connecting to each other could be limited by the available power source and required current for each strip 912.

As shown in the FIGURE 16, the outtake connector 1506 on one strip 912a could be connected to the intake connector 1500 on another strip 912b through an electrical wire 1604 with similar mating connectors 1600, 1602 at its end. This type of connection provides additional flexibility and routing while extending the number of strip in the Smartstrip. As shown in the FIGURE 17, the connecting wire 1604 might be an affixed part of the connector and Smartstrip or a separate part that could be used as needed.

Now referring to FIGURES 18 and 19, a perspective view and exploded perspective view, respectively, of an Intelligent Illuminating Bulb 1800 also referred as II Bulb in accordance with one embodiment of the present invention are shown. The II Bulb 1800 is a lamp or bulb like structure embodiment of an II Device 140. There could be numerous versions or like embodiments, but the general description will be disclosed herein. The II Bulb 1800 consists of the same arrangement and inclusion of some or all of the elements described above in reference to the II Device of FIGURE 1.

The II Bulb 1800 includes a housing 1802, a DC/DC power converter 104, a controller/processor 106 electrically connected to the DC/DC power converter 104, a LED current control circuit 120 communicably coupled to the controller/processor 106 and electrically connected to the DC/DC power converter 104, and two or more LEDs 122 comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit 120. The DC/DC power converter 104, the controller/processor 106 and the LED current control circuit 120 are disposed within the housing 1802, and the two or more LEDs 122 are proximate to or within an aperture 1804 of the housing 1802. A heat sink 124 is disposed within or outside the housing 1802. A reflector 126 is disposed within the aperture 1804 of the housing 1802 and around the two or more LEDs 122. A diffuser or lens 128 seals the aperture 1804 of the housing 1802. The LED current control circuit 120 provides an on/off signal having a cycle time to each LED 122 in response to one or more control signals received from the controller/processor 106 such that the two or more LEDs 122 produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.

Other embodiments will include additional components. For example, the additional components may include: a real time clock (RTC) circuit 110 communicably coupled to the controller/processor 106; a memory 108 communicably coupled to the controller/processor 106; a wireless transceiver circuit 112 communicably coupled to the controller/processor 106; an antenna 114 communicably coupled to the wireless transceiver circuit 112; a hard reset circuit 116 communicably coupled to the controller/processor 106; and/or an ambient light sensor circuit 118 communicably coupled to the controller/processor 106. These components were previously described in reference to FIGURE 1.

The connector 100 would be an Edison base or bi-pin for which when the connector is inserted into the appropriate light socket, the connector would provide appropriate contact to extend the power source into the body

of the II Bulb 1800. In addition, the connector 100 will provide some structural stability in fastening the II Bulb 1800 into a socket. In some alternate versions of the II Bulb 1800 the connector might also be a plug-in or battery powered connector. The physical location of the antenna 114 and/or wireless transceiver circuit 112 could be placed in multiple physical locations related to the II Bulb 1800. For example, it might be placed outside of the II Bulb 1800 or inside the II Bulb 1800. Placing it outside, might increase the range of wireless communication for the II Bulb 1800, especially when installed in locations with poor reception. Alternatively, the antenna 114 might be built into the physical structure of the II Bulb 1800 or be part of the main board inside the II Bulb 1800.

The LED current control circuit 120 executes commands from the controller/processor 106 to control the current passed through the LEDs 122. The LED current control circuit 120 might take different forms dependent on the II Device embodiment 1800 as previously described. Each II Bulb 1800 would have some arrangement of LEDs 122 that could vary in color and type (brightness) depending on different II Bulbs. Various types of LEDs 122 would be placed on a LEDs board 136 in a spaced and arranged fashion and connected electronically to other circuitry as explained earlier. The LEDs board 136 consists of electrically connected LEDs 122 placed on a single surface. The combination of LEDs 122 could be of various types and various colors. For example, the LEDs 122 might vary in color such as red, green, blue, and/or white LEDs. The LEDs 122 might also vary in their maximum output luminosity. The combination of illuminations of these LEDs 122 could produce various levels of brightness and/or color. LEDs 122 on the board would be arranged so that the light from them would mix well forming a uniform color and overall light from the II Bulb 1800 would spread uniformly in at a particular degree around the circumference of the diffuser 128. In addition, the LED board 136 might be combined or surround other circuitry such as the hard reset circuit 116 and/or ambient light sensor 118. For embodiments where this is the case, the LEDs 122 could take a different arrangement to accommodate for the placement of those circuitries.

Referring now to FIGURE 20, a diagram of a LEDs Board 2008 in accordance with one embodiment of the present invention is shown. As an example of the LEDs board arrangement, the white LEDs 2006 could be placed at the center of the LEDs board 2008 with red LEDs 2000 on the exterior and blue 2004 and green LEDs 2002 placed in between. In addition, there is an arrangement for electrical contacts 2010, 2012 on the LEDs board 2008 at some place as shown. The arrangement can be used to connect sensors such as ambient light sensor of the ambient light sensor circuit 118 and the reset switch of the hard reset circuit 116 on the on the II Device to their respective circuitry that could be on the main board 134. The arrangement might be on certain planes such as vertical, horizontal, and diagonals. In addition, the proportional relationship in the number of certain color LEDs to other types could vary dependent on the light emitted by the LED and the specific embodiment requirements.

II Bulb 1800 may consist of Hard Reset circuit 116 as explained earlier. The location of the hard reset circuit might be co-located with other external components such as the ambient light sensor 118, LEDs 122, diffuser 128, or other II Bulb components or structural parts. In this sense the physical location with respect to the II Bulb 1800 might vary. Now referring to FIGURE 55, a potential placement of the photosensor 5502 and reset switch 5504 on the light mixing cover/diffuser 128, 5500 that is on the top of LEDs board 2008 of II Bulb. The heat sink and related components and parts 124 are required in some embodiments of the II Bulb 1800. As explained earlier the heat sink and related components 124 dissipate the heat generated by the LEDs 122 and LED current control circuit 120 and it could take multiple sizes, shapes, and materials dependent on the II Bulb embodiment.

Other 'related components' refers to related parts required for the fitment of heat sink and parts required of the housing and inner or outer structure of the II Bulb 1800. These materials and arrangement might of course differ depending on the particular II Bulb embodiment.

As explained earlier, there would be a diffuser 128 that is a part of the II Bulb 1800 that spreads and/or 'mixes' the illumination produced by the LEDs 122. There could be an ambient sensor, a part of ambient sensor circuit 118 and/or hard reset button, a part of hard reset circuit 116 on the diffuser 128, in which case, the diffuser 128 could be transparent at that place. Also, the diffuser in that case, may have a through-hole arrangement for electrical and mechanical connections of the sensor and button to the II Bulb 1800. In the II Bulb as well, as explained earlier, the light reflector 126 is used to amplify or focus the illumination generated by the LEDs.

Referring now to FIGURE 48, another embodiment of II Device 140 system with the wireless energy receiver 4804 and wireless energy transmitter 4802 is shown. The wireless energy transmitter 4802 transmits the energy wirelessly to the II Device 140 through wireless energy receiver 4804. The wireless energy receiver 4804 that is connected to II Device 140 feeds the energy received to the II Device 140 through its connector 100 or directly to the AC/DC converter 102. In this case, the input ratings of AC/DC converter 102 might be different than the universal ratings as explained earlier (AC power 60V-290V/45-65Hz). Wireless energy receiver 4804 may have inbuilt AC/DC converter in which case, the DC output generated of wireless energy receiver 4804 is directly given to the DC/DC converter 104.

Referring now to FIGURE 56, another embodiment of II Device 140 in the form of LED lighting panel 5600 is shown. The panel is mostly used on the ceiling for down lighting. It might consist of number of LEDs groups 5602 on the front wall of the panel arranged in horizontal and vertical planes on LEDs board as shown in FIGURE 56. The panel 5600 might also consist of LEDs groups 5602 on side walls of the panel 5600. The LED board could be similar to the LEDs board 2008 explained while describing II Bulb. Each LEDs group 5602 might have various types and colors of LEDs, for example – Each LEDs group may consist of Red, Green, Blue and White LEDs making LEDs Group, in turn LED lighting panel 5600 to produce light with various colors and brightness.

The LED lighting panel, an embodiment of II Device also consists of other circuitry such as LED Current control circuit 120, Real Time Clock Circuit 110, etc. as explained in FIG. 1. Here, the heat sink either connects to the LEDs through LEDs board or there could be heat transfer adhesive(s) (potentially different adhesives for different LEDs groups) between the LEDs board and heat sink. There could be a common light mixing cover/diffuser 128 for all LEDs groups 5602 or multiple light mixing covers/diffuser for each or multiple LEDs groups.

All the required electronic circuitry per II Device 140 would be inside the lighting panel 5600, while the positions of the ambient light sensor(s) of ambient light sensor circuitries 118 and the reset switch of the hard reset circuit could vary. They could reside on the top/front wall of the panel 5600, on the side walls of the panel 5600. The ambient light sensor and the wireless transceiver circuit 112 could also take other placements as explained earlier. There could be multiple ambient light sensor circuitries 118 on the LED lighting panel 5600 with light sensor taking the positions on side walls of the panel 5600 as well.

The panel could have single or multiple connectors 100 of various types as explained earlier while describing connector 100 in II Device 140. In addition, theses connectors could be connected to the lighting panel 5600 through an electric cable or AC power cord 902. There would be a mechanical arrangement to fit the lighting

panel 5600 to the ceiling in the form of an adhesive, fastener(s), screw-in mechanism or any other possible arrangement. The panel could also be used for the recessed lighting i.e. inside the ceiling.

Referring now to FIGURE 57, another embodiment of II Device 140 in the form of LED Can, a recessed LED downlight Can 5700 that is mostly used in ceilings is shown. It might consist of LEDs board 2008 as explained in II Bulb with LEDs facing downwards while Can is installed into the ceiling. The LED Can 5700, an embodiment of II Device also consists of other circuitry such as LED current control circuit 120, real time clock circuit 110, etc. as explained in FIG. 1. Here, the heat sink is a part of the Can fixture and is connected to the LEDs through LEDs board itself or there could be heat transfer adhesive between the LEDs board and heat sink. There would be a light mixing cover/diffuser 128 for LEDs board 2008 on top of the Can facing downwards.

All the other required electronic circuitry per FIGURE 1 of II Device 140 would be inside the lighting Can 5700, while the positions of the ambient light sensor(s) of ambient light sensor circuitries 118 and the reset switch of the hard reset circuit could vary as explained while explaining II Bulb.

The Can 5700 could have single or multiple connectors 100 of any types as explained earlier while describing connector 100 in II Device 140. In addition, the connector could be connected to the lighting Can 5700 through an electric cable or AC power cord 902. There would be a mechanical arrangement to fit the lighting Can 5700 inside the ceiling through adhesive, fasteners, screw-in mechanisms or any other possible arrangement.

With a wirelessly connected II Device, it will be important for the device application to understand the current status of each II Device within the network. In addition, it would be beneficial for each smart light or an auxiliary wireless device to know the status and signal strength of other Smart lights within its proximity. This would provide a better user experience and a more efficient lighting control system.

Now referring to FIGURE 21, a flow chart of a status request/update process for a wireless device or auxiliary device to II Device in accordance with one embodiment of the present invention is shown. The basic process for a status request from the wireless device or auxiliary device shown by element 2100 would begin with block 2102. Upon a status update defined event 2103, the device application will trigger a command through the wireless device or auxiliary device to send a wireless communication to all II Devices in the vicinity 2104. This command will then get extended through the mesh network 2105 (see communication and mesh network processes for reference in as needed.) Upon receipt 2106, each II Device will both respond to the command with the current status of that II Device 2108 and extend the responses of other II Devices via the mesh network 2105. Upon receipt back by the wireless device or auxiliary device, the status information will be interpreted by the device application 2110 and either store the information in the device application memory as an input to execute further commands 2114, trigger a second communication or command to the II Device network 2116, or take some other action 2112. The process completes in block 2118.

Referring now to FIGURE 22, a flow chart of a status update process for II Device to II Device in accordance with one embodiment of the present invention is shown. The basic process for an internal II Device network status refresh from II Device to II Device shown by element 2200 would begin with block 2201. Upon a status update defined event 2202, a command will be triggered in one or many Smart lights to send a wireless communication to all II Devices in the vicinity 2204. This command will then get extended through the mesh network 2205. Upon receiving status updates sent by other II Devices 2206, the status information will be interpreted by the II Device (processor) 2208 and used to either store the II Device ID's received and some associated data of the status in II Device's memory 2212, trigger a second communication or command to the II

Device network 2214, or take some other action such as reconciling time or program differences 2210. The process for II Device to II Device completes with block 2216. The processes described in part 2100 and 2200 could be executed in some tandem or integrated fashion dependent on the specific program or task at hand.

The device application, auxiliary device, II Device itself and related II Devices and II Device network could update status information upon different defined events, time periods, or processes signified by 2101. For example, upon start-up or launch of the device application a command could be sent to gather the status information and subsequent layout of each Smart light within the network. As another example, after a defined time period while the device application is open, the wireless device could send a command to gather the status information and subsequent layout of each II Device within the network. As another example, given a different defined time period, each II Device could send a command to gather the status information and subsequent layout of each II Device within the network. As another example, during certain programs either actively runs through the device application or passively in the II Device network, either example b) or c) could be executed at differing times to better suit the program or application. Or it could be any combination of the previously described examples.

The actual status of each II Device may include but not limited to the following information: (a) the ID# and signal strength of other II Device within range; (b) the color and/or brightness at which the II Device is currently illuminated; (c) the status of programs, defaults, and profile information stored in the II Device's memory; and (d) the current time/date as stored in the RTC.

There are a number of different potential processes and programs that would require the current status of the II Devices communicated. For the disclosure of this invention, it will be assumed that the status of the II Devices will already be known if having the status of one or the network of II Devices is generally required to execute the program or process. In many cases the process of obtaining the status of an II Device is included in description and drawings. In other cases, the status need not be required in the program or process.

Now referring to FIGURE 23, a flow chart of a communication process from a device to II Device in accordance with one embodiment of the present invention is shown through element 2300. The process begins with block 2301. Given a wireless device (WD) is equipped with hardware and systems to execute wireless communication protocols (Bluetooth, Wi-Fi, ZigBee, or any other wireless protocol) as well as an appropriate device application 2302, a user could send a lighting command to an II Device by selecting the command via the device application 2304. Upon the user's selection of a command for a specific II Device, the device application would translate the user's requested command into a light setting command and the specific stored ID for the selected II Device 2306. This light setting command would include instructions for the specified II Device ID to execute such as on/off, color, brightness, or a program. The light setting command would be translated into the appropriate wireless communication protocol and wirelessly sent via the wireless device 2308. The II Device if in range of the wireless communication or mesh network 2309 relay communication would receive the protocol via the II Device's antenna 2310. The transceiver/receiver circuitry would decode the wireless protocol to find the light setting command and send that to the controller/processor 2312. The controller will execute that command with the respective II Device's related components 2314. Upon successful execution, the II Device will respond through the appropriate wireless communication that it has executed the light setting command 2316 - 2318. The process ends with block 2320.

Referring now to FIGURE 24, a flow chart of a communication process from a device to multiple II Devices in accordance with one embodiment of the present invention is shown referred to as element 2400. The

process begins with block 2401. Similar to the process of sending a light setting command from a wireless device to an II Device 2300, given an appropriate wireless device and device application 2302, a user could select a command for multiple II Devices via the device application 2402 that would send a wireless communication through the wireless device pertaining to multiple II Devices 2404, 2406, which could be extended through the mesh network 2407. Upon receiving the wireless communications 2408, the II Devices could decode 2410, execute the command 2412, and each respond to verify the command has been executed utilizing the appropriate communication methods shown as 2414- 2416. The process would end with block 2418.

Now referring to FIGURE 23 as well as FIGURE 24, similar to the process of sending a light setting command from a wireless device to an II Device 2300 and the process for sending a light setting command from a wireless device to multiple II Devices 2400, a user could use multiple wireless devices or a combination thereof to send a command to one or multiple II Devices. As long as the wireless devices have the appropriate wireless protocol and associated hardware, has some version of the device application with an authorized profile 2302, and is in range of the II Device (or mesh network), then the wireless devices could send a command in the same way that one wireless device could, to one or multiple II Devices.

Now referring to FIGURE 25, an II Device 140 within a mesh network (a lighting system) will be described. The ability for one II Device to receive a wireless communication from a wireless device equipped with the device application, and pass on the communication to another II Device to execute the command within the wireless communication. On a broader scale, having a network of II Devices be able to extend and relay a wireless device's command to extend the signal range or go beyond the limited number of devices it can communicate with directly or one-to-one. Additionally, have the II Devices within the network confirm the execution of the command and possible automated or user guided troubleshooting steps.

Consider a wireless device (WD) (2550, 2552, 2554) is equipped with hardware and systems to execute wireless communication protocols (Bluetooth, Wi-Fi, ZigBee, or any other wireless protocol) as well as the installed device application. Each wireless communication system has some limitation in terms of range (measured in meters or feet). WD1 2550 can communicate with II Device1 2500, II Device2 2502 and II Device3 2504 directly, however, it cannot communicate with other II Devices directly because of range limitation. WD1 2550 can communicate with II Device4 2506 by passing the commands and data through II Device3 2504. Similarly, by passing commands/data through II Device3 2504 and II Device4 2506, WD1 2550 and II Device5 2508 can communicate with each other. In the diagram, WD1 2550 can communicate with each II Device directly or through II Device(s). The diagram is an example of mesh network with which the controlling wireless device (WD in this case) can communicate with all II Device(s) able to communicate with each other.

In diagram above the II Devices are divided in different network levels as follow: (a) II Devices which are in direct vicinity of WD1 2550 are network level 1 called as NWL1 where II Device1 2500, II Device2 2502, II Device3 2504 are NWL1 II Devices; (b) II Devices which are in the vicinity of NWL1 II Devices, but not in direct vicinity of WD1 2550 are network level 2 called as NWL2 II Devices where II Device4 2506 is NWL2 II Device; (c) II Devices which are in the vicinity of NWL2, but not in the vicinity of WD1 2550 or NWL1 are NWL3 II Devices where II Device5 2508 and II Device7 2512 are NWL3; and (d) similarly, II Device6 2510 is NWL4 II Device.

The process for forming a mesh network will now be described. There are multiple processes that the wireless device and network of II Devices could communicate with each other to set-up a mesh network, dependent

on the size of the network (number of II Devices), the dispersion in location of the II Devices (power signal), and other factors. The process would generally involve the wireless device communicating with all II Devices within its signal range, and having each II Device also communicate to other II Devices within its signal range, with an ultimate output sent back to the wireless device including the current status and ID's of all II Devices in signal range for wireless device and each II Device within the network.

WD1 2550 communicates with NWL1 II Devices and stores their ids and statuses in the memory 106 and creates a network among them. Each II Device also communicates with other II Devices and stores their ids and statuses in the memory 106 and creates a network among them. WD1 2550 then sends commands to NWL1 II Devices asking what other II Devices they can communicate with and their ids and statuses. Each NWL1 II Device responds to the commands and provides information on their connections/network with ids and statuses. WD1 2550 then sends commands to NWL2 II Devices through respective NWL1 II Device to get the information on the II Devices in their network and their statuses. NWL2 II Devices responds back to WD1 2550 through respective NWL1 II Device with their network information. WD now has all II Device ids in its memory at NWL1, NWL2 and NWL3 levels. In the same fashion, WD1 2550 continues to build its network map by sending commands to next network level II Devices (in this case, NWL4) through intermediary network level II Devices and gets information on their network. This process would continue until either the wireless device receives information from all lights set-up within the device application or selected for a particular command, or until all II Devices that can be reached through the mesh network have been captured either directly or through the mesh network to the wireless device.

Using the statuses and information from each II Device, the application device run on the wireless device 2550 would then create a map of the entire network, including what II Devices are connected to what II Device and each connection's signal strength, and store it into its memory 106. WD1 2550 can find out the most effective path to communicate with a particular II Device in the mesh network depending upon the signal strengths between WD1 2550 and that particular II Device and signal strengths between WD1 2550 and other II Devices wirelessly connected to other II Devices and that particular II Device. E.g. in diagram above, signal strength between WD1 2550 and II Device8 2514 is very low. This may cause communication errors between WD1 2550 and II Device8 2514. Therefore, WD1 2550 can chose to communicate with II Device8 2514 through II Device2 2502 as signal strength between WD1 2550 and II Device2 2502 and that between II Device2 2502 and II Device8 2514 is good, leading to less errors in communication. When a command is sent from the wireless device to an II Device through a mesh network, the II Device will respond to confirm the command has been executed in a similar path or along a more effective path given any potential changes in the network based on any changes in terms of movement of wireless device, signal strength, etc. The mesh network could be limited to NWL1 or NWL2 or any other network level based upon the criticality of application and different II Device embodiments.

Considering the fact that some types of communication protocol/methods have a limit to the number of devices that can be connected or have communication among, the device application will intuitively take these as input constraints to the formation of an optimal mesh network and path for the wireless communication of a command. As example, if the wireless communication uses Bluetooth technology, there might be some constraints. Considering a piconet topology (ad-hoc computer network using Bluetooth technology), a master Bluetooth device (Mostly a Wireless Device or II Device in this case) can communicate with a maximum of seven Bluetooth devices at a time. Understanding this constraint, the wireless device(s) and II Devices could execute the mesh network process in such a way to optimize both the total number of II Devices captured by the network and the path to send

any specific command through the mesh network. This can be achieved by executing the standard mesh networking process, and the device application considering the resulting map of the network to calculate and decide which specific II Devices to keep connected within the direct connection of the wireless device and which to keep connected through other II Devices.

5 Considering a case where more than seven II Devices are found within the vicinity of the wireless device, the device application after receiving the initial network mapping would adjust which II Devices to directly connect to and which to connect to through another II Device to attempt to reduce the number of II Devices directly connected to the wireless device. This would open up the ability of the wireless device to search for and connect to additional II Devices within initial proximity that might not have been able to connect before due to the limit of
10 seven devices. This process would be balanced to ensure those lights that could only connect through another II Device are also accounted for and signal strength is at the highest possible levels. Note that this constraint might not be the case for all versions of Bluetooth topology or technology.

 The steps for forming a dynamic mesh network will now be described. Similarly to controlling multiple II Devices with multiple devices, multiple wireless devices, in this case, WD1 2550, WD2 2552 and WD3 2554 could
15 control one or many II Devices via the mesh network. Each wireless device, in this case, WD1 2550, WD2 2552 and WD3 2554 would execute the mesh network process in relation to its location as explained earlier with reference to wireless device WD1 2550 and II Devices in its vicinity at different network levels such as NWL1, NWL2 and NWL3.

 Along the same lines, a dynamic mesh networking is required as a wireless device (WD) can move from
20 one place to another changing for itself the II Devices in NWL1 and possibly the II Devices in other related network levels such as NWL2, NWL3, etc.. In the dynamic mesh network process, the wireless device and II Devices follow the same process as explained in the formation of mesh network, but the process is repeated on a continuous basis. Specifically, the wireless device and each related II Device would keep updating their individual network as explained earlier after every defined time interval. Each II Device would also keep providing the ids and statuses of
25 II Devices in its network to the wireless device(s) in a defined time interval. This time interval would vary from a few seconds to hours depending upon the complexity and criticality of the application being run, power consumption, dispersion of II Devices, and total no. of wireless devices and II Devices in the network.

 In FIGURE 25, accessing an II Device network through various devices in accordance with one embodiment of the present invention is shown as well. Different types of wireless devices could work together to
30 form, extend, and translate different communication methods to support the mesh network. These different wireless devices could be standard wireless devices such as smartphones, tablets, computers, or other standard controlling wireless devices with the device application loaded. Alternatively, these different wireless devices could be an auxiliary device with some specialized or standardized device application to either perform a specific function or general function in relation to the mesh network.

35 As example, a wireless device located outside of direct contact with the lighting network, but within range to another wireless device within range of the lighting network, could send commands through the wireless device to the lighting network and subsequent mesh network. In this case, the remote wireless device RD 2548 would originate the commands and then the localized wireless device WD1 2550 would act as the first network level of the mesh network. Note that the communication method between the remote wireless device RD 2548 and the localized
40 wireless device WD1 2550 might be different than the communication method between the localized wireless

device WD1 2550 and the II Devices lighting network. As an example, the remote wireless device (RD) 2548 may communicate with the localized wireless device WD1 2550 via an internet based protocol while the localized wireless device WD1 2550 communicates with the lighting network via a Bluetooth protocol. Also, remote wireless device (RD) 2548 could be another embodiment of Intelligent Illuminating Device 140.

5 Additionally, the remote wireless device RD 2548 might send a communication to the localized wireless device WD1 2550 to send a specific communication to the lighting network upon some defined event. In addition, the remote wireless device RD 2548 need not necessarily be outside of the range of the lighting control system. The wireless device WD1 2550 may also act as a specialized auxiliary wireless device such as an external ambient light sensor and communicate with other wireless devices.

10 The Real Time Clock inside of each II Device would need to be periodically updated to ensure accuracy. To achieve this, the device application on the wireless device would refer to and share its own current date and time information via the wireless communication and connection process – either as part of the status update process or an alternate process. Additionally, the II Devices themselves can update and reconcile discrepancies within the date/time without the wireless device itself being present in the network. The actual process to update the date/time
15 setting of the RTC in an II Device from the wireless device/device application might be executed in a number of different ways.

 The following are potential but not limited to all examples of how a device to II Device date/time update process would be triggered, generally represented as element 2602. The wireless device/device application might send the date/time setting upon every command sent to the II Device network, and when received the II Device(s)
20 would update the current date/time setting in the RTC and store latest update date/time in the II Device's memory. The wireless device/device application might periodically over some time or number of processes send the date/time setting upon every command sent to the II Device network, and when received the II Device(s) would update the current date/time setting in the RTC and store latest update date/time in the II Device's memory. The wireless device/device application might send the date/time setting only when specific programming commands are sent or
25 active that requires information from the RTC and store latest update date/time in the II Device's memory. The wireless device/device application might send the date/time setting after some time setting is changed within the wireless device/device application. Further, any combination of the above might be applicable.

 Similarly, the process where II Devices share and reconcile date/time settings might be executed in a number of different ways. The following are potential but not limited to all examples of how an II Device to II
30 Device date/time update process would be triggered, collectively represented as element 2702. The II Devices might share and reconcile their date/time at some multiple of when their status is shared. The II Devices might share and reconcile their date/time only when executing certain commands or processes. The II Devices might share and reconcile their date/time after some defined period of time. The II Devices might share but only reconcile their date/time when they are different. The II Devices might reconcile the date/time based on the most recent
35 update of date/time setting. Further, any combination of the above might be applicable.

 Now referring to FIGURE 26, a flow chart of a wireless device update date/time process in II Device in accordance with one embodiment of the present invention is shown and referred to as element 2600. The actual reconciliation process and dependency in commands would proceed as follows, beginning with block 2601. Anytime the wireless device sends a date/time update to any number of II Devices 2604, 2606, the II Device will
40 update and match its internal time via the II Device's RTC and memory 2608, 2610. The II Device's memory will

also update the date/time value as the original date/time when the RTC was updated 2608, 2612. The II Device would then confirm the execution of the date/time update back to the wireless device 2614, 2616. In some cases, the wireless device might execute a troubleshooting process if not all II Devices confirm execution of the date/time status update 2618, 2620. The process would conclude with block 2622.

5 Referring now to FIGURE 27, a flow chart of an II Device update date/time in II Device in accordance with one embodiment of the present invention is shown and referred to as element 2700. When an II Device to II Device event occurs as referred to previously as 2702, either through a status update or solely a date/time communication, the II Device(s) would send a date/time communication out to any II Devices either directly within range 2704 or within range through the mesh network 2705. When an II Device(s) receive the date/time
10 communication from another II Device 2706, the receiving II Device will compare the receiving date/time update to its own date/time status in the RTC 2708. If the received date/time communication was set more recently than that of the II Device's 2710, then the receiving II Device will update and match its internal time via the II Device's RTC and memory 2714, 2716. The II Device's memory will also update the date/time value when the RTC was updated 2714, 2718. If the values are the same or the received date/time was updated later than the receiving II Device's
15 internally stored date/time 2710 to 2712, then the II Device takes no action 2712 and will complete the II Device to II Device date/time communication process 2720. Considering a mesh network system where there are numerous paths and scenarios, broadly the II Device's themselves will only update their date/time when the received date time originated from a more recent date/time update. Originated refers to the specific date/time when a wireless device sends an update to the II Device(s). If an II Device then passes that date/time on to another II Device, the originated
20 date would still refer to the original date/time when the wireless device sent the update to the II Device(s).

Referring now to FIGURE 28, a flow chart of basic control areas in accordance with one embodiment of the present invention is shown and represented by element 2800. Using the device application on a number of different wireless devices, a user could communicate and control the wireless lighting system in a number of ways. A user could control a single II Device, a combination of II Devices, a predetermined group of II Devices, multiple
25 groups of II Devices, and the whole set-up of networked II Devices. Control pertains to adjusting brightness, color, running a program, or setting a program to run at a future time or upon some event. All processes begin with block 2801 and continue as follows:

Controlling a single II Device through the application: (a) a user will navigate through screens on the application to select 2802 an individual II Device (e.g., can arrive by 'drilling down' into a group or selecting the
30 unique II Device to control); (b) once the single II Device is selected 2804, the device application will display potential options for control 2806; (c) potential options for control include but are not limited to the following collectively signified by 2808: (i) turning on/off to default, (ii) changing brightness, saturation, and/or color, and (iii) running a program now or upon some condition such as time. Alternate options for user customization include but are not limited to: (i) adding the II Device to an existing or new group, (ii) viewing the II Device's group
35 assignments, (iii) viewing a hierarchy of programs and scenes that the II Device is included in, and (iv) troubleshooting the II Device. Once a user has selected the option for control, the device application will interpret the selection into a light control setting for the selected II Device 2810 and send a wireless communication via the appropriate processes, represented here collectively by element 2812. As such, once the individual II Device receives the communication, it will then interpret the instructions and execute the command, then relay confirmation
40 back to the wireless device per the appropriate communications processes.

Controlling multiple II Devices through the application: (a) a user will navigate through screens on the application and select multiple II Devices 2802 (e.g., can arrive by 'drilling down' into a group or selecting the unique light IDs to control; (b) once the II Device IDs are selected 2814, the user will be given options for control 2816; (c) potential options for control include but are not limited to the following collectively signified by 2818: (i) turning on/off to default, (ii) changing brightness, saturation, and/or color, and (iii) running a program now or upon some condition such as time. Alternate options for user customization include but are not limited to: (i) adding the II Device to an existing or new group, and (ii) troubleshooting the II Device. Once a user has selected the option for control, the device application will interpret the selection into a light control setting for the selected II Devices 2810 and send a wireless communication via the appropriate processes, represented here collectively by element 2812. As such, once the individual II Device receives the communication, it will then interpret the instructions and execute the command, then relay confirmation back to the wireless device per the appropriate communication processes represented by 2812.

Controlling a group or multiple groups of II Devices through the application. A user will navigate through screens on the application and select a group or multiple groups of II Devices 2802. Groups of II Devices will be user configurable combinations of individual II Devices. They will most closely relate to rooms, but can have multiple combinations. Once the group 2820 or groups 2826 are selected, the user will be given options for control 2822, 2828, including but are not limited to the following collectively represented as element 2824 for a group or 2830 for multiple groups: (i) turning on/off to default, (ii) changing brightness and/or color, (iii) running a program now or upon some condition such as time, and (iv) turning on/off a program that is set to run in the future or upon some condition.

Alternate options for user customization include but are not limited to: (i) drilling down into individual II Devices for control, (ii) adding the group to an existing or new group, (iii) viewing a hierarchy saved settings, programs, and scenes that the group is included in, and (iv) troubleshooting the group. Once a user has selected the option for control, the device application will interpret the selection into a light control setting for the each II Device within the selected group or groups 2810 and send a wireless communication via the appropriate processes, represented here collectively by element 2812. As such, once each II Device within the selected group(s) receives the communication, it will then interpret the instructions and execute the command, then relay confirmation back to the wireless device per the appropriate processes discussed in the communication processes represented by 2812.

Controlling a whole network of lights through the application is similar in fashion to controlling multiple groups, represented by a similar sequence of elements 2802, 2832, 2834, 2836, 2810, and 2812. All basic control processes end at block 2838.

Programming is a process by which an II Device, multiple II Devices, a group, or multiple groups can execute a command or sequence of commands given some other event occurs or condition is met. Similarly, an II Device, multiple II Devices, group, or multiple groups could be given a sequence of commands to execute in sequence at some time interval. Unique to the invention disclosed, a user can create programmed commands, send them wirelessly to any number of specified II Devices, and the command would execute given a condition being met. The condition will generally be related to time, but many types of conditions could be interpreted into time based activities. For example, wireless devices able to access the internet provide a wealth of potential conditions that could be converted to time passed or the wireless device could passively monitor the condition and send a command when met.

Generally a condition could be executed through these sources: (a) the wireless device sends a command to any number of II Devices to execute a program given a date/time passing or date/time being met (e.g., simulated sunrise, timer, etc.); (b) the wireless device sends a command to any number of II Devices to execute a program given some other conditionally based input directly available to the II Device (e.g., ambient light sensor program); (c) the wireless device sends a command to any number of II Devices to execute a program with the condition being met at that time and the action stored in the II Devices memory (e.g., reset process); (d) the wireless device sends a command to any number of II Devices to execute a program with the condition being met at that time and the action specified through the command (e.g., starry night); (e) the wireless device sends a command to any number of II Devices to execute a program given some other conditionally based input available to the lighting control network is available to said II Devices (e.g., auxiliary ambient light sensor program); (f) the wireless device sends a command to any number of II Devices to execute a program in coordination with wireless communications/commands provided sequentially through the device application (e.g., music sync); (g) the wireless device runs a program to monitor some condition and upon that condition being met sends a command to any number of II Devices to execute a specified command or sequence of commands (e.g., weather alerts); (h) any combination or sequential representation of the above program types.

Creating a program involves similar processes to basic control. A user selects an II Device, multiple II Devices, group, or multiple groups to run a program. The user then selects a program to be run by the selected II Device(s): (a) there could be predefined suggested programs based on the items selected (e.g., stored in device application memory); (b) the user could create their own program; (c) each program will consist of at least one command to be run when one or more conditions are met, or multiple commands to be run sequentially or upon further conditions being met (e.g., user to set/select condition); (d) the program can be run at that time or saved to run at a future time (e.g., the program can be set to repeat on certain dates/times, such as days of the week, every X days, or any time lapse interval). The command or series of commands is then sent via the wireless network to each associated II Device(s). This is done through the appropriate wireless communication process. Each II Device(s) then interprets the command or series of commands, executes the command, or stores the command in memory to be executed when conditions are met. Similarly, each II Device(s) would confirm the program command via the appropriate communication method process.

Now referring to FIGURE 29, a flow chart of a programming process in accordance with one embodiment of the present invention is shown and referred to as element 2900. Once a program or programs are saved a user can recall and toggle those programs on/off. The process begins with block 2901. At the main level of the device application 2902, there will be a 'programs' button. When selected 2904 this will display all programs associated with the active profile. Each program will be listed with their current status as active vs. inactive. The programs will be sorted based on active vs. inactive status with active listed first. Secondly, the programs will be sorted based on the proximity of the associated II Devices to each program 2906. When toggled on 2908, the application will send the command or series of commands via the wireless network to each associated II Device(s) 2910 through one or more appropriate communication processes, collectively represented here as 2912. The actual light setting associated with the program might be stored in device application so that the wireless communication is to execute a specific program type command. The actual light setting might also be stored in the II Device itself 2914 so that the device application/wireless device only requests the II Device to run that program. Each II Device(s) then interprets the command or series of commands and their related program conditions, executes the command given a present condition, or stores the command in memory to be executed at a later condition time or event. In the latter case,

once the condition is met the II Device(s) will execute the program command 2918. Then if there are further conditional commands within the program 2920, the II Device will continue to monitor for conditions until they are met 2916 and the II Device similarly follows the process to execute the program command 2918. Once no further conditional commands are in the program 2920, the program completes and changes to inactive status 2922 so that the program commands are deleted from the memory of each related II Device, and the program returned to an off status in the device application 2924. Alternately, a program that was set to run can be turned off 2908 so that the wireless device sends a command to the related II Devices to not execute the conditional command prompted by the program 2928. This command would be communicated through one or more appropriate communication processes, collectively represented here as 2912. When received, each II Device would change the program to complete and change it to inactive status 2922 so that the program commands are deleted from the memory of each related II Device, and the program returned to an off status in the device application 2924. The program might still be saved in the device application memory for future use, if a saved program. The program run process ends in block 2930.

In the case where program commands would overlap with each other, the device application will prompt the user to confirm the program selection. In such case, the selected program will overlap any conflicting previously activated program. Alternatively, if the program commands originated from multiple devices or profiles, the II Devices will execute programs in the order of profile hierarchy. Alternatively, the programs might execute in the order of the last received command.

Scenes & suggested scenes will now be described. A scene is a predefined setting or program related to multiple II Devices and/or groups, so that with one user selection any or all II Devices would execute a specified setting or program. This element is useful to support very holistic functional lighting like turning off all II Devices before going to bed, turning on some II Devices to walk to the bathroom, setting a mood for dinner or a movie, or many other personal preferences. A scene is comprised of a defined light setting and/or program for each of any number of individual II Devices and/or any number of groups. When a scene is activated, the device application recalls the defined light setting(s) and/or program and the associated II Device (s)/group(s) and sends a standard wireless command to each.

Referring now to FIGURE 30, a flow chart of a process for creating a scene in accordance with one embodiment of the present invention is shown. The scene control selection can be both suggestive and user configurable. A user could drill into each established scene to view or edit the states for each II Device, add more II Devices, etc. A user could also select a scene to be run at a previous time such as through an automation program. Scenes might display graphically in the user interface with the most used scenes or the scenes containing the II Devices with the closest signal strength higher in order. Users could also drag and drop the order of scenes displayed to their preference.

Once a network of II Devices is set-up, the application might suggest some pre-configured scenes dependent on the number of II Devices set-up within the network and the names of the groups (most likely rooms) that were assigned. More specifically, the device application would refer to the list of groups configured by the user, and if certain predefined keywords or combinations of words were found within those groups, the application would suggest/show a scene related to that group or groups in the scene options. Also, the device application would refer to the number of II Devices, the number of groups, and the number of II Devices within each group to create suggested/predefined scenes. With more II Devices, groups, and II Devices within groups, more complex scenes could be suggested, or more group specific scenes could be suggested. All # of II Devices would include scenes all

off and all on related to turning all II Devices off within the addressable network, or turning all II Devices on. As example, for any lighting network containing a group of lights with the word “TV”, “Television”, “movie”, “film”, or related word, the application would suggest a lighting scene related to watching a movie, such as a soft blue light emitted from each of the II Devices. The types of suggested scenes could vary dependent on different applications.

5 Through the device application, the user can create a new scene, referred to as element 3000 and beginning in block 3001, by first selecting the option to create a scene in the device application 3002 and selecting any number of II Device(s) and/or group(s), with which to start creating the scene 3004. The user would then select/create the lighting control setting or program for the selected II Device(s) and/or group(s) II Device. Here, the light setting might be a previously user saved configuration, an automated application suggested configuration, or a newly
10 created configuration 3006. Once selected, the user would then have the option to add additional subsets of II Device(s) and/or groups to the scene 3008, which would revert back to a similar configuration process for that selection 3004, 3006. Once the user has configured all the II Device(s) and/or group(s) that they wish 3008, the scene, comprised of any combination of II Device(s) and/or group(s), each with a specified light setting or program, will be saved and the user could assign a specified name 3010. This information will be stored in the device
15 application memory 3012 and the process will end in block 3014.

Note that each II Device within the scene is able to have a different II Device brightness and/or color. In addition, pre-defined programs for II Device(s) can also be run or activated through a scene in combination with a specific type of lighting to be executed at that time. For example, a ‘time to sleep’ scene might turn off all the II Devices in the network, except for one II Device on very low blue light in a child’s bedroom, and activate the II
20 Device alarms for all bedrooms in the house for a certain time. Once the user has selected the II Devices and lighting output, the user can save that scene for future use as referred to previously in 3010. The scene is saved within the device application memory 3012.

Now referring to FIGURE 31, a flow chart of a process for executing a scene command in accordance with one embodiment of the present invention is shown as element 3100. The process begins in block 3101. To turn a
25 scene on, when the device application is open 3102, the user would select (switch on) the desired saved (or suggested) scene as an option presented in the device application interface 3104. The device application would then retrieve and convert the scene selection into specific light setting commands and/or programs to be executed by each of the related II Devices in the scene 3106. The wireless device would then convert the series of II Device light setting commands or programs into the appropriate wireless communications directed at each of the related II
30 Devices within the group 3108. Upon receipt, each II Device would execute its related light setting command or program and send the appropriate wireless communication back to the wireless device to confirm execution of the scene 3110. The process completes in block 3112.

Changing and adding unique groupings of II Device (Setting up your own groups) allows for user configurable set-up, alteration, and assignment of any number of II Device combinations of the addressable lighting
35 network. Within the device application, each II Device has its own unique ID. Through the application a user can combine any number of II Devices and or existing groups together to form a group of II Devices. This can be done through user gestures (dragging and dropping), selecting an individual and assigning to a group, or through the easy-setup program. Once any number of lights is assigned into a group. A user can select commands to all II Devices within the group by simply selecting the group.

Referring now to FIGURE 32, a flow chart of a process for creating a new group or adding to an existing group in accordance with one embodiment of the present invention is shown as element 3200. The process begins with block 3201. A user selects any number or combination of II Devices and/or groups through the device application 3202. The user then selects the option to either create a new group from the selection or add the selection to an existing group 3204. If creating a new group from selection 3206: (i) then the user will need to name the group 3208 (e.g., the device application might have a list of predefined naming conventions that a user has the option of selecting 3210, or they can type their own); (ii) the user would then be prompted through the device application to set a group default light setting for all II Devices within the group 3212 (e.g., a user could select different unique light settings for each II Device within the group that are all saved under the group light setting (see default process for more details); (iii) as the user is selecting the group default light setting, if in proximity to the actual lighting network the wireless device would adjust the related II Devices to execute the light settings as the user is toggling different options while selecting a default group setting 3214; (iv) once a user selects and sets the group default light setting 3212, then the group setting could be saved 3216 to the device application's memory to be run in the future 3218 with the process ending in block 3224. For adding the selection to an existing group 3220: (i) the user would then select what group to add the selection to via the device application 3222; (ii) the user would then be prompted to confirm extension of the default group setting to the newly selected II Devices/groups or create new light settings for the selected II Devices within the group 3212; (iii) as the user is selecting the group default light setting, if in proximity to the actual lighting network the wireless device could adjust the related II Devices to execute the light settings as the user is toggling different options 3214; and (iv) once a user selects and sets the group default light setting 3212, then the group setting could be saved 3216 to the device application's memory to be run in the future 3218 with the process ending in block 3224.

Now referring to FIGURE 33, a flow chart of a process for executing a group command in accordance with one embodiment of the present invention is shown as element 3300. The process begins in block 3302. User selects group(s) 3304 and related light setting command/program 3306 through the device application user interface. The application then identifies the II Devices assigned to the selected group through internal memory 3308. Wireless device running application sends commands through wireless communication for those specified II Devices in the group 3310 following the appropriate communication methods/processes. Each II Device receives and executes the intended light control setting or program 3312. Each II Device responds to the wireless device to confirm execution of the group command 3314 following the appropriate communication methods/processes. Upon receipt of all confirmations the device application would update the group to 'active' or 'on' in the user interface 3316 with the process ending in block 3318. Note that any individual II Device can be assigned to multiple groups. Multiple groups can be combined, adjusted, or used to create new groups. Also note that in some scenarios not all II Devices assigned to a group could be accessed due to signal range limitations or other problems. In these cases, the user would still have the ability to control those II Devices that are accessible at that time. Similarly, a notation could be made in the user interface signifying a group that is not fully accessible.

A process will now be described for setting, using, and changing default light levels for any number of II Devices (including switching on/off through wall switch), so that a user can easily customize, save, and recall their standard lighting preference. Additionally, a process allowing for anyone to turn on the preset default of the II Devices, without using the application will also be described. Each II Device will always have an associated default light level. Each II Device might have multiple related default light levels with the following framework. (i) Manufacturing default – for each II Device the most basic light setting stored in each II Device's internal memory.

The manufacturing default light setting will always be stored in the II Device's memory. (ii) Light default – for each II Device, the active default light setting that will be executed when the II Device is turned on directly as in the process steps of 2800 to 2804 to 2838 (not through a group command) or upon power restoration. Each II Device can only have one light default. This default light setting is stored within each II Device's memory until the II Device is reset or the light default is changed. When unassigned, the light default reverts to the manufacturing default. Group default(s) – The light setting that will be executed by each II Device within the selected group when the selected group is turned on through the device application. The group default is stored within the device application related to each group. Each II Device is able to execute multiple group defaults, dependent on which group the user has selected to turn on and their individual commands within the group default. During the set-up process, or any time after installation, a user can change the light default or group default settings through the device application.

The manufacturing default will most likely be a standard high output white type of light. This light setting will be programmed into each II Device during the manufacturing process and stored into the II Device's memory. This default will first be executed when the II Device is powered on for the first time. As such, the manufacturing default is independent of the device application. After a light default is assigned, the light default setting will take precedence over the manufacturing default; however the manufacturing default setting will still stay stored within the II Device's memory. When a light is reset to the manufacturing state, either through the hard or soft reset function, the light default will be erased and the II Device will revert back to the manufacturing default acting as the light default.

Referring now to FIGURE 34, a flow chart of a process for creating or adjusting a light default in accordance with one embodiment of the present invention is shown and referred to as 3400. The process begins at block 3402. At any time after setting up an II Device with the device application such as the process described in 3900, a user can select or adjust a personalized light default setting. A user can select one or more II Device(s) through the device application 3406, adjust the color and/or brightness 3408 and set that selection as the light default for the respective II Device(s) 3410. Upon assignment of the light default, the device application via the wireless device will send a wireless communication to the related II Device(s) 3412, through an appropriate communication means. The communication will instruct each II Device to store its respective configured setting in its internal memory as the light default setting, instead of the manufacturing default or previously assigned light default 3414. This communication request will then be executed by the controller and related components, including the storage of the new light default in the II Device's memory 3416. The assigned light default light setting will also be stored in the device application memory 3418. This would end the process for setting a new or changing an existing light default setting 3420. The light default setting can be changed or adjusted at any time and would follow a similar, if not the same, process for creating a new light default as described as element 3400. Each II Device can only have one light default at a time.

Now referring to FIGURE 35, a flow chart of a process for creating or adjust a group default in accordance with one embodiment of the present invention is shown and referred to as 3500. The process begins with block 3502. First, the user would select the group to assign or adjust a group default 3504. This could happen either through selection of an existing group in the device application 3506 or when a user creates a group as in the process 3200. A selected group might consist of one group or multiple groups together. The user will then need to specify the particular light setting for that selected group(s) to execute when turned on as a group 3508. Once a group default is selected for the group 3510, the associated light setting for each II Device within the group will be

stored within the device application 3512, to be executed at that time or in the future. If a group default is set for associated II Devices that do not have a light default 3514, the group default light setting will also be assigned and communicated to each related II Device as the light default light setting 3516. This will most likely happen during the initial set-up and grouping process. In this scenario, the device application and related wireless device will execute the wireless command similar to that in setting a light default 3400, and the group default process will be complete as signified by block 3520. Similarly, if unedited at the light default level, future changes to the group default will similarly change the respective light default setting. When an II Device associated with the group already has an assigned light default 3514, but that light default was originally set by creating that same group default that is being configured 3518, then the light default will be adjusted as the group default it was originated from is adjusted 3516 and each II Device will execute the process to adjust its default light setting with the group default light setting as in the process 3400. The group default process will then be complete as signified by block 3520. If the light default setting did not originate from the group default being configured 3518, then the light default will not be updated and the group default process will be complete as signified by block 3520. When the group default is executed it follows a similar process as that for executing a group command or 3300.

Referring now to FIGURE 36, a flow chart of a power restoration process in accordance with one embodiment of the present invention is shown and referred to as process element 3600. The process begins with block 3602. Anytime an II Device goes from not having an electric current 3604 to having an electric current 3606, for any period of time, the II Device will execute the power restoration mode 3608. If a light default is assigned to the II Device 3610, the power restoration mode will trigger the II Device to recall the light default setting from its internal memory and execute the light default setting 3612. If unassigned 3610, the II Device will recall the manufacturing default setting from its internal memory and execute the manufacturing default setting 3614. In addition, the power restoration event and/or association in executing either the light default setting or manufacturing default setting could act as an input event or condition for specific programs 3616, such as the quick set-up or quick grouping processes, or as a status defined event 2101 or part of the II Device's next status update 3618 as described in 2100 or 2200. The process ends with block 3620. This would commonly occur when a light switch is changed from 'off to on, or from on to off to on. A user would not need to utilize the device application to trigger the light default action in this sense. The power restoration mode, or more simply turning the power source to the II Device off, will cease any currently running (the II Device is executing it at that time) program, scene, or setting, but will not erase any program that is active (set to be run in the future) and its associated setting from the II Device's memory. A user could choose not to utilize the power restoration mode can by turning it off through the user's settings on the device application.

Now referring to FIGURE 37, a flow chart of a process for executing a default command through an on/off toggle in accordance with one embodiment of the present invention is shown and referred to as 3700. The process begins with block 3702. A user would select the desired II Device(s) and/or group(s) through the device application 3704 and toggles the basic 'on' command related to executing the selection's respective defaults 3706. When toggled 'on' the device application would retrieve the appropriate saved default including the related II Device(s) and their associated light settings 3708. The wireless device would then send an appropriate wireless communication to the II Device(s)/group(s) to execute their respective light setting 3710. Each related II Device would then receive and execute the command 3712, and then it will respond to the wireless device confirming execution of the command 3714 following the appropriate communication methods/processes. The process would end with block 3716. A user could turn off or adjust any running default command through the process outline

above, 3700. Referring now to FIGURES 38A-F, diagrams of various screens on device application in accordance with one embodiment of the present invention are shown. The device application will generally be run on a wireless device such as a smartphone, table, or computer. In these cases, the device application will most likely have the below screens and sections to support user control of the wireless lighting control system. A user could toggle
5 between screens through various human computer interaction methods, dependent on the wireless device, but most commonly will be gestures and/or touch selections.

As shown in FIGURE 38A, a device 3800 displaying a favorites screen 3802 will display a list of user generated favorite commands relating to II Devices, groups, programs, and scenes. Each item displayed on the screen, as exemplified by 3804 as one item, would be a specific selection of II Devices and an associated action that
10 could be activated through toggling of the on/off button, represented by 3806. When selected, the wireless device and related II Devices will execute the related communication method for that command. A user can also add or delete favorite settings through this screen or various other screens, for example a user could select 3808 in the figure to perform this command.

As shown in FIGURE 38B, a device 3800 displaying a screen 3818 will display a list of all groups created
15 within the device application's profile. Each or multiple groups, as exemplified by one group as 3820, could be selected to turn on to the group default setting, or off, exemplified by the selection of 3822. Each or multiple groups could also be selected and then given some specific command or other option as outlined in the groups section. When selected, the wireless device and related II Devices in the group (s) will execute the related communication method for that command. A user can also select a group to view the individual II Device screen
20 filtered to just that group. A user can add, edit, and or delete group(s) and default group settings through this screen or various other screens, for example a user could select 3824 in the figure to perform this command.

As shown in FIGURE 38C, a device 3800 displaying a programs screen 3832 will display a list of all programs created or suggested (manufacturing default programs) within the device application's profile with an on/off status for each program. Each program, as exemplified as one program by 3834, could be selected to turn on
25 or off, a command potentially executed by toggling 3836. Additionally, each program could be selected, edited, or deleted. When a program command is selected, the wireless device and related II Devices to the program will execute the related communication method for that program. A user can add or delete program(s) through this screen or various other screens, for example a user could select 3838 in the figure to perform this command.

As shown in FIGURE 38D, a device 3800 displaying a scene screen 3848 will display a list of all scenes
30 created or suggested (manufacturing default scenes) within the device application's profile with an on/off status for each program. Each scene, as exemplified as one item by 3850, could be selected to turn on or off, a command potentially executed by toggling 3852. Additionally, each scene could be selected, edited, or deleted. When a scene command is selected, the wireless device and related II Devices to the scene will execute the related communication method for that scene. A user can add or delete scene(s) through this screen or various other screens, for example a
35 user could select 3854 in the figure to perform this command.

As shown in FIGURE 38E, a configure screen 3860 is used to adjust the color 3862, brightness 3868, saturation 3874, and other configuration for selections of II Device(s), group(s), program(s), and/or scene(s). The configure screen 3860 might be different depending on the selection and specific type of configuration. In general, the configuration screen 3860 will consist of the three level lighting control interface 3850 and a list of the selection

(II Device(s)/group(s)) 3852. There would most likely be related configuration screens for the selection of program conditions, scene creation/editing, and other more complex configurations.

More specifically, certain II Devices with color and white could be controlled through three levels: color 3862, saturation 3868, and brightness 3874. This functionality is derived by the capabilities of the schemes in the LED controlling circuit and related LEDs and supported device application. Color levels would be derived by combining different variations and combinations in the average luminosity passed through the II Device's LEDs. A color level selection 3862 refers to an input on a user interface that would go to create any number of colors derived from the mixing of the LEDs found in the II Device. The color level could be controlled incrementally or at fixed points, for example a user could select a color level from a color slider 3864. Alternatively, a user could select specific colors from the color level such as blue, green, red, etc. as represented by 3866.

Brightness levels would be derived by either increasing or decreasing the average current passed through the LEDs of the II Device, but in the same proportion as that required for the selected color. The difference in brightness levels would only be apparent in variations in the luminosity of the light emitted from the II Device. The color will stay constant when adjusting the brightness. Similarly, a brightness level selection 3868 could be controlled incrementally or at fixed points, for example a user could select a brightness level from a slider 3870. Alternatively, a user could select specific brightness levels such as 25%, 50%, dim, bright, etc. as represented by 3872.

Saturation levels would be derived by adding or subtracting some proportional amount of average current passed through the white LEDs with respect to the average current combinations of the set color. The overall effect of increasing the saturation level would be reducing the relative amount of white light produced by the II Device in relation to the colored LEDs. The overall effect of decreasing the saturation level would be increasing the relative amount of white light produced by the II Device in relation to the colored LEDs. Similarly, the saturation level selection 3874 could be controlled incrementally or at fixed points, for example a user could select a saturation level from a slider 3876. Alternatively, a user could select specific saturation levels such as 25%, 50%, lighter, darker, etc. as represented by 3878. Note that the change in saturation selected through the device application would not necessarily have a linear relationship to the amount of white light added or reduced, but it could be exponential or through some other calculation. The overall effect and process would manage the saturation levels so that the perceived difference is gradual to the user, while managing for the constraint in the amount of current available to the LEDs.

As shown in FIGURE 38F, a device 3800 displaying a II Device screen will display a list of all II Devices either selected or identified within the device application's profile, the screen represented by 3882. Each II Device, as exemplified as one II Device by 3884, could be selected to turn on or off to the light default, a command potentially executed by toggling 3886, or configured in some other fashion. Additionally, each II Device or combination of II Devices could be selected, edited, or given some other command or selection as outline in the basic control section. When an II Device command is selected, the wireless device and related II Device(s) will execute the related communication method, for example a user could select 3888 in the figure to perform these types of commands.

Now referring to FIGURE 39, a flow chart of a quick set-up process for connected lights in accordance with one embodiment of the present invention is shown and referred to as 3900. A process that allows an II Device or multiple II Devices to quickly and securely establish a connection with a wireless device and the associated

device application and with other connected II Devices around it. The process begins in block 3902. Each II Device when initially purchased or reset will be in a manufacturing state 3904. When in a manufacturing state, upon receiving initial power (current), the II Device(s) will enter power restoration mode 3906 as described in FIG. 36. The II Device(s) will then be prone to discovery by a wireless device with the associated device application 3908. The II Device(s) would also execute the manufacturing default light setting 3910. Upon launch of the quick set-up process on the device application 3912, the wireless device and II Device (s) in the manufacturing state will then identify and connect to each other if within range or through an extended mesh network in the manufacturing state to create a secure paired connection 3914. The device application on the wireless device will then store each detected II Device's unique ID 3916, so that it can communicate with it in the future. Each II Device would similarly recognize and store a unique ID associated to the user's device/profile 3918, so that only that smartphone/profile ID can send directions to the II Device in the future 3920. Similarly, the II Devices could send commands and communicate with each other.

In some embodiments –the set-up process could use different color light settings as cues in the set-up process. For example, the II Device would display a certain color upon initial power up, signaling to the user that the II Device is not connected to the network. Then upon establishing connection to a profile, the II Device would change colors to signal the connection has been established 3922. Next, a user might confirm that all II Devices are connected and select an option in the device application to move forward with the set-up 3924. If not all connected, then execute troubleshooting steps with user. Identify problem II Device. Execute quick troubleshooting steps 3926 – step closer, screw in/secure connection to power source. User can possibly provide confirmation through the device application that all II Devices are a specific color. All II Devices become connected, and user selects option that II Devices are not all connected, then prompt to select color of light. Should be color of unpaired light or no light, if unpaired light, ask user to step closer to the II Device and select OK. Then should connect and user can continue set-up. If no light, ask user to make sure that the II Device is firmly screwed in and the light switch is on. Then proceed through set-up menu. Once user confirms set-up of installed II Devices 3924, they can continue with any further set-up or customization processes 3928, such as adding names, defaults, and favorites. A user can repeat this process to continue setting up other II Devices 3930 until all intended II Devices are set-up and the quick set-up process is complete 3932.

Referring now to FIGURE 40, a flow chart of a quick group process through power restoration in accordance with one embodiment of the present invention is shown and referred to as process element 4000. A quick group process through power restoration provides a quick way for a user to combine II Devices into a named group through use of the power restoration mode. It could be a guided process within the set-up process of the II Devices network through the device application as described in FIG. 39. It also could be run after the initial set-up of the II Device network. The process begins with block 4002. Upon launch of the quick group process through the device application 4004, though device application instruction, or in the natural course of set-up, the user will turn off the power source to the related II Devices that they would like to group, then turn the power source back on 4006. When done, this will prompt the related II Devices to enter the power restoration mode 4008. This action will most likely be through the use of a wall switch. The II Devices will execute the appropriate default setting as discussed in FIG. 36. The device application and related wireless device will then search for all II Devices that have entered the power restoration mode through various communication methods previously discussed, record their unique IDs 4010, and display the associated II Devices through the user interface on the device application or some other type of user feedback means 4012. The user will then be prompted to confirm that the correct II Devices were

captured 4014. Could use color cues to help with the confirmation as discussed in FIG. 49. If user does not confirm, then go to troubleshooting steps 4016. If yes, then continue with the process to create a new group 4016 as outlined in FIG. 32. After setting up a quick group the user might then be asked if they would like to set-up another quick group through the device application 4018. If yes, then repeat the quick group process 4002. If no, then end quick group process 4020.

Upon initial set-up of a lighting network, a user will create a profile. Profile refers to a combination of unique username and password that would be related to one or many user's accounts. The profile would have multiple purposes – 1) to provide an authentication method for communication within the wireless lighting system (network of II Devices and wireless devices), 2) to associate and save user preferences and configured settings of the wireless lighting system to the device application and possibly saved elsewhere, and 3) provide a user associated account for billing, support, or other services. Through the initial set-up process, as described in FIG. 39, each II Device within a lighting control system will store the Profile's username and password or some encrypted version of the profile's username/password in its memory. Similarly, the wireless device and device application will store all II Device ID's within the lighting control system (lighting network) to the device application memory.

Now referring to FIGURE 41, a flow chart of a profile authentication process in accordance with one embodiment of the present invention is shown and referred to as 4100. See also FIGURES 22-26 for other related process information. The profile authentication process begins in block 4102. Upon any communication from a wireless device or other II Device to one or many II Devices, the wireless communication will include some version, possibly encrypted, of the associated profile 4104. Upon receipt of a wireless communication 4106, each II Device will verify or authenticate the command by referring to the stored profile(s) in the communication. If the profile from the wireless communication, recovered from the II Devices memory 4114, matches that of the stored profile(s) 4108, then the II Device will execute the appropriate response specified by the wireless communication 4110. If not, then the II Device will disregard the communication 4112. The process ends then at block 4114. Referring now to FIGURE 42, a flow chart of a process for saving settings under a profile in accordance with one embodiment of the present invention is shown and referred to as element 4200. The process begins in block 4202. After a user has created a profile 4204, when a user creates any number of settings or information as represented as 4206 (programs, defaults, groups, scenes, favorites or other information), the settings and related information can be saved to the device application memory under the heading of the user's profile 4208. This would allow for replication and/or back-up of user preferences to avoid loss of data and user convenience 4210. In addition, this would allow for sharing, duplication, and restoration of user settings through authentication means by referring to the user profile 4212.

In some cases, a user could save their profile and associated settings to a computer 4214, either through the back-up of the application to application management software or through some light control system specific back-up software. In addition, the profile information and settings could be saved or backed up through a direct connection or through some wireless connection. In addition, the profile information could be saved to a remote data center, or in 'the cloud' 4216.

After a profile is saved or 'backed-up', a user could restore settings and profile information to an existing or new wireless device/device application 4218. A user could share the profile information and authentication as described in FIG. 43 and included here as block 4220. A similar process would be used for adding a new wireless device with device application running the same profile or duplication 4222. Note that there may be multiple

profiles assigned to one lighting control system or II Device network. Similarly, the same device application could host multiple user profiles. The same profile could be shared across multiple wireless devices. The timing and exact process of a profile saving event 4224 might differ depending on the device application. It might happen and reoccur automatically at given time periods or events, or require some input from the user to either specify events/times, or require a user to select a save option. Though the actual process might be ongoing, for the purposes of this description, the process ends in block 4226.

All II Devices(s) will have unique id(s). Ids will depend upon the types of II Device embodiments: (a) there could be different types of II Devices depending upon the application where they will be used (e.g., II Devices made for higher light (luminosity) output and limited color range could be called as type 1 II Device, while II Device with only white light output with controllable brightness could be called as type 2 II Device. Similarly, there would be different types of II Devices based upon different shapes and/or sizes and/or features and/or light outputs in terms of colors and brightness.); (b) there could be numerous potential ID structuring of the II Devices, but consider the below as a representative example:

II Device id will have following structure with "aaabbbccc". "aaa" could be any number of characters defining the device as II Device. These characters will be common and at the same place in the ids of all II Device. "bbb" could be any number of characters defining the type of II Device. These characters will be common for a particular type of II Device, but will be different for different types of II Devices. These characters will at the same place in the id of all II Devices. "ccc" could be any number of characters and with that II Devices will get a unique id. For example, consider id "illdev001001012712", "illdev012234010512" for two different II Devices – here, first ten characters "II Device" in both the ids will identify the device as II Device. Next four characters "t001" in first id and "t012" in second id identifies the devices as different types of II Devices. Last 9 characters "001012712" in first id and "234010512" in second id combined with other characters defines a unique id for the two II Devices.

The wireless lighting control system, including both wireless devices and II Devices will be able to differentiate its related commands from other wireless communication system commands through the unique IDs prefix, such as "aaa". Additionally, a wireless communication within the wireless lighting control system would also be associated with a profile id for authentication purposes. When a wireless device then sends a command to an II Device it will send the command directed at the specific ID required to execute that command. Similarly, there could be a command related to a specific ID that is embedded in a command sent to another II Device ID, in this case the second command would communicate to send the command to the second II Device. See mesh network processes for further information.

Profile Sharing. A user's profile including their configured settings can be transferred in a multitude of ways from an authenticated device application / wireless device to other non-authenticated device applications / wireless devices to provide authentication, share profile settings and information, or other profile related information. Utilizing the device application, there is an option to pass on authorization to the lighting control system (II Device network) from one wireless device to another wireless device. Additionally, a user can share or copy their profile (saved settings) with another wireless device. The receiving wireless device would need to have some version of the device application on their device. There are a few different processes one could take to execute profile sharing, but consider the below as an example:

Now referring to FIGURE 43, a block diagram of a device to device profile sharing process in accordance with one embodiment of the present invention is shown and referred to as 4300. To execute this process, one would

open the authenticated device application on one wireless device as represented by 4302. Then open the device application on the receiving or new wireless device as represented by 4304. A user would then select command on the authenticated wireless device application to share profile. Might in some cases need to select command on the non-authenticated wireless device to receive shared profile. The authenticated wireless device might then be prompted to select what aspect of the settings to share, such as provide access to network, share groupings, share programming, copy full profile settings, or mirror full profile settings. Upon selection of aspects to share, the wireless devices would then connect via a wireless communication 4306 (Bluetooth most likely) and begin transferring the selected information, as represented by 4308, from the authenticated wireless device to the receiving wireless device. Upon receiving the selected information the user should have access to whatever aspects were selected.

Referring now to FIGURE 44, a flow chart of a process for adding an authenticated profile directly through the II Device in accordance with one embodiment of the present invention is shown and referred to as 4400. In this process, the authenticated profile 4402 would send a wireless communication to the wireless control system (II Device network), represented by 4404, with the command to add the non-authenticated profile 4410 to each II Device's list of authenticated profiles. Each II Device, represented here collectively as 4406, would then execute the command and add the authenticated profile to each II Device's list of authenticated profiles as represented collectively by 4408. Once complete, the non-authenticated profile would then be authenticated and able to communicate and control the lighting control system (II Device network), as represented by 4412. Also, consider that a user could share/transfer a profile to one other device through text. An alternate way to share profile and settings would be to select an option through the application to send a text message to another phone. This method would be useful when both devices are not present. And the second device is a mobile device. The text message would include a unique URL to download the application and auto-populate the profile username and possibly the password. In addition, consider that multiple devices could simply refer or log-in to an existing authenticated profile that has been saved to some accessible source. This would allow any wireless device with an associated device application to access, receive, or create and authenticate a new profile by logging in with the authenticated profile's credentials (username password).

Now referring to FIGURE 45, a flow chart of a hard reset process in accordance with one embodiment of the present invention is shown. The process begins with block 4502. A hard reset with physical button, and restore to system will now be described. Included in the design of the II Device might be an external button that when pushed resets the II Device back to its original manufacturing state. This will be helpful when moving II Devices from different locations or power sources, for troubleshooting purposes, and for security purposes, especially when a user no longer has access to the application device. The physical description and system composing the hard reset can be found in the 'II Device' section HHHH. The process by which the hard reset occurs will be referred to as 4500 and is described as follows, beginning with block 4502: (a) a user will physically activate the reset button on the outside of an II Device 4504; (b) a signal will then be sent to the internal processor of the II Device with commands to execute the hard reset program that will erase all user added memory and return to the manufactured state 4506; (c) the processor and related components of the II Device will execute the required commands of the hard reset program 4508; (d) all user added memory will be erased from the II Device, not including factory added memory 4510; (e) the II Device will return back to the manufacturing state 4512. The process for set-up would continue with FIG. 48. The hard reset process ends with block 4514.

Referring now to FIGURE 46, a flow chart of a soft reset through application in accordance with one embodiment of the present invention is shown and referred to as 4600. Included in the device application is an option that when selected will reset an II Device or multiple II Devices back to their original manufacturing state. This will be helpful when moving II Devices from different locations or power sources, for troubleshooting purposes, and for security purposes. The soft reset process begins with block 4602. Within the application device, a user would select a setting that activates the soft resets command and program 4604. This setting may or may not require authentication through entering of the users profile and password 4606. The user would then select specific the II Device(s) and/or groups, including the entire lighting network, with which to execute the soft reset function 4608. A user might use the 'color coding' process to select individual II Devices.

Upon selection, a wireless communication will be sent from the wireless device/device application to each illuminated device selected, through the appropriate communication methods 4610. When each II Device receives the communication, the processor and related components will execute the soft reset program and commands 4612, and all user added memory will be erased from the II Device 4614. Each II Device will return to the manufacturing state 4616. The process for set-up would continue with FIG. 48. The soft reset process ends with block 4618.

Now referring to FIGURE 47, a flow chart of a process for adding a new II Device into an existing II Device network in accordance with one embodiment of the present invention is shown and referred to as 4700. This is the process by which a user can easily introduce into the II Device network.

Introducing a new II Device to an existing II Device network follows a similar process as first setting up an II Device for the first time. Process is similar to quick set-up and easy room set-up processes. There are many potential processes to adding an II Device(s) to an existing network, here is one example. The process begins with block 4702. The intended II Device(s) will be in a manufacturing default, either coming from initial purchase or through a reset process 4704. A user will connect the II Device(s) to a power source (most likely by screwing in and turning on a light switch, and the II Device(s) will receive power and enter the power restoration mode 4706. Upon receiving power the II Device(s) will enter II Device(s) will be prone to discovery by the device application run on a wireless device and other II Devices within proximity 4708. In addition, the II Device(s) will execute the manufacturing default light setting 4709. Then upon a user input on the device application 4710 or through a status update process where the new II Devices are found 4712, the device application will execute the process for adding an II Device to the application 4714. To elaborate, the status update process, as discussed in FIG. 21 and 22, might call for the device application to look for all II Devices in proximity. This search will include identifying those II Devices that are not yet assigned to a profile, or in a manufacturing state. Next, the device application and associated wireless device establish a connection with the II Device(s) 4716. The device application might then provide an option for the user to confirm whether they are adding other II Devices to the II Device network 4718. If a user selects no, it will ignore the II Device's request to pair and end the process of adding a new II Device to an existing network 4720. This might happen by rare chance when people in neighboring buildings install II Devices at the same time within range from each other. If a user selects yes to confirm the addition of new II Device(s), the II Device(s) and device application will follow the process outline in FIG. 39, blocks 3916 – 3926, collectively represented here by block 4722. This includes storing the light ID in the device application memory and storing the profile ID in the device application memory. Then, in place of block 3938 to move forward with the set-up process, a user might then be prompted with other choices on how to set-up and customize the II Devices within the network 4724, including adding the selection to an existing group 4726, creating a new group with new or mirrored settings

for the selection 4728, or creating custom settings for each II Device in the selection 4730. Depending on the user's request, the appropriate set-up would continue as described in other various set-up processes, until complete 4720.

FIGURE 47 is also representative of a flow chart of a process for reintegration of II Device(s) back into an existing II Device network in accordance with one embodiment of the present invention. Considering that the adding of the II Device(s) has proceeded through until block 4716, where the device application/wireless device and II Device(s) have established a connection. If the device application finds that the II Device ID (or multiple IDs) matches that of an II Device ID stored in the device application 4734, then it should trigger the II Device reintegration sub-process. If there is no match, then the process of adding II Device(s) would continue as normal along block 4718 as described previously. After finding a match to a previous II Device, the device application might confirm that the user would like to reintegrate the detected II Device(s) 4736. If a user selects no, then the process of adding II Device(s) would continue as normal along block 4718. If the user selects yes, then the device application would then reassign or reconnect all stored information, profiles, defaults, and other settings to the associated II Device(s) ID as stored in the device application memory collectively represented as block 4738. This would require the device application/wireless device to then send a command to the II Device(s) to execute/store the following: (a) all related profile IDs (if stored or connected to the active profile ID); (b) all profile settings including light default(s), active programs, and time settings. The newly connected II Device upon receipt will execute/store the commands and respond to confirm receipt. The device application will similarly update its memory with the re-inclusion of the II Device(s), and they will then be re-integrated into the II Device network with all previously stored settings in the device application, and the process will end in block 4720.

Now referring to FIGURE 49, a block diagram of a color coding identification process in accordance with one embodiment of the present invention is shown and referred to as 4900. It might be difficult for a user to select a specific II Device(s) for troubleshooting or configuration, especially as the number of II Devices within a network increases. To improve the process of selecting specific II Device(s), described here is a method to temporarily change the color of II Devices in the II Device network and similarly provide a display of different II Devices on the device application that mimic the same colors of their representative II Devices. This process might be executed in relation to a number of different activities or processes. We'll assume for simplicity sake that any potential processes could trigger the process to color the II Devices and refer to such an event as 'color coding process trigger'.

Upon a color coding process trigger, the device application would assign a different color to each of any number of selected II Devices and/or groups. The device application/wireless device would then send a wireless communication to each of the selected II Devices to execute a light control setting relating to the assigned color for that II Device. The device application as represented by 4902, would then display all of the selected II Devices with a representation of the light that's emitted by that particular II Device each represented as 4904 - 4920. A user would then be able to visually see which II Device relates to the II Device representations in the device application and easily select the intended II Device(s). For example, the II Device represented by 4904 would be colored red in some fashion, and the actual corresponding II Device would emit the same red color.

Referring now to FIGURES 50-52, various diagrams of sorting screens based on various criteria in accordance with one embodiment of the present invention are shown. For certain screens within the device application, it would be beneficial to sort the list of II Devices and/or groups in some fashion that would be relevant

to the user. Disclosed here are some basic sorting methods with which to sort certain lists found within screens of the device application.

As shown in FIGURE 50 and represented by 5000, it would often be the case that a user would want to command or control II Devices in closer physical proximity than those in further proximity to the user. To support this scenario, certain lists 5006 in the device application 5002 could be sorted by signal strength with stronger signals displayed first in the device application, represented as example by 5004. This could relate to lists of: (a) II Devices – sorted based on individual signal strength; (b) Groups – sorted based on average signal strength of related II Devices; (c) Programs/scenes – sorted based on average signal strength of related II Devices. The figure represents a list of groups sorted by signal strength, with each group and its associated signal strength represented by 5008 - 5016.

As shown in FIGURE 51 and represented by 5100, it would often be the case that a user would want to command or control II Devices that are currently executing some command. To support this scenario, certain lists 5106 in the device application 5102 could be sorted by their active status with items that are on displayed first, represented as example by 5104. This could relate to lists of: (a) II Devices – II Devices that are on displayed first; (b) Groups – Groups that are on displayed first; (c) Programs/scenes – Programs/scenes that are active displayed first. The figure represents a list of groups sorted by active status, with each group and its associated signal strength represented by 5108 – 5116.

As shown in FIGURE 52 and represented by 5200, considering that at times all II Devices might not be available because their power source is turned off (light switch) or they are out of range, it might be beneficial to sort/filter certain lists of items 5206 in the device application 5202 based on received statuses so that only those II Devices for which statuses are received by the wireless device are displayed or displayed first, represented as example by 5204. This would relate mostly to II Devices and groups, but possibly to programs and scenes where the un-addressable II Devices number is large. The figure represents a list of groups sorted by addressable status, with each group and its associated signal strength represented by 5208 – 5216.

It would often be the case that a user would want to sort or filter items in the device application based on some personal preferences or settings. This might be flexible and configurable, or permanent, depending on the application. Note that different sorting methods could be combined in different ways, so as to first sort by one method and then another. This would vary depending on the specific screen in the device application.

Now referring to FIGURE 53, a flow chart of an automation programming process in accordance with one embodiment of the present invention is shown and referred to as 5300. Automation refers to the program to be activated at user specified conditions pertaining to day(s) of the week, times, and/or dates. The process begins with block 5302. A user will select an option in the device application to create a program, specifically here an automation program 5304. The user will select any combination and number of II Device(s) or group(s) 5306. The user will then select the intended light setting or program to be executed based on the automation condition 5308. This might originate from new user customization 5310, existing saved user favorites and defaults 5312, or as a suggested setting or program 5314. The intended light setting might be a single action or more of a program in itself as multiple actions run successively. For example, a simple automation program would turn the II Device(s) on to a specific setting and color at a defined time. Alternately, another automation program would be to turn II Device(s) on and off successively. The user will then select a specific day(s) of the week, date, and/or time to execute the setting and /or program 5316. The request could be a single event or repeating event selected by the

user. For example, start on date/time, stop on date/time. Or, run every third Monday of the month, etc. A user would have the option to save the automation program 5318 and/or execute the automation program at that time 5320. If the user saves the automation program, it can be re-run at another time by following the process described in FIG. 29. If the user chooses to execute the newly created automation program, the device application/wireless
 5 device in coordination with the respective II Devices will execute the command as described in FIG. 29 as if the program was activated as beginning with block 2908. After both cases the creation process would conclude as represented by 5322.

Similar to all programs, the user can toggle automation programs on/off via the device application. When the program is off, the II Device(s) will not store the command in memory. When the automation program is
 10 toggled on in the future, the command will be resent to the appropriate II Devices. In the case that conflicting programs are active with the user requested II Device(s) and time, the device application might notify the user and ask for the user to select which program they would like to keep active. Alternately, the II Device(s) will internally have a priority level assigned to different profiles and/or types of requests.

An alarm_timer relates to a program process by which at a certain user designated time or lapse of time, an
 15 action would occur in any number of II Devices or group of II Devices. The alarm_timer processes are similar to those described for general programs and automation programs. Through the device application a user would select the program to run the alarm or timer and select the II Devices and/or groups to execute the program. An alarm selection signifies that at a certain selected time, the selected II Devices and/or groups would execute an alarm command to adjust lighting to the user's requested command. The requested command might be of a dynamic
 20 nature or a program in itself so as an execution of multiple commands in sequence such as a flashing or changing of color or brightness. When an alarm program is selected, the device application would interpret the time requested by the user and send a command to the lights and/or groups selected to execute the command or series of commands at that specified time. Each II Device would receive the commands through the wireless communication, interpret the commands by the processor, and then store the request in memory to be executed at a later time. Inside each II
 25 Device, the processor would monitor the internal real time clock and look for a match in the clock's time to the alarm program request stored in memory. If it matches, then the processor would execute the alarm command(s).

A timer selection signifies that after a certain amount of time passes, an II Device or combination of II
 Devices would act in some predefined manor. The user would first select the II Device(s) and/or group(s), or multiple to run the program. Then the user selects the amount of time in minutes, hrs. etc. via their application.
 30 Once selected then the device running the application will send a wireless signal to the designated II Device(s) with the specific amount of time to count down from. At the point when all the II Device(s) confirm receipt of the timer request to the device's application, the timer will begin in unison with all II Device(s) applicable. Each II Device will then countdown using internal real time clock, processor, and other embedded components. If multiple II Devices, they will count down individually, but all in unison. When the timer reaches zero, the II Device(s) will
 35 execute the command requested by the user. A user can request to repeat any timer programs to count down and then repeat. The application interface might also present a timer display showing the amount of time counting down. Upon reaching zero, the application might also present some other actions within the application. This time down feature might also be valued for gaming scenarios using the II Devices as signals.

Referring now to FIGURE 54, a flow chart of a music sync process in accordance with one embodiment of
 40 the present invention is shown and referred to as 5400. This is a type of program specifically for automatically

synchronizing the II Device(s) to music played on the same enabled device. The process begins with block 5402. Through the device application or through a specialty device application, the user will access the music sync program 5404. The user would then select the II Device(s) with which to sync the music 5406. The user will then select the type of II Device arrangement and the light setting theme 5408. Options for selection could depend on a number of different factors, such as the number of II Devices selected 5410, the proximity of the selected II Devices 5412, suggested options 5414, user history or saved preferences 5416, or completely new customized configurations 5418. For example considering the arrangement, if the number of II Devices is 1, then the device application will only sync to a mono type interpretation of the audio. If number of II Devices is 2 or more, then the device application will evenly distribute and assign each II Device to either of the 2 primary (L, R) stereo channels within the music file. The device application will visibly show each II Device and to which channel (L, R) the II Device are assigned to.

Further considering arrangement, if a music file is able to carry multiple channels or if the music file can be broken into multiple channels based on frequency, pitch, or other aspects of sound, an II Device could similarly be assigned or distributed across multiple II Devices. Similarly, considering selection of the light theme, the device application might display potential lighting themes options for the user to select or the user can customize their own preferences. Here, there might be default settings that have a color and/or brightness theme associated with each channel. The settings will be variations of color or themes of color assigned to each channel. For example, one might include all colors available randomly assigned to each II Device. Another option might allow for the channel colors to change over time. Another option might suggest only red hued colors, or any other type of color hue. Once an arrangement and lighting theme is selected, the user will be able to see and verify the selection 5420. At any time, the user will be able to reconfigure the arrangement or light themes, 5422, such as to move or reassign lights to different channels, select between mono or stereo lighting modes, or choose a different theme. Once the configuration is selected, the application device will notify the selected II Devices of the command and ensure all II Devices are ready and addressable 5424. This will be done via the appropriate communication and control processes. The user would then select music file(s) stored on the device (or streaming music) to be played 5426. As the music is played through the device application, the device application will interpret the music file wavelengths to send continuing commands to each II Device previously selected to turn on and off, adjust brightness, and change colors depending on the music construct within that channel at that time and the selected arrangement and theme.

Possibilities for interpreting the music construct is as follows: For each music channel in the music file (L,R), when there some output of sound to be played or amplitude in the music, that would correlate with the light(s) assigned to that channel to turn on (to emit light). For example, if a bass drum is played in the left channel, the audible sound would coordinate to the visible light from that assigned left channel's II Device(s). For each channel (as previously assigned), the brightness of the light emitted by each II Device could brighten or dim dependent on the respective increase or decrease in amplitude of the music within that channels music file. Such as that louder sounds would coordinate with brighter lights and vice-versa. Respective amplitude would be the dependent variable, not true amplitude. Additionally, different pitch ranges might correlate with different color combinations of light output. Additionally, the bpm (beats per minute) might be interpreted so that after a standard measure of bars (time of playing) the color or channel assignment of the II Devices might change.

A user could also adjust the overall brightness maximum output to their preference through the device application, similarly referred to in the figure as 5422. This information would be taken into context before relaying

commands through to the II Devices. The application device would automatically or through user input manage and match the output of audio to the output of lighting commands and delay the audio output to any delay in communication to the II Devices so as the actual sound heard through a speaker would match the same time that the light illuminated from the II Device(s) 5428. The application would continue to run on the device while continuing to interpret/translate the music and channels played into commands to be executed by the assigned II Device(s). When the music sync program application is stopped or exited 5430, the assigned II Devices would revert back to their previous programmed state if applicable or default level 5432. The music sync program/application would complete 5434.

A predefined program so a user can set their II Devices to slowly turn on with certain color displays at specific times to simulate the effect of a sunrise. In many parts of the world, people have to get up before the sun, this process allows for a user to select their II Devices to turn on slowly, mimicking a sunrise, before their alarm or at a certain time to help wake them up. Setting up the program through the device application, a user could select the special program through the predefined program list or through the groups menu. The sunrise program would be a suggested program for those groups containing the word 'bedroom'. The user would be able to adjust the length and type of sunrise if they choose. Type relates to variations in color schemes. The user will be asked to enter a time for the sunrise program to execute, or to create an alarm with the sunrise. If the alarm program is also set, the two could be run simultaneously or within one program. Once set and accepted, the application device will communicate the automation program request to the selected light(s). The light(s) will receive the automation program request and store the program in memory to be executed upon the requested time. The program settings could be saved for future use or set to run at any frequency similar to any automation program.

Executing the program. When the sunrise program is active, the program will be executed similar to any other automation or alarm program. The suggested colors used in the sunrise program will most likely include orange and red colors that would brighten over time until fully lit when the alarm or timer condition is met. Blue LEDs might also be included to provide the short wavelength light mimicking that of the sun.

In some embodiments, a light will be connected or equipped with an ambient light sensor that can detect the light levels present within an area, relay that information to the II Device's controller, which could be interpreted as a program input resulting in a change in the lighting brightness and/or color. Various programs are possible to utilize the II Device sensor's information as an input to causing some output in terms of a change in the brightness and/or color of one or more II Devices. In one program example, a user will select a preferred light level for II Device(s) or group(s) through the device application. Each II Device can have a different setting, giving the user to select any number of unique combinations. Selecting the preferred level might also be done through the user defined defaults for each II Device. When selected, the device application will then send a request through the controlling device to each II Device that the user has selected through the program, asking for each II Device's related ambient light sensor information. The device application upon receiving the light sensor information will store the default settings in the application or device's memory relative to each II Device. Alternatively, the II Device itself will record the sensor information in its own memory. The user can then at any other time activate an automatic adjustment program. Upon activation, the device application will send a communication to each II Device associated with the program. The communication will instruct each II Device to compare the current II Device sensor information against that associated with the preferred lighting level. This information would either be stored in the II Device's memory or relayed via the device application's communication.

The II Device would then adjust its brightness and/or color depending on the light sensor data's relationship between the current and preferred lighting level. Simplified, if the current light sensor showed less luminosity than the preferred level, then the II Device would increase its own brightness. Alternately, if the current light sensor showed more luminosity than the preferred level, then the II Device would decrease its own brightness.

5 The relationship between the difference in current and preferred light received will not be an equal or absolute relationship to the change in the brightness of the light. Alternatively, it will be some functional relationship dependent on the absolute and respective levels of light. The program and/or II Devices themselves would repeat this process for the duration that the program is active.

10 It will be understood by those of skill in the art that information and signals may be represented using any of a variety of different technologies and techniques (e.g., data, instructions, commands, information, signals, bits, symbols, and chips may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof). Likewise, the various illustrative logical blocks, modules, circuits, and algorithm steps described herein may be implemented as electronic hardware, computer software, or combinations of both, depending on the application and functionality. Moreover, the various logical blocks,
15 modules, and circuits described herein may be implemented or performed with a general purpose processor (e.g., microprocessor, conventional processor, controller, microcontroller, state machine or combination of computing devices), a digital signal processor ("DSP"), an application specific integrated circuit ("ASIC"), a field programmable gate array ("FPGA") or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. Similarly,
20 steps of a method or process described herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. Although preferred embodiments of the present invention have been described in detail, it will be understood by those skilled in the art that various modifications can be made
25 therein without departing from the spirit and scope of the invention as set forth in the appended claims.

CLAIMS

What is claimed is:

1. A lighting device comprising:
 - a DC/DC power converter;
 - 5 a controller/processor electrically connected to the DC/DC power converter;
 - a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter;
 - two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit; and
 - 10 wherein the LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or OFF during the cycle time.
2. The lighting device as recited in claim 1, wherein the specified color is produced by turning ON the first color LED for a first portion of the cycle time and turning ON the second color LED for a second portion of the cycle time.
3. The lighting device as recited in claim 1, wherein the two or more LEDs are not turned ON at the same time.
4. The lighting device as recited in claim 1, wherein each on/off signal provides a maximum current supplied by the DC/DC power converter to the LED.
5. The lighting device as recited in claim 1, wherein the on/off signal for the first LED comprises two or more pulses during a portion of the cycle time that the first LED is turned ON.
6. The lighting device as recited in claim 1, wherein the on/off signals to the two or more LEDs further produce the blended light having a specified saturation.
7. The lighting device as recited in claim 1, wherein the on/off signals to the two or more LEDs further produce the blended light having specified brightness or intensity.
8. The lighting device as recited in claim 7, wherein the specified brightness or intensity is determined by a duty cycle of the on/off signals.
9. The lighting device as recited in claim 1, wherein the cycle time is less than 12ms.
10. The lighting device as recited in claim 1, wherein at least one of the LEDs comprises a series of LEDs, a group of LEDs, an array of LEDs, two or more series-connected LEDs, two or more parallel-connected LEDs or a combination thereof.
11. The lighting device as recited in claim 1, wherein the first color LED and the second color LED are selected from the group consisting essentially of a red LED, a green LED, a blue LED, a red LED, a white LED and a tri-color LED.
12. The lighting device as recited in claim 1, further comprising a real time clock circuit communicably coupled to the controller/processor.
13. The lighting device as recited in claim 12, wherein the real time clock circuit is integrated into the controller/processor.

14. The lighting device as recited in claim 12, further comprising a battery electrically connected to the real time clock circuit.
15. The lighting device as recited in claim 1, further comprising a memory communicably coupled to the controller/processor.
- 5 16. The lighting device as recited in claim 15, wherein the memory is integrated into the controller/processor.
17. The lighting device as recited in claim 1, further comprising:
a power supply connector/fastener; and
an AC/DC power converter electrically connected to the power supply connector/fastener and the DC/DC power converter.
- 10 18. The lighting device as recited in claim 1, wherein the LED current control circuit comprises a PWM driver, a switching or multiplexer circuit, or one or more LED driver circuit.
19. The lighting device as recited in claim 1, further comprising an ambient light sensor circuit communicably coupled to the controller/processor.
20. The lighting device as recited in claim 19, wherein the ambient light sensor detects a level of one or more color components of an ambient light, wherein the one or more color components comprise a red, a green, a blue, a cyan, a yellow, a magenta, or a black.
- 15 21. The lighting device as recited in claim 19, wherein the ambient light sensor is located to detect an ambient light and a light emitted by the lighting device such that the controller/processor adjusts one or more of the on/off signals provided to the two or more LEDs.
- 20 22. The lighting device as recited in claim 1, further comprising a hard reset circuit communicably coupled to the controller/processor.
23. The lighting device as recited in claim 1, further comprising an AC or DC power supply connected to the power supply connector.
24. The lighting device as recited in claim 1, further comprising:
25 a wireless transceiver circuit communicably coupled to the controller/processor; and
an antenna communicably coupled to the wireless transceiver circuit.
25. The lighting device as recited in claim 24, wherein the controller/processor communicates with one or more other lighting devices, remote controllers, sensors, other devices, or a combination thereof.
26. The lighting device as recited in claim 25, wherein the lighting device and the other lighting devices are
30 part of a mesh network, a group or a combination thereof.
27. The lighting device as recited in claim 26, wherein the controller/processor provides a status information to the other lighting devices, remote controllers or other devices within the mesh network or group.
28. The lighting device as recited in claim 24, wherein the controller/processor receives a status information from the other lighting devices, remote controllers or other devices within the mesh network and uses the status
35 information as an input to execute one or more commands, change the on/off signals, trigger a communication or command to the mesh network or group, or a combination thereof.
29. The lighting device as recited in claim 24, wherein the controller/processor enters a discovery mode to detect the other lighting devices within the mesh network or group when the lighting device is turned on.
30. The lighting device as recited in claim 1, wherein the controller/processor executes one or more programs
40 to control the LED current control circuit to produce a light in accordance with the one or more programs.

31. The lighting device as recited in claim 30, wherein the one or more programs comprise one or more default programs, one or more user created programs, or a combination thereof.

32. The lighting device as recited in claim 1, wherein the controller/processor includes a security program that prevents unauthorized access to the one or more programs.

5 33. The lighting device as recited in claim 1, further comprising:

a flexible strip;

an electrical connector affixed to the flexible strip;

wherein the two or more LEDs are affixed to the flexible strip and electrically connected to the electrical connector; and

10 wherein the DC/DC power converter, the controller/processor and the LED current control circuit are remotely located with respect to the flexible strip and electrically connected to the electrical connector via a wire, a cable or a connecting strip.

34. The lighting device as recited in claim 33, further comprising a heat sink affixed to the flexible strip.

15 35. The lighting device as recited in claim 33, further comprising a reflector affixed to the flexible strip behind or around the two or more LEDs.

36. The lighting device as recited in claim 33, further comprising a diffuser or lens affixed to the flexible strip above the two or more LEDs.

37. The lighting device as recited in claim 33, further comprising a light strip connector affixed to the flexible strip and electrically connected to the LED current control circuit.

20 38. The lighting device as recited in claim 37, where in the light strip connector is connected in parallel or series with the two or more LEDs.

39. The lighting device as recited in claim 1, further comprising a housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the housing, and the two or more LEDs are proximate to or within an aperture of the housing.

25 40. The lighting device as recited in claim 39, further comprising a heat sink disposed within or outside the housing.

41. The lighting device as recited in claim 39, further comprising a reflector disposed within the aperture of the housing and around the two or more LEDs.

30 42. The lighting device as recited in claim 39, further comprising a diffuser or lens sealing the aperture of the housing.

43. The lighting device as recited in claim 1, further comprising:

a panel housing, wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the panel housing;

35 a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the panel housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

wherein the two or more LEDs are affixed to the panel housing and electrically connected to the electrical connector.

40 44. The lighting device as recited in claim 43, further comprising a heat sink affixed to or integrated into the panel housing.

45. The lighting device as recited in claim 43, further comprising a reflector affixed to the panel housing behind or around the two or more LEDs.

46. The lighting device as recited in claim 43, further comprising a diffuser or lens affixed to the panel housing above the two or more LEDs.

5 47. The lighting device as recited in claim 1, further comprising:

a can light housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the can light housing, and the two or more LEDs are proximate to or within an aperture of the can light housing;

10 a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the can light housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

a heat sink disposed within or integrated into the can light housing.

48. The lighting device as recited in claim 47, further comprising a reflector disposed within the aperture of the can light housing and around the two or more LEDs.

15 49. The lighting device as recited in claim 47, further comprising a diffuser or lens sealing the aperture of the can light housing.

50. A lighting system comprising:

two or lighting devices, wherein each lighting device comprises:

a DC/DC power converter,

20 a controller/processor electrically connected to the DC/DC power converter,

a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter,

two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit,

25 a wireless transceiver circuit communicably coupled to the controller/processor,

an antenna communicably coupled to the wireless transceiver circuit, and

wherein the LED current control circuit provides an on/off signal having a cycle time to each LED in response to one or more control signals received from the controller/processor such that the two or more LEDs produce a blended light having a specified color based on how long each LED is turned ON and/or
30 OFF during the cycle time; and

wherein the controller/processors of the two or more lighting devices communicate with one another using the wireless transceivers and antennas of the two or more lighting devices.

51. The lighting system as recited in claim 50, wherein the specified color is produced by turning ON the first color LED for a first portion of the cycle time and turning ON the second color LED for a second portion of the
35 cycle time.

52. The lighting system as recited in claim 50, wherein the two or more LEDs are not turned ON at the same time.

53. The lighting system as recited in claim 50, wherein each on/off signal provides a maximum current supplied by the DC/DC power converter to the LED.

40 54. The lighting system as recited in claim 50, wherein the on/off signal for the first LED comprises two or more pulses during a portion of the cycle time that the first LED is turned ON.

55. The lighting system as recited in claim 50, wherein the on/off signals to the two or more LEDs further produce the blended light having a specified saturation.

56. The lighting system as recited in claim 50, wherein the on/off signals to the two or more LEDs further produce the blended light having specified brightness or intensity.

5 57. The lighting system as recited in claim 56, wherein the specified brightness or intensity is determined by a duty cycle of the on/off signals.

58. The lighting system as recited in claim 50, wherein the cycle time is less than 12ms.

59. The lighting system as recited in claim 50, wherein at least one of the LEDs comprises a series of LEDs, a group of LEDs, an array of LEDs, two or more series-connected LEDs, two or more parallel-connected LEDs or a
10 combination thereof.

60. The lighting system as recited in claim 50, wherein the first color LED and the second color LED are selected from the group consisting essentially of a red LED, a green LED, a blue LED, a red LED, a white LED and a tri-color LED.

61. The lighting system as recited in claim 50, further comprising a real time clock circuit communicably
15 coupled to the controller/processor.

62. The lighting system as recited in claim 61, wherein the real time clock circuit is integrated into the controller/processor.

63. The lighting system as recited in claim 61, further comprising a battery electrically connected to the real time clock circuit.

20 64. The lighting system as recited in claim 50, further comprising a memory communicably coupled to the controller/processor.

65. The lighting system as recited in claim 64, wherein the memory is integrated into the controller/processor.

66. The lighting system as recited in claim 50, further comprising:

a power supply connector/fastener; and

25 an AC/DC power converter electrically connected to the power supply connector/fastener and the DC/DC power converter.

67. The lighting system as recited in claim 50, wherein the LED current control circuit comprises a PWM driver, a switching or multiplexer circuit, or one or more LED driver circuit.

68. The lighting system as recited in claim 50, further comprising an ambient light sensor circuit
30 communicably coupled to the controller/processor.

69. The lighting system as recited in claim 68, wherein the ambient light sensor detects a level of one or more color components of an ambient light, wherein the one or more color components comprise a red, a green, a blue, a cyan, a yellow, a magenta, or a black.

70. The lighting system as recited in claim 68, wherein the ambient light sensor is located to detect an ambient
35 light and a light emitted by the lighting device such that the controller/processor adjusts one or more of the on/off signals provided to the LED connectors.

71. The lighting system as recited in claim 50, further comprising a hard reset circuit communicably coupled to the controller/processor.

72. The lighting system as recited in claim 50, further comprising an AC or DC power supply connected to the
40 power supply connector.

73. The lighting system as recited in claim 50, further comprising a wireless controller that communicates with the controller/processors of the two or more lighting devices using the wireless transceivers and antennas of the two or more lighting devices.

74. The lighting system as recited in claim 73, wherein the wireless controller sends one or more commands to controller/processor of one of the lighting devices, each controller/processor of the lighting devices, a group of controller/processors of the lighting devices or a combination thereof.

75. The lighting system as recited in claim 73, wherein the wireless controller assigns at least two or more of the lighting devices to a group of lighting devices.

76. The lighting system as recited in claim 73, wherein one or more parameters of the two or more lighting devices are displayed on the wireless controller.

77. The lighting system as recited in claim 76, wherein the two or more lighting devices are displayed on the wireless controller in accordance with a user-defined filter or a user-defined storing based on one or more criteria.

78. The lighting system as recited in claim 50, further comprising one or more sensors that communicate with the controller/processors of the two or more lighting devices using the wireless transceivers and antennas of the two or more lighting devices.

79. The lighting system as recited in claim 50, wherein the two or more lighting devices are part of a mesh network, a group or a combination thereof.

80. The lighting system as recited in claim 79, wherein each controller/processor of the two or more lighting devices provides a status information to the other controller/processors within the mesh network or group.

81. The lighting system as recited in claim 79, wherein each controller/processor of the two or more lighting devices receives a status information from the other controller/processors within the mesh network or group and uses the status information as an input to execute one or more commands, change the on/off signals, trigger a communication or command to the mesh network or group, or a combination thereof.

82. The lighting system as recited in claim 79, wherein each controller/processor of the two or more lighting devices enters a discovery mode to detect the other lighting devices within the mesh network or group when each lighting device is turned on.

83. The lighting system as recited in claim 79, wherein the controller/processor of one of the two or more lighting devices enters a reintegration mode to reconnect to the other lighting devices.

84. The lighting system as recited in claim 79, wherein the controller/processors of the two or more lighting devices share one or more user profiles.

85. The lighting system as recited in claim 79, wherein the controller/processors of the two or more lighting devices share a date/time information.

86. The lighting system as recited in claim 50, wherein the controller/processor executes one or more programs to control the LED current control circuit to produce a light in accordance with the one or more programs.

87. The lighting system as recited in claim 86, wherein the one or more programs comprise one or more default programs, one or more user created programs, or a combination thereof.

88. The lighting system as recited in claim 86, wherein the controller/processor includes a security program that prevents unauthorized access to the one or more programs.

89. The lighting system as recited in claim 50, wherein at least one of the lighting devices further comprise:
a flexible strip;
an electrical connector affixed to the flexible strip;

wherein the two or more LEDs are affixed to the flexible strip and electrically connected to the electrical connector; and

wherein the DC/DC power converter, the controller/processor and the LED current control circuit are remotely located with respect to the flexible strip and electrically connected to the electrical connector via a wire, a cable or a connecting strip.

90. The lighting system as recited in claim 89, wherein the at least one of the lighting devices further comprises a heat sink affixed to the flexible strip.

91. The lighting system as recited in claim 89, wherein the at least one of the lighting devices further comprises a reflector affixed to the flexible strip behind or around the two or more LEDs.

92. The lighting system as recited in claim 89, wherein the at least one of the lighting devices further comprises a diffuser or lens affixed to the flexible strip above the two or more LEDs.

93. The lighting system as recited in claim 89, wherein the at least one of the lighting devices further comprises a light strip connector affixed to the flexible strip and electrically connected to the LED current control circuit.

94. The lighting system as recited in claim 93, wherein the light strip connector is connected in parallel or series with the two or more LEDs.

95. The lighting system as recited in claim 50, wherein at least one of the lighting devices further comprises a housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the housing, and the two or more LEDs are proximate to or within an aperture of the housing.

96. The lighting system as recited in claim 95, wherein the at least one of the lighting devices further comprises a heat sink disposed within or outside the housing.

97. The lighting system as recited in claim 95, wherein the at least one of the lighting devices further comprises a reflector disposed within the aperture of the housing and around the two or more LEDs.

98. The lighting system as recited in claim 95, wherein the at least one of the lighting devices further comprises a diffuser or lens sealing the aperture of the housing.

99. The lighting system as recited in claim 50, further comprising:

a panel housing, wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the panel housing;

a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the panel housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

wherein the two or more LEDs are affixed to the panel housing and electrically connected to the electrical connector.

100. The lighting system as recited in claim 99, further comprising a heat sink affixed to or integrated into the panel housing.

101. The lighting system as recited in claim 99, further comprising a reflector affixed to the panel housing behind or around the two or more LEDs.

102. The lighting system as recited in claim 99, further comprising a diffuser or lens affixed to the panel housing above the two or more LEDs.

103. The lighting system as recited in claim 50, further comprising:

a can light housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the can light housing, and the two or more LEDs are proximate to or within an aperture of the can light housing;

a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the can light housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

a heat sink disposed within or integrated into the can light housing.

104. The lighting system as recited in claim 103, further comprising a reflector disposed within the aperture of the can light housing and around the two or more LEDs.

105. The lighting system as recited in claim 103, further comprising a diffuser or lens sealing the aperture of the can light housing.

106. A method for controlling one or more lighting devices comprising the steps of:
providing the one or lighting devices, wherein each lighting device comprises:

a DC/DC power converter,

a controller/processor electrically connected to the DC/DC power converter,

a light emitting diode (LED) current control circuit communicably coupled to the controller/processor and electrically connected to the DC/DC power converter, and

two or more LEDs comprising at least a first color LED and a second color LED electrically connected to the LED current control circuit;

sending one or more control signals from the controller/processor to the LED current control circuit corresponding to a blended light having a specified color; and

sending an on/off signal having a cycle time from the LED current control circuit to each LED in response to the one or more control signals such that the two or more LEDs produce the blended light having the specified color based on how long each LED is turned ON and/or OFF during the cycle time.

107. The method as recited in claim 106, wherein the specified color is produced by turning ON the first color LED for a first portion of the cycle time and turning ON the second color LED for a second portion of the cycle time.

108. The method as recited in claim 106, wherein the two or more LEDs are not turned ON at the same time.

109. The method as recited in claim 106, wherein each on/off signal provides a maximum current supplied by the DC/DC power converter to the LED.

110. The method as recited in claim 106, wherein the on/off signal for the first LED comprises two or more pulses during a portion of the cycle time that the first LED is turned ON.

111. The method as recited in claim 106, wherein the on/off signals to the two or more LEDs further produce the blended light having a specified saturation.

112. The method as recited in claim 106, wherein the on/off signals to the two or more LEDs further produce the blended light having specified brightness or intensity.

113. The method as recited in claim 112, wherein the specified brightness or intensity is determined by a duty cycle of the on/off signals.

114. The method as recited in claim 106, wherein the cycle time is less than 12ms.

115. The method as recited in claim 106, wherein at least one of the LEDs comprises a series of LEDs, a group of LEDs, an array of LEDs, two or more series-connected LEDs, two or more parallel-connected LEDs or a combination thereof.

116. The method as recited in claim 106, wherein the first color LED and the second color LED are selected from the group consisting essentially of a red LED, a green LED, a blue LED, a red LED, a white LED and a tri-color LED.

117. The method as recited in claim 106, further comprising a real time clock circuit communicably coupled to the controller/processor.

118. The method as recited in claim 117, wherein the real time clock circuit is integrated into the controller/processor.

119. The method as recited in claim 117, further comprising a battery electrically connected to the real time clock circuit.

120. The method as recited in claim 106, further comprising a memory communicably coupled to the controller/processor.

121. The method as recited in claim 120, wherein the memory is integrated into the controller/processor.

122. The method as recited in claim 106, further comprising:
a power supply connector/fastener; and
an AC/DC power converter electrically connected to the power supply connector/fastener and the DC/DC power converter.

123. The method as recited in claim 106, wherein the LED current control circuit comprises a PWM driver, a switching or multiplexer circuit, or one or more LED driver circuit.

124. The method as recited in claim 106, further comprising an ambient light sensor circuit communicably coupled to the controller/processor.

125. The method as recited in claim 124, wherein the ambient light sensor detects a level of one or more color components of an ambient light, wherein the one or more color components comprise a red, a green, a blue, a cyan, a yellow, a magenta, or a black.

126. The method as recited in claim 124, wherein the ambient light sensor is located to detect an ambient light and a light emitted by the lighting device such that the controller/processor adjusts one or more of the on/off signals provided to the LED connectors.

127. The method as recited in claim 106, further comprising a hard reset circuit communicably coupled to the controller/processor.

128. The method as recited in claim 106, further comprising an AC or DC power supply connected to the power supply connector.

129. The method as recited in claim 106, further comprising:
a wireless transceiver circuit communicably coupled to the controller/processor; and
an antenna communicably coupled to the wireless transceiver circuit.

130. The method as recited in claim 129, further comprising a wireless controller that communicates with the controller/processors of the one or more lighting devices using the wireless transceivers and antennas of the one or more lighting devices.

131. The method as recited in claim 130, further comprising the step of sending one or more commands from the wireless controller to controller/processor of one of the lighting devices, each controller/processor of the lighting devices, a group of controller/processors of the lighting devices or a combination thereof.

132. The method as recited in claim 130, further comprising the step of assigning two or more of the lighting devices to a group of lighting devices using the wireless controller.

133. The method as recited in claim 130, further comprising the step of displaying one or more parameters of the one or more lighting devices on the wireless controller.

134. The method as recited in claim 133, wherein the one or more lighting devices are displayed on the wireless controller in accordance with a user-defined filter or a user-defined storing based on one or more criteria.

135. The method as recited in claim 130, wherein the one or more lighting devices comprise at least two lighting devices and further comprising the step of forming a mesh network, a group or a combination thereof using the at least two lighting devices.

136. The method as recited in claim 135, further comprising the step of adding one or more one or more sensors that communicate with the controller/processors of the one or more lighting devices using the wireless transceivers and antennas of the one or more lighting devices.

137. The method as recited in claim 135, further comprising the step of providing a status information from each controller/processor of the two or more lighting devices to the other controller/processors within the mesh network or group.

138. The method as recited in claim 135, further comprising the steps of:
receiving a status information at each controller/processor of the two or more lighting devices from the other controller/processors within the mesh network or group; and
using the status information as an input to execute one or more commands, change the on/off signals, trigger a communication or command to the mesh network or group, or a combination thereof.

139. The method as recited in claim 135, further comprising the step of entering a discovery mode at each controller/processor of the two or more lighting devices to detect the other lighting devices within the mesh network or group when each lighting device is turned on.

140. The method as recited in claim 135, further comprising the step of entering a reintegration mode at one of the lighting devices to reconnect to the other lighting devices.

141. The method as recited in claim 135, further comprising the step of sharing one or more user provides between the controller/processors of the two or more lighting devices.

142. The method as recited in claim 135, further comprising the step of sharing a date/time information between the controller/processors of the two or more lighting devices.

143. The method as recited in claim 106, further comprising the step of executing one or more programs to control the LED current control circuit to produce a light in accordance with the one or more programs.

144. The method as recited in claim 143, wherein the one or more programs comprise one or more default programs, one or more user created programs, or a combination thereof.

145. The method as recited in claim 143, wherein the controller/processor includes a security program that prevents unauthorized access to the one or more programs.

146. The method as recited in claim 106, wherein at least one of the lighting devices further comprise:
a flexible strip;
an electrical connector affixed to the flexible strip;

wherein the two or more LEDs are affixed to the flexible strip and electrically connected to the electrical connector; and

wherein the DC/DC power converter, the controller/processor and the LED current control circuit are remotely located with respect to the flexible strip and electrically connected to the electrical connector via a wire, a cable or a connecting strip.

147. The method as recited in claim 146, wherein the at least one of the lighting devices further comprises a heat sink affixed to the flexible strip.

148. The method as recited in claim 146, wherein the at least one of the lighting devices further comprises a reflector affixed to the flexible strip behind or around the two or more LEDs.

149. The method as recited in claim 146, wherein the at least one of the lighting devices further comprises a diffuser or lens affixed to the flexible strip above the two or more LEDs.

150. The method as recited in claim 146, wherein the at least one of the lighting devices further comprises a light strip connector affixed to the flexible strip and electrically connected to the LED current control circuit.

151. The method as recited in claim 146, wherein the light strip connector is connected in parallel or series with the two or more LEDs.

152. The method as recited in claim 106, wherein at least one of the lighting devices further comprises a housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the housing, and the two or more LEDs are proximate to or within an aperture of the housing.

153. The method as recited in claim 152, wherein the at least one of the lighting devices further comprises a heat sink disposed within or outside the housing.

154. The method as recited in claim 152, wherein the at least one of the lighting devices further comprises a reflector disposed within the aperture of the housing and around the two or more LEDs.

155. The method as recited in claim 152, wherein the at least one of the lighting devices further comprises a diffuser or lens sealing the aperture of the housing.

156. The method as recited in claim 106, further comprising:

a panel housing, wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the panel housing;

a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the panel housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

wherein the two or more LEDs are affixed to the panel housing and electrically connected to the electrical connector.

157. The method as recited in claim 156, further comprising a heat sink affixed to or integrated into the panel housing.

158. The method as recited in claim 156, further comprising a reflector affixed to the panel housing behind or around the two or more LEDs.

159. The method as recited in claim 156, further comprising a diffuser or lens affixed to the panel housing above the two or more LEDs.

160. The method as recited in claim 106, further comprising:

a can light housing wherein the DC/DC power converter, the controller/processor and the LED current control circuit are disposed within the can light housing, and the two or more LEDs are proximate to or within an aperture of the can light housing;

5 a wire, a cable or a connecting strip electrically connected to the DC/DC power converter and extending outward from the can light housing;

an electrical connector electrically connected to the wire, the cable or the connecting strip; and

a heat sink disposed within or integrated into the can light housing.

161. The method as recited in claim 160, further comprising a reflector disposed within the aperture of the can light housing and around the two or more LEDs.

10 162. The method as recited in claim 160, further comprising a diffuser or lens sealing the aperture of the can light housing.

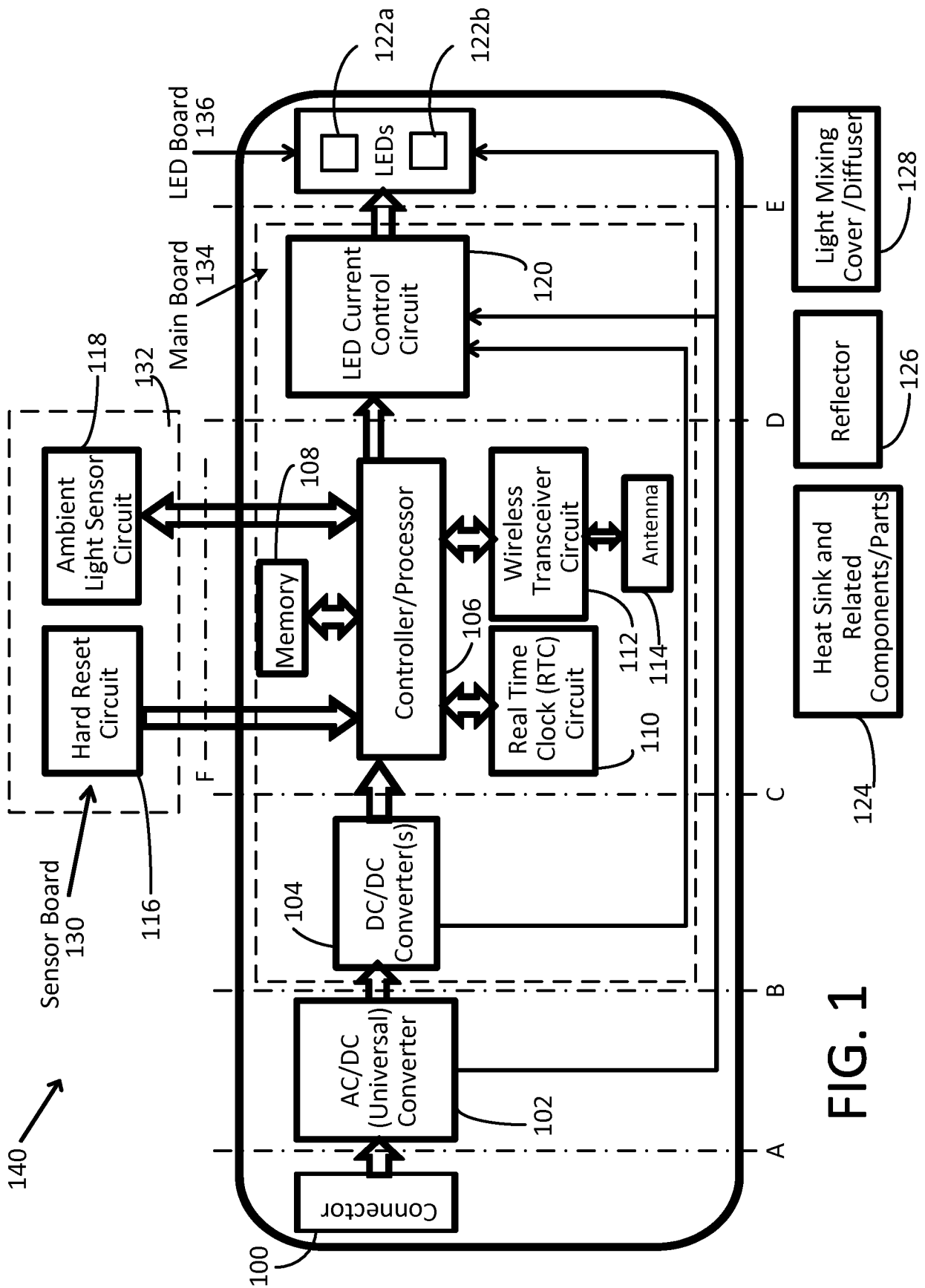
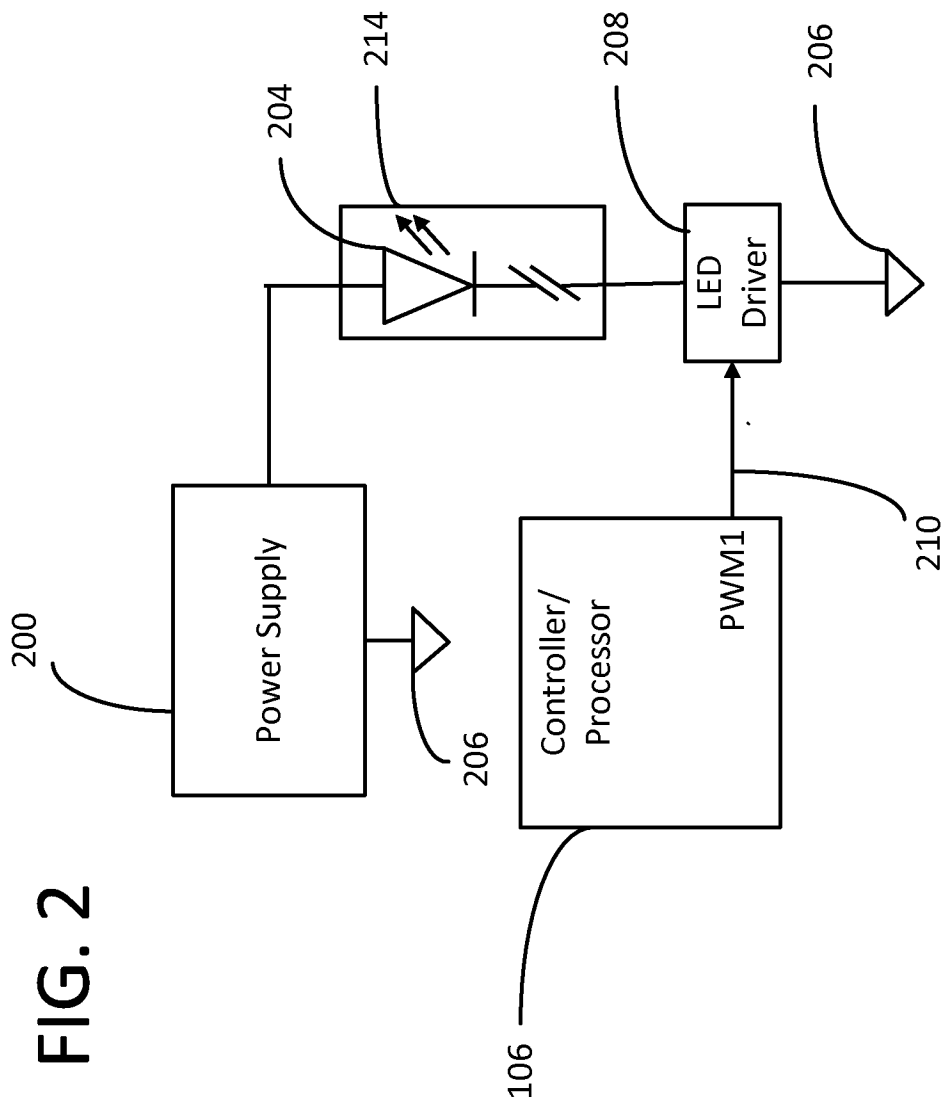
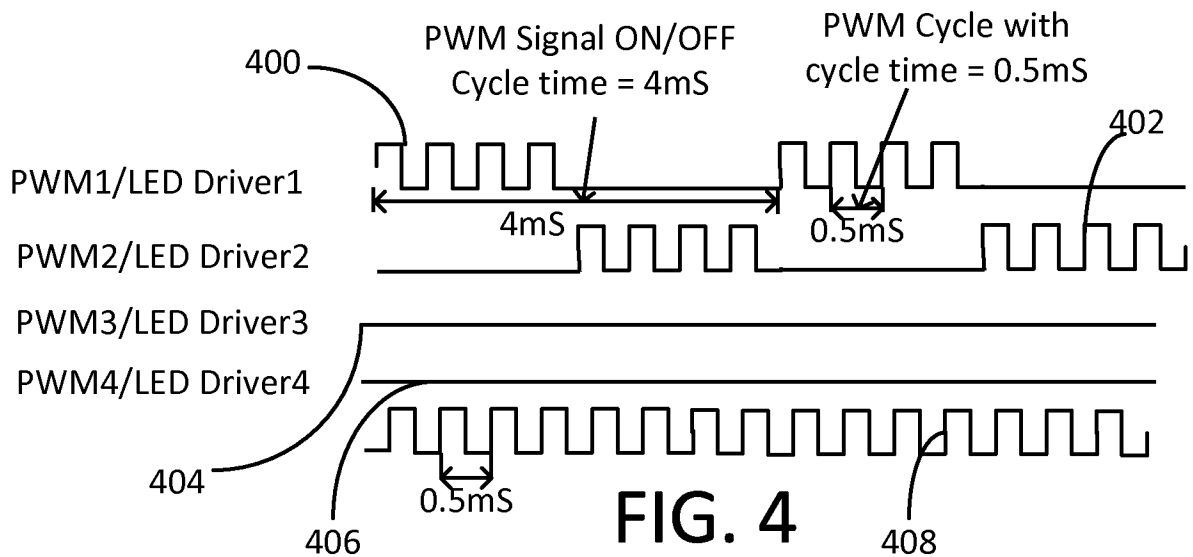
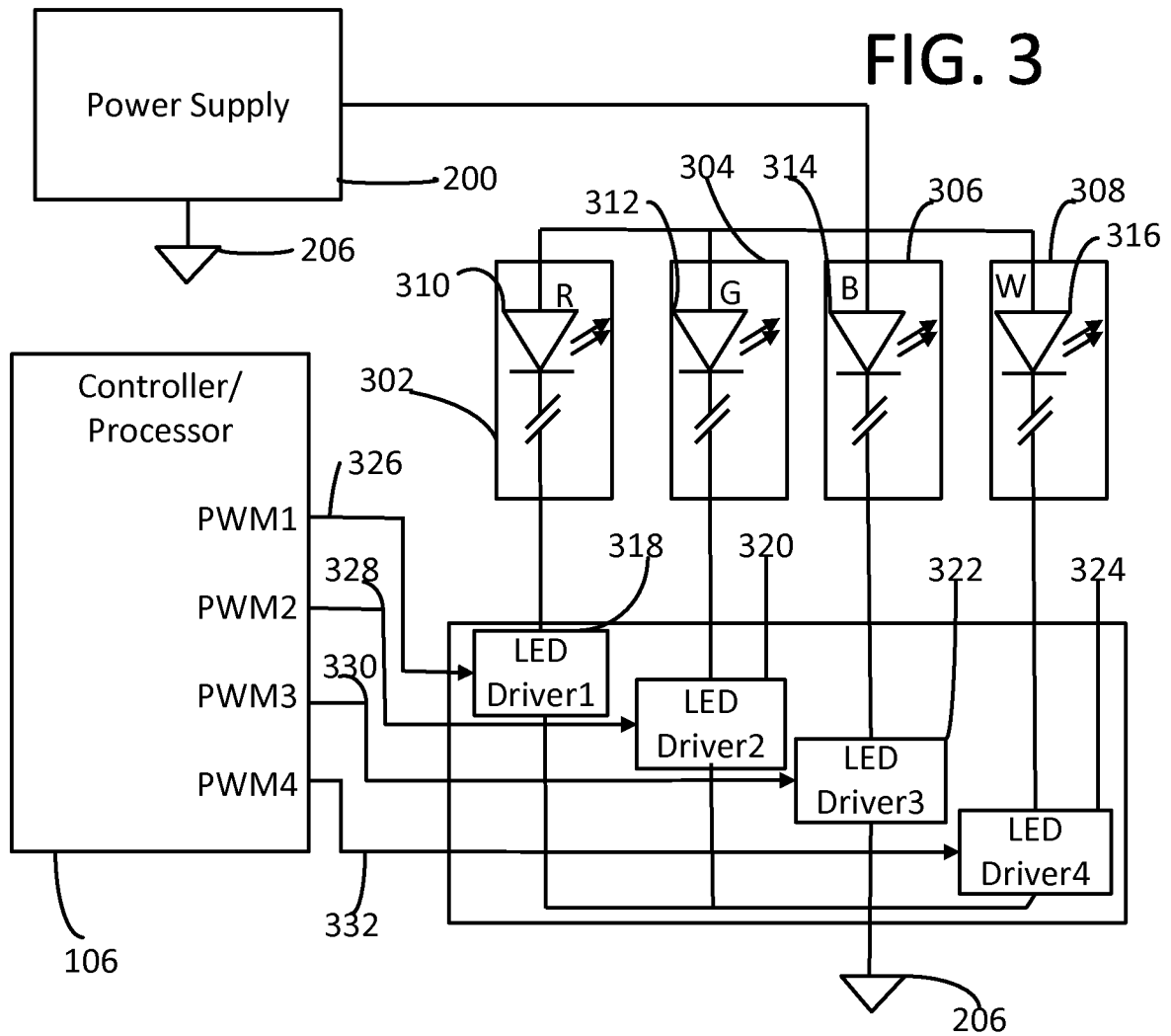
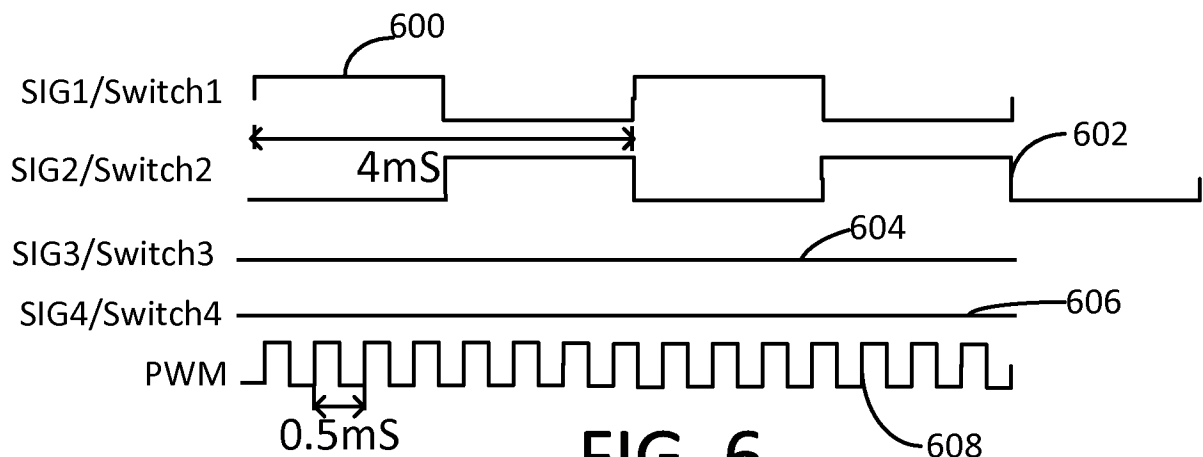
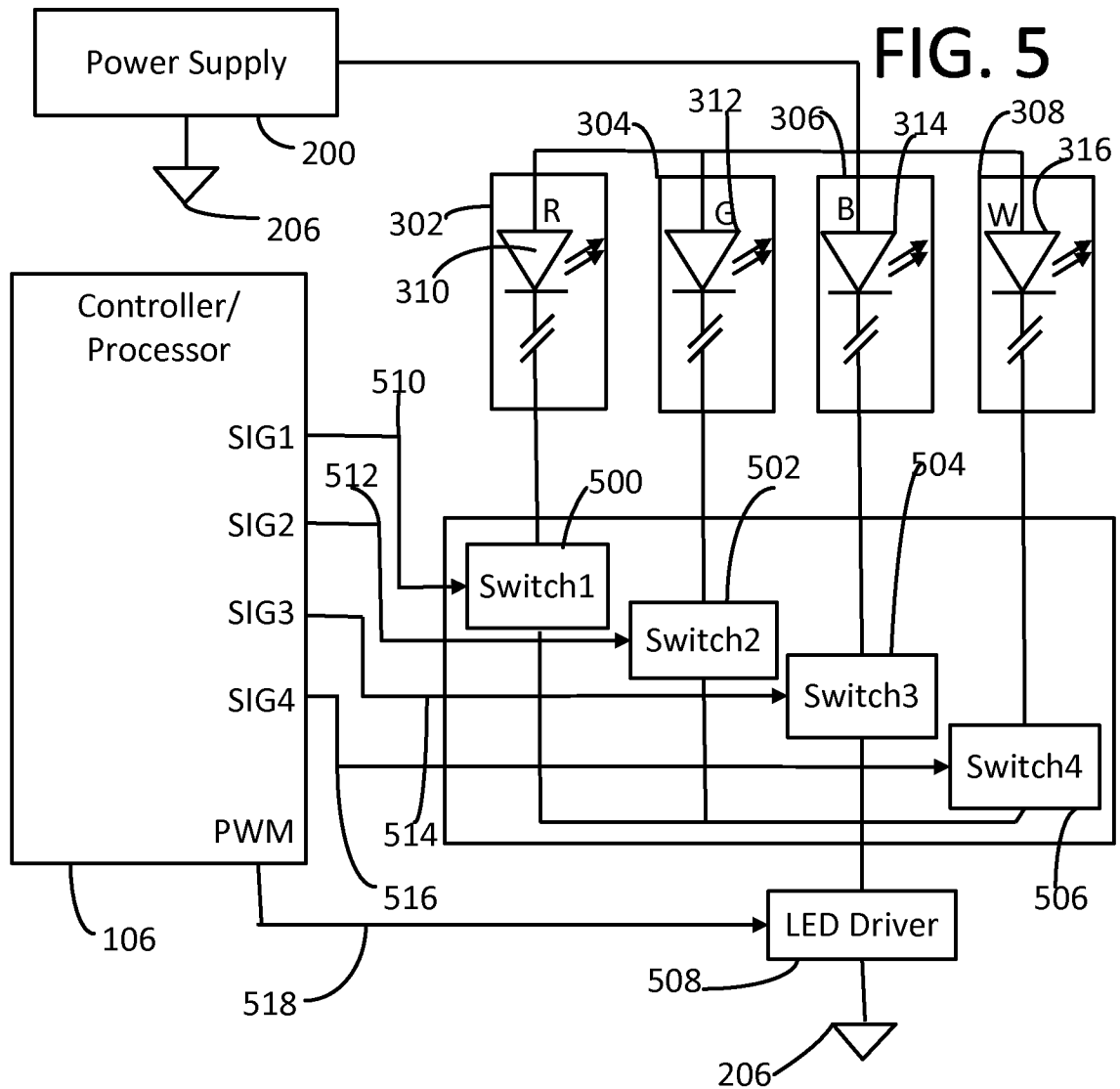


FIG. 1

FIG. 2







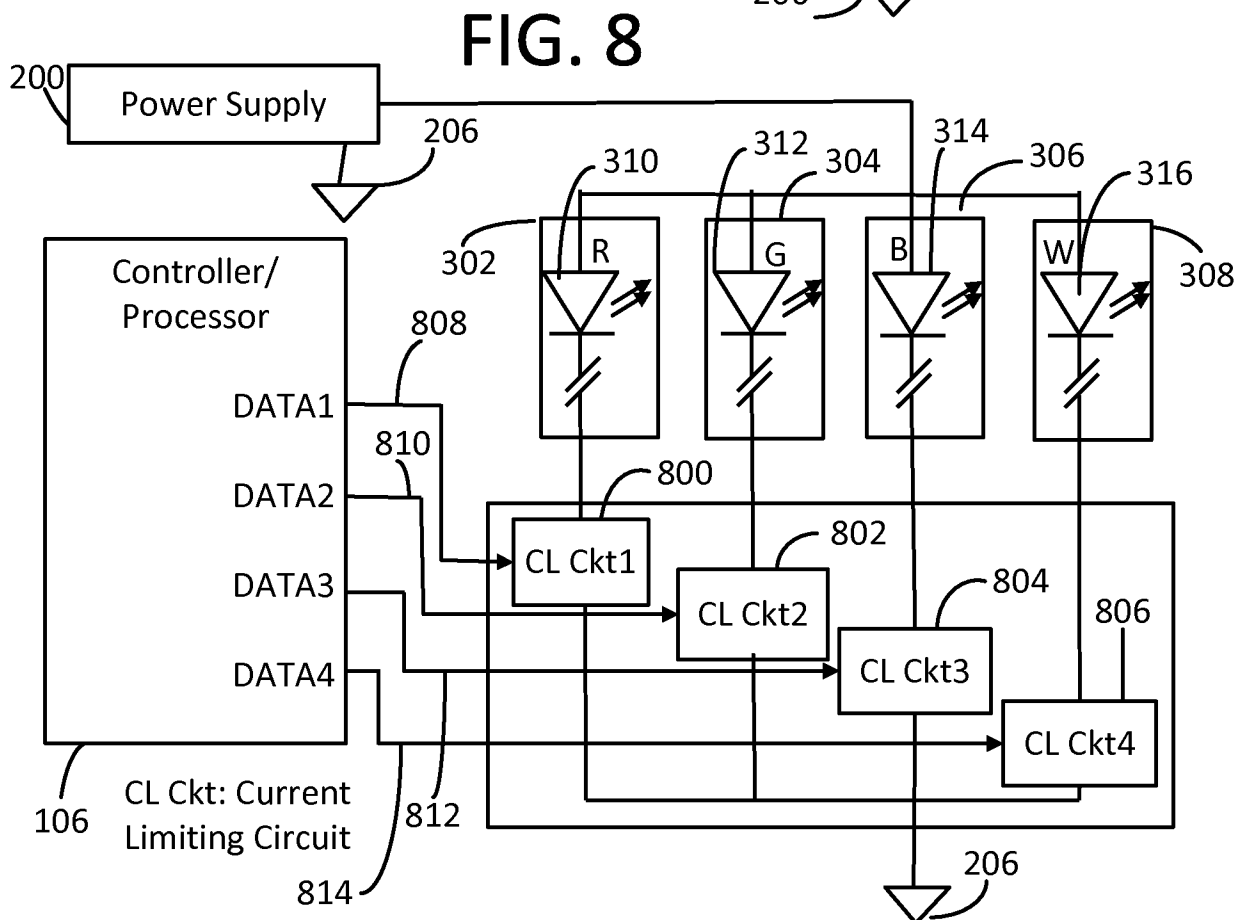
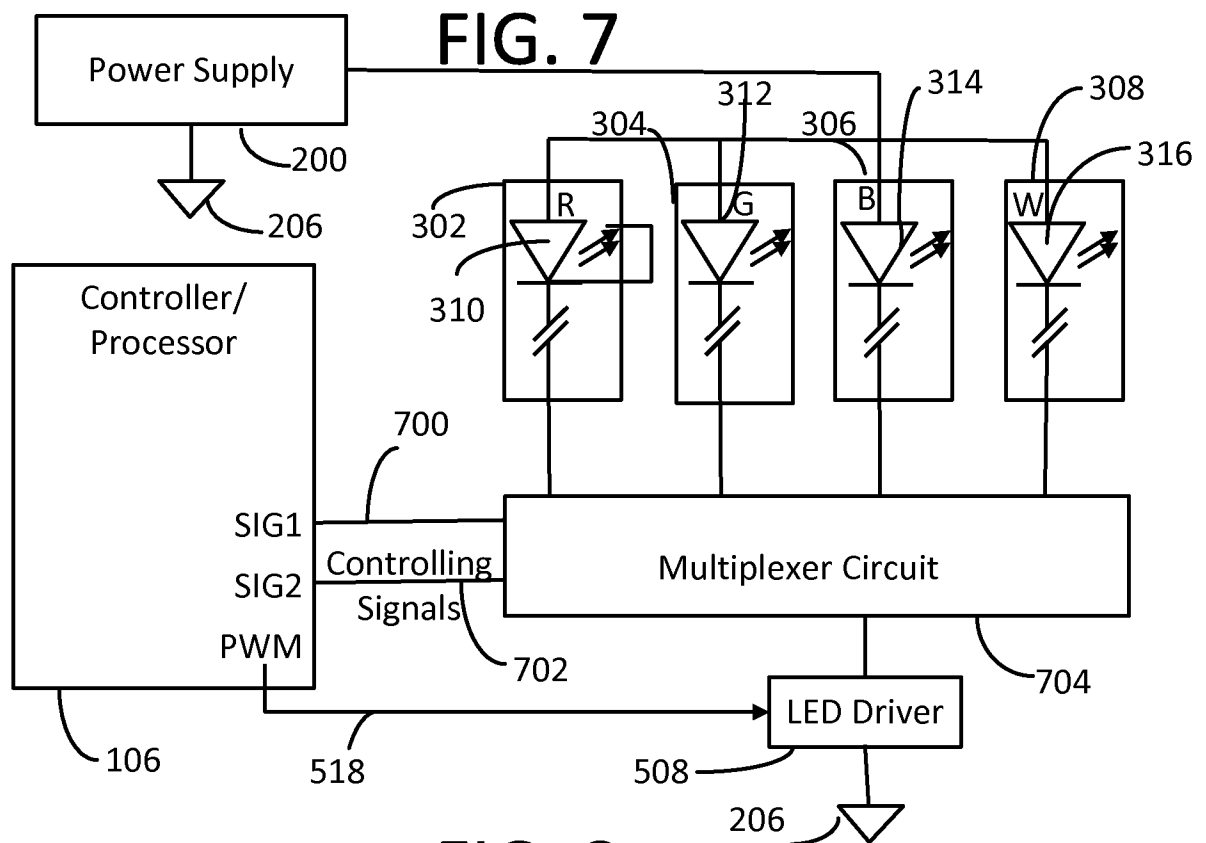
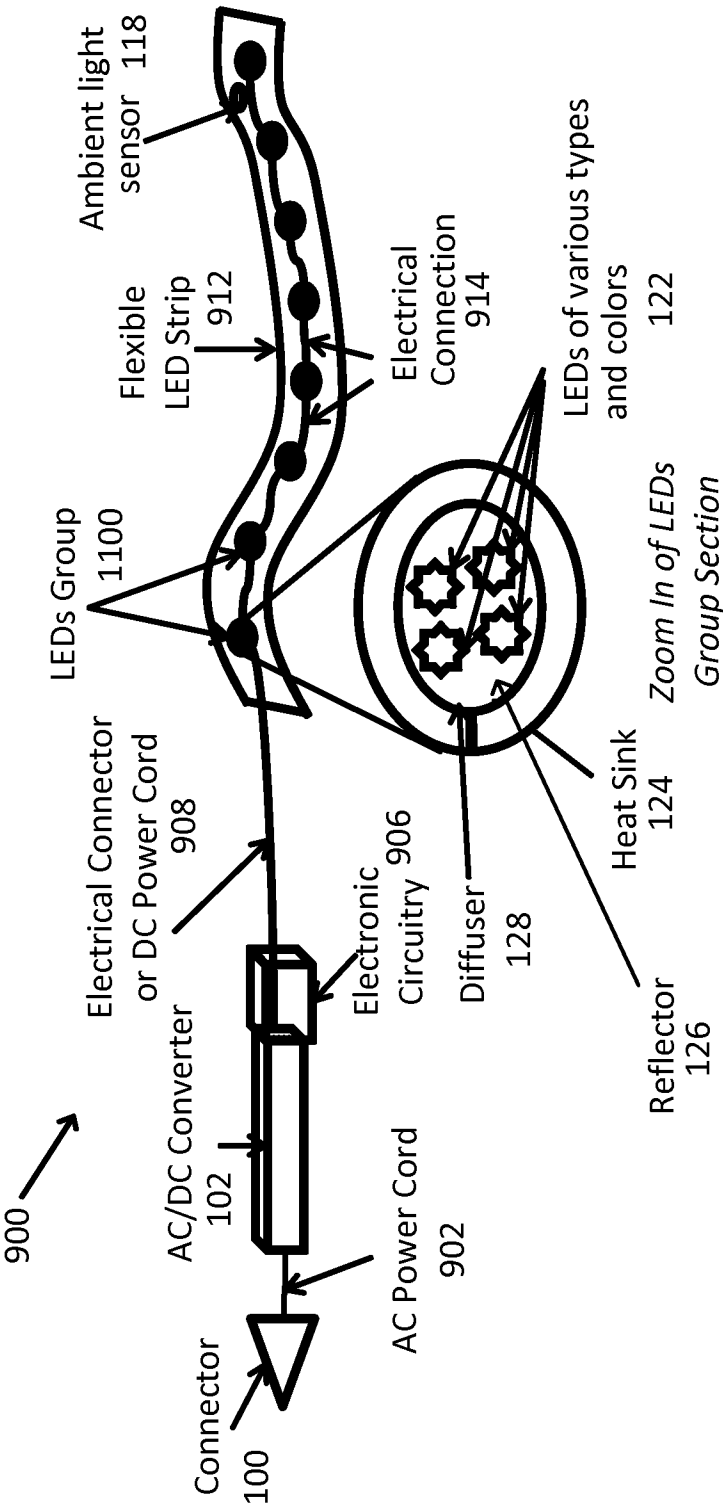


FIG. 9



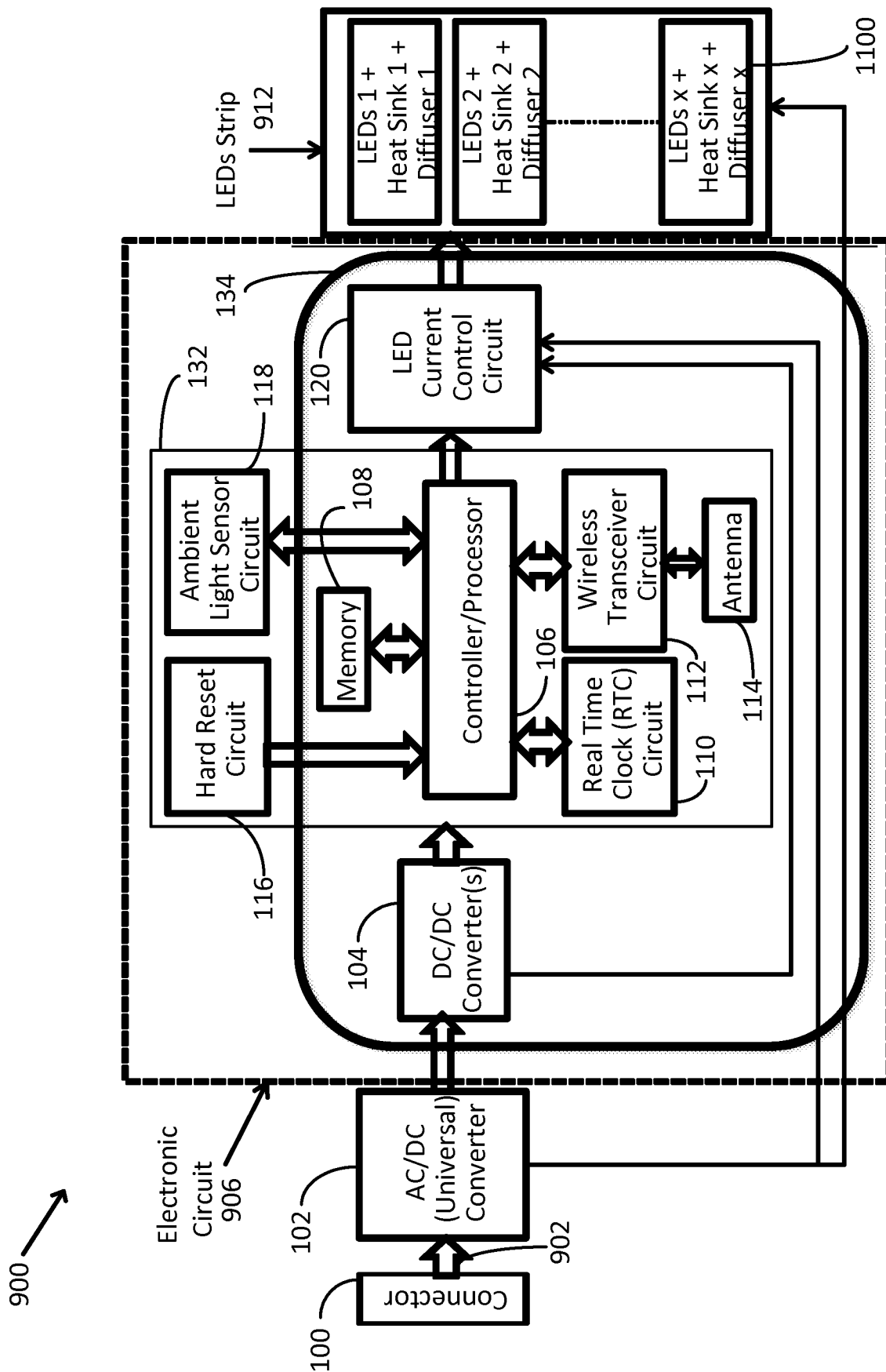


FIG. 10

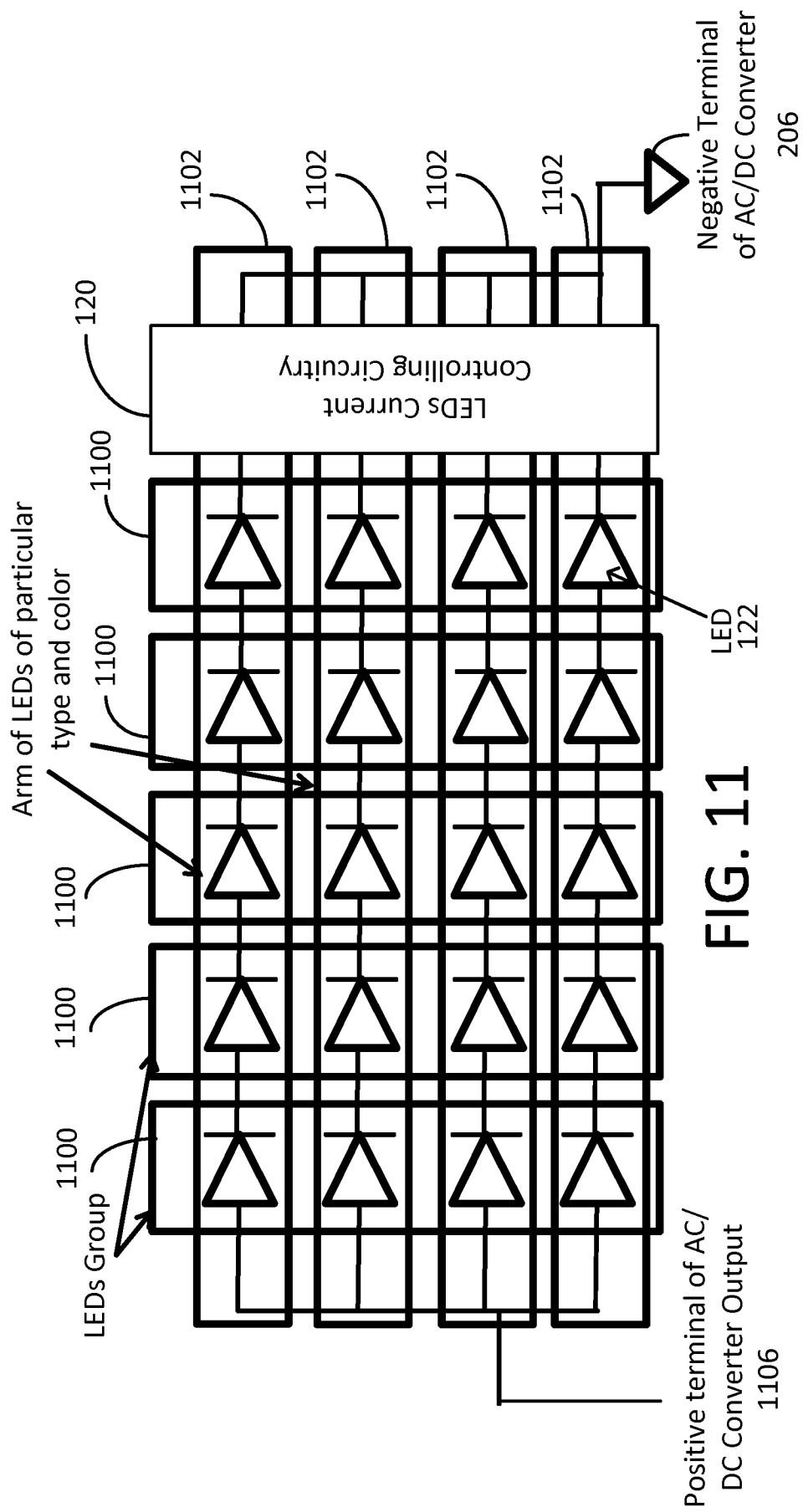


FIG. 11

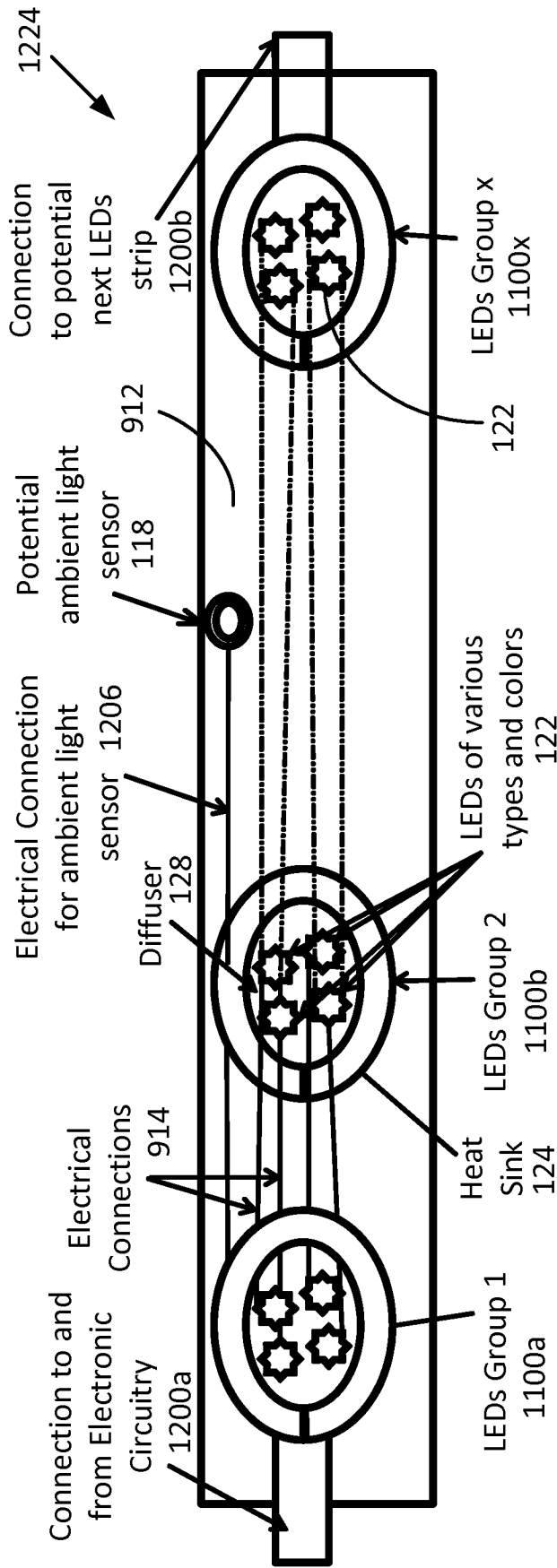


FIG. 12A-1 (front view)

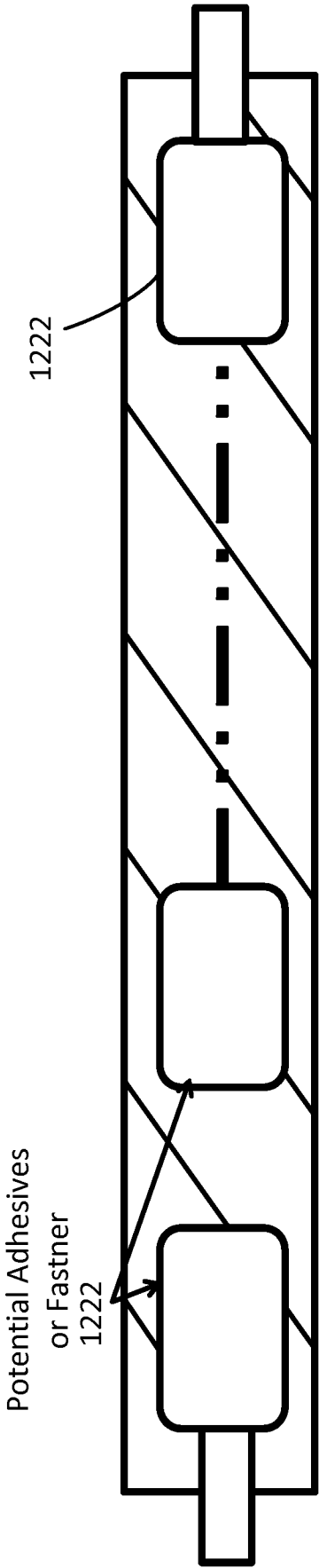


FIG. 12A-1 (back view)

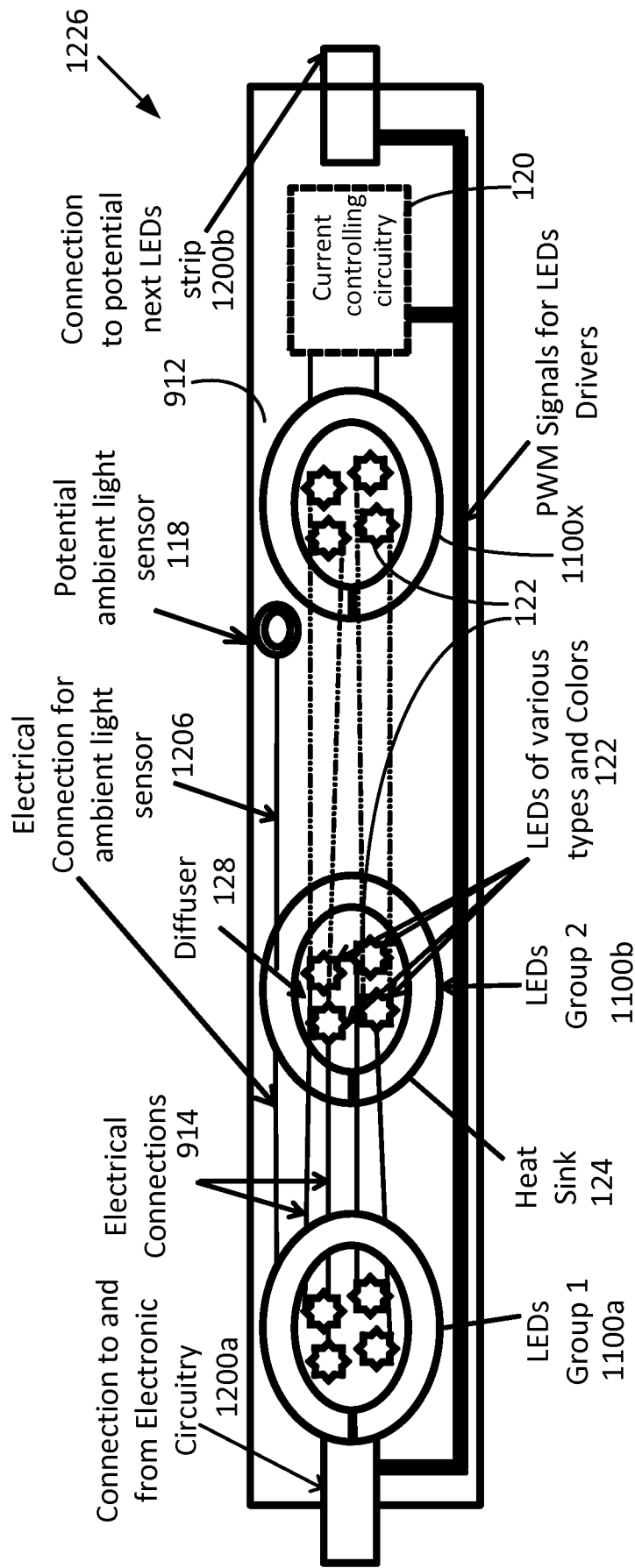


FIG. 12B-1 (front view)

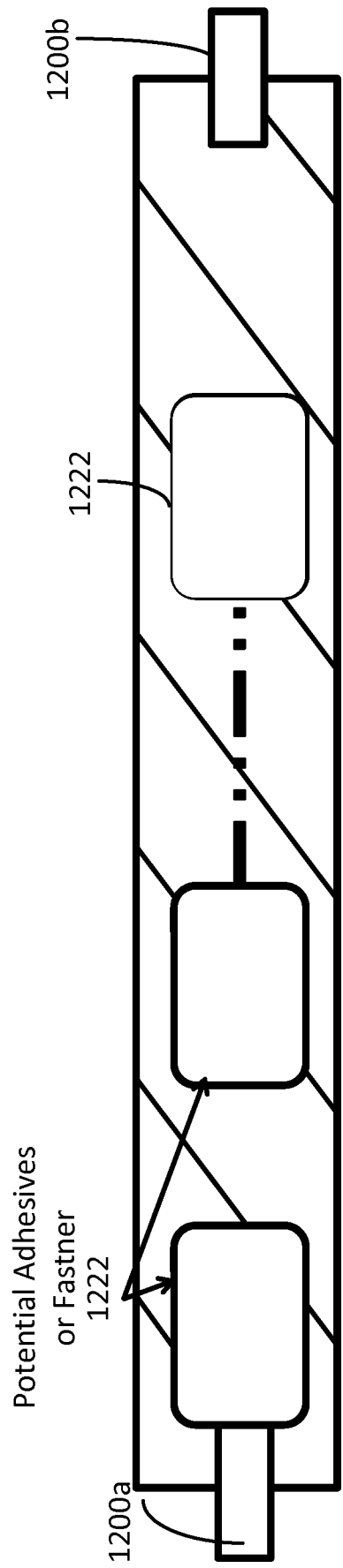


FIG. 12B-2 (back view)

FIG. 13

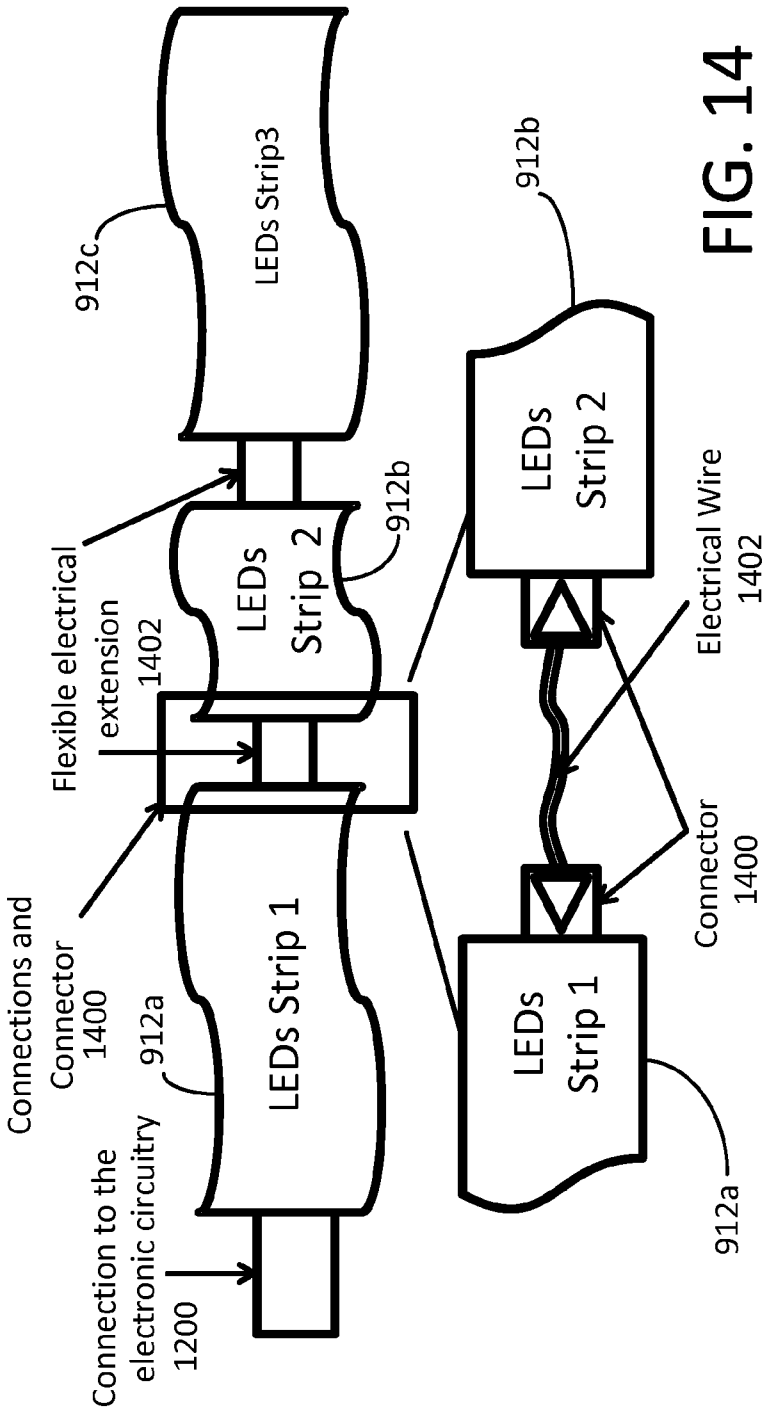
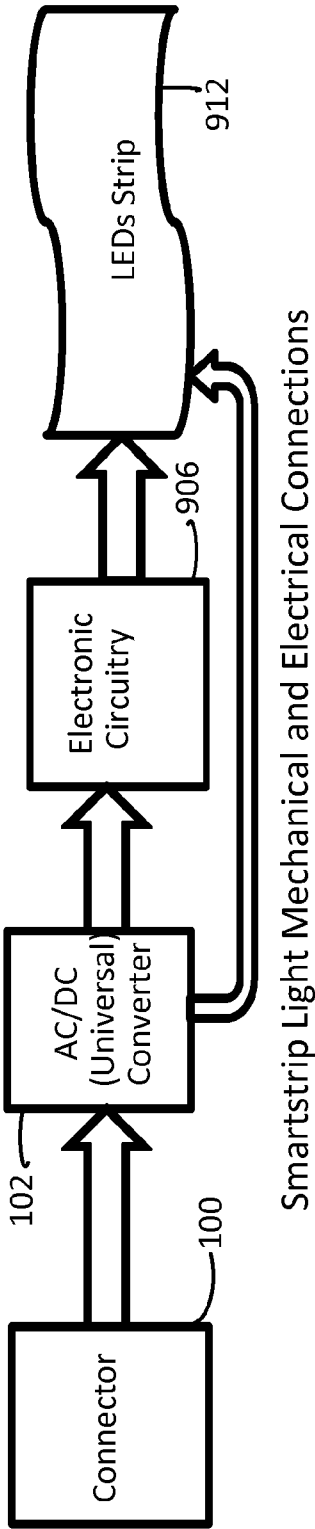
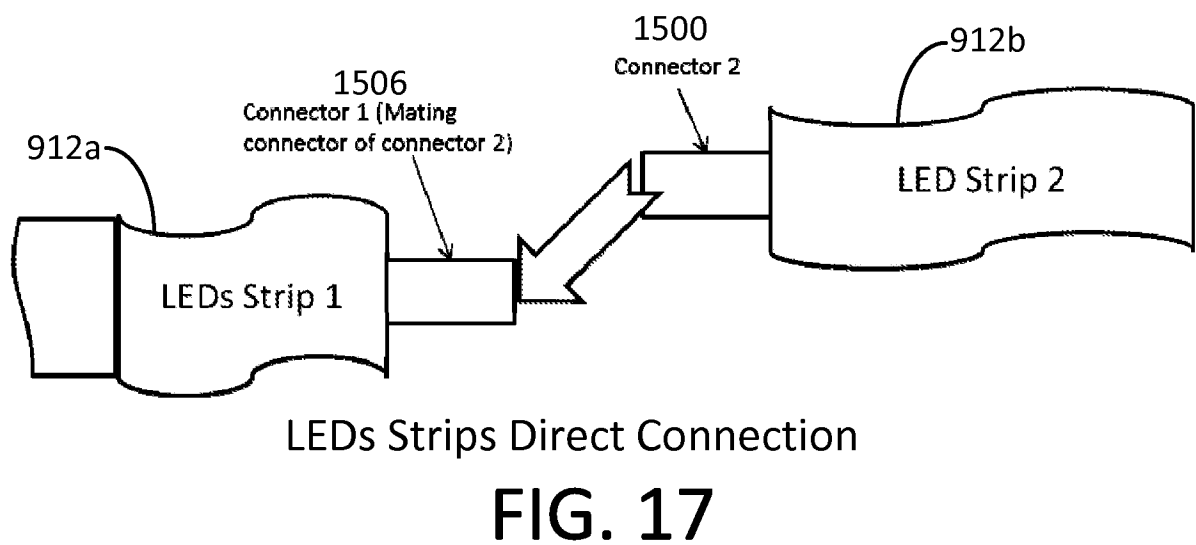
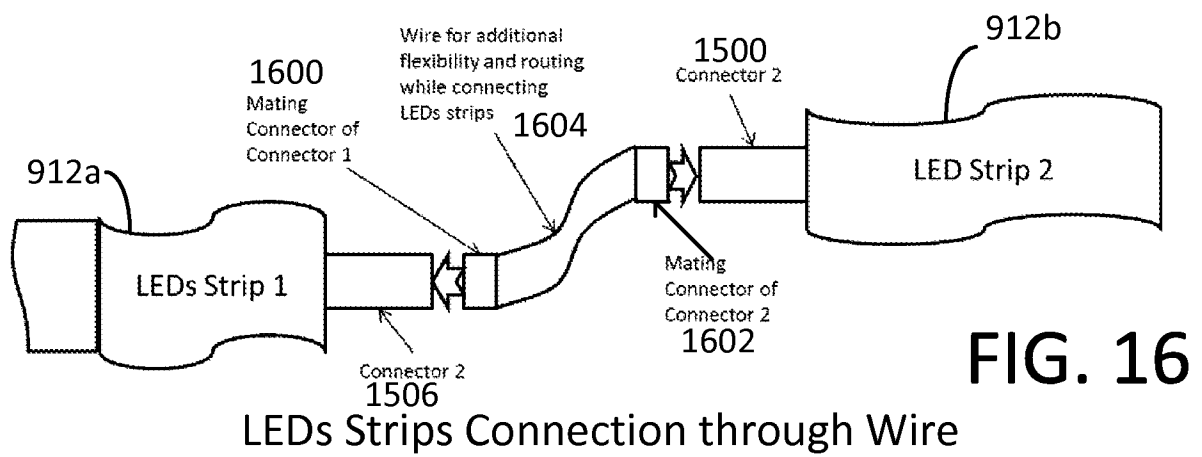
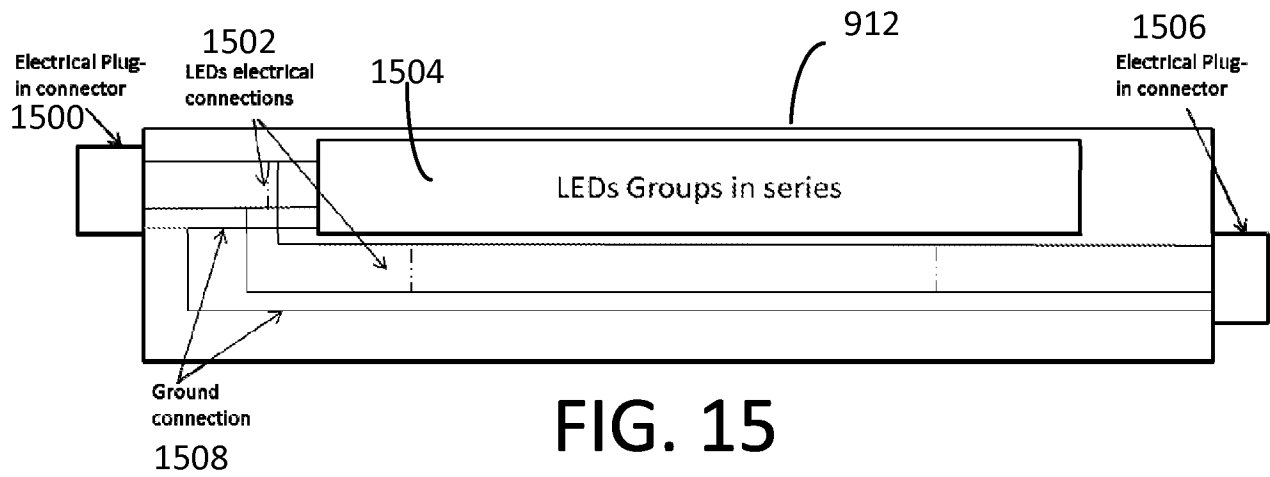


FIG. 14

Connections and connector – Zoomed In



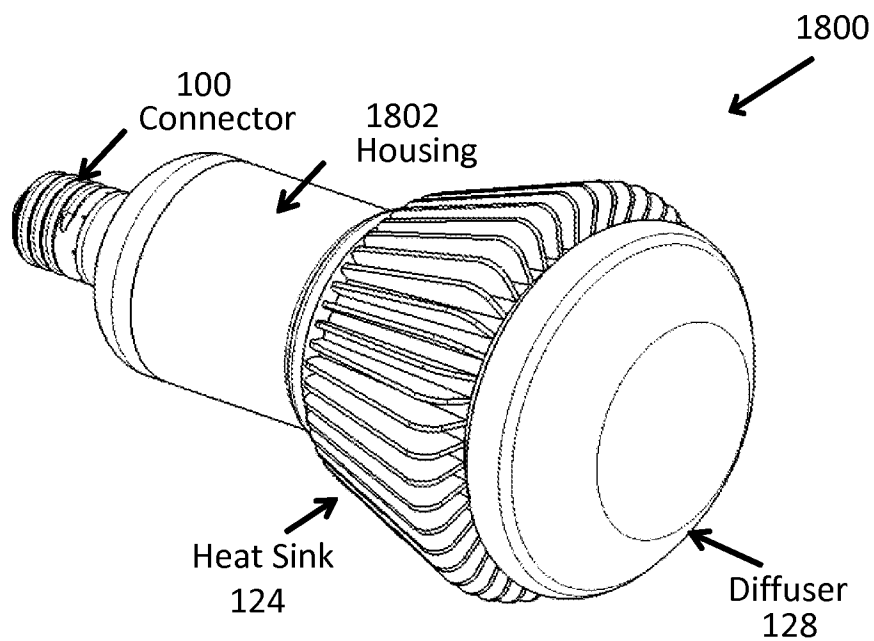


FIG. 18

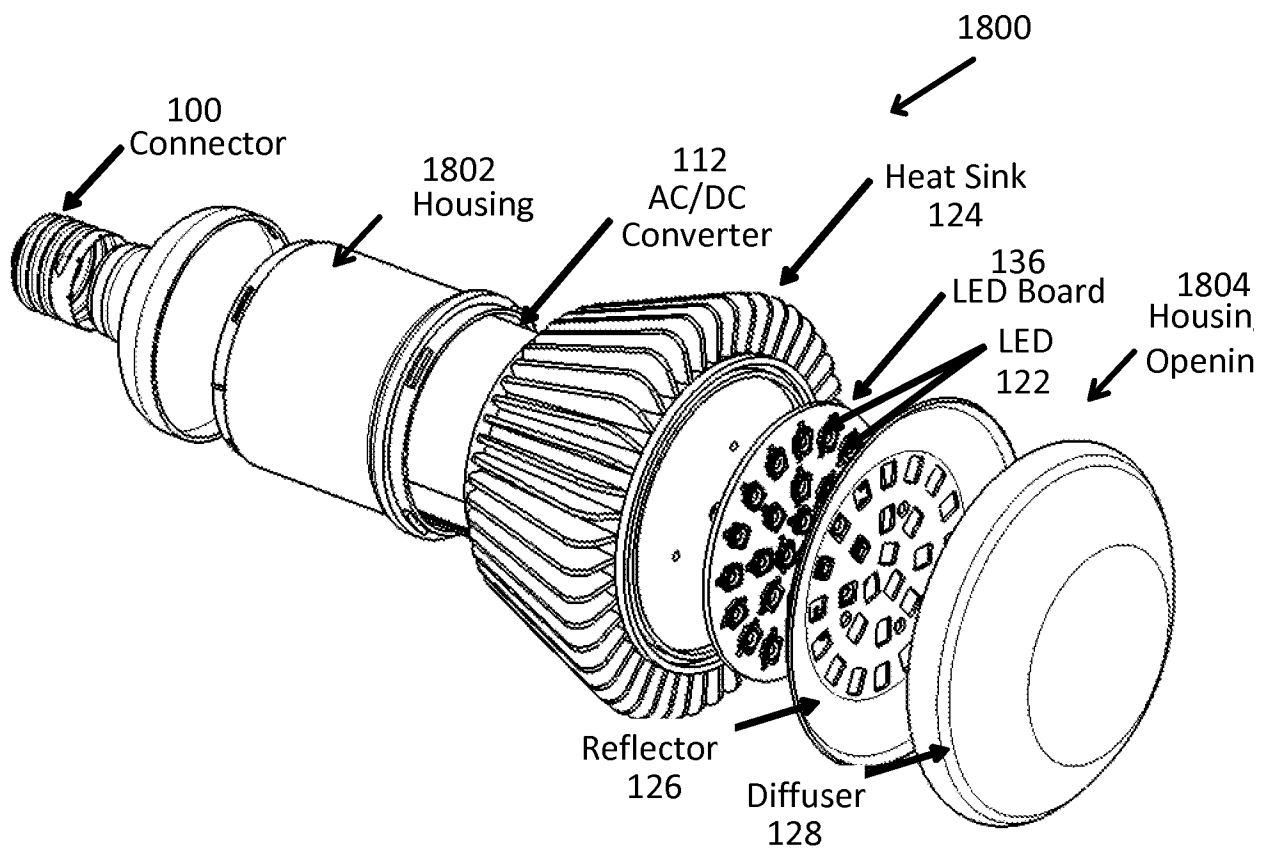


FIG. 19

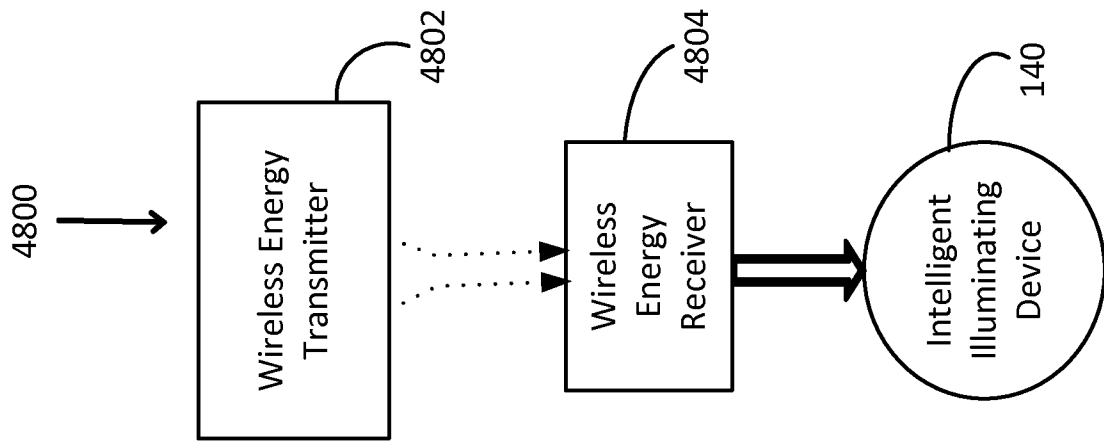
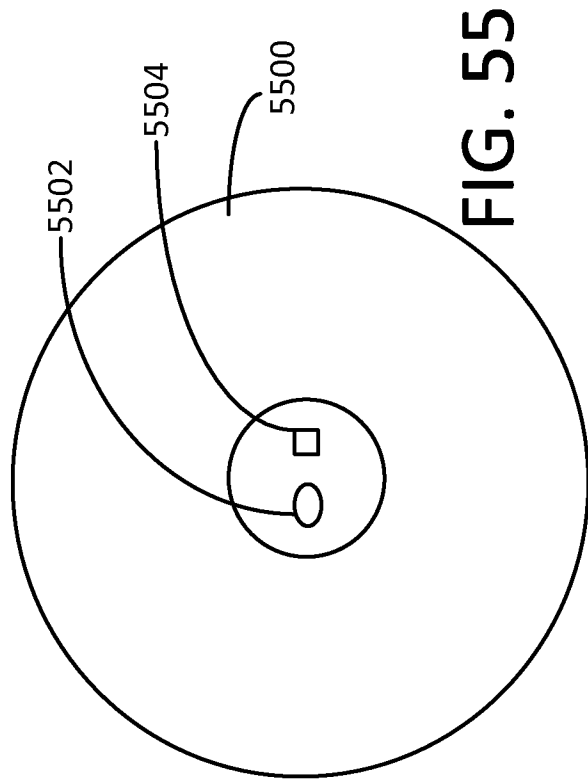
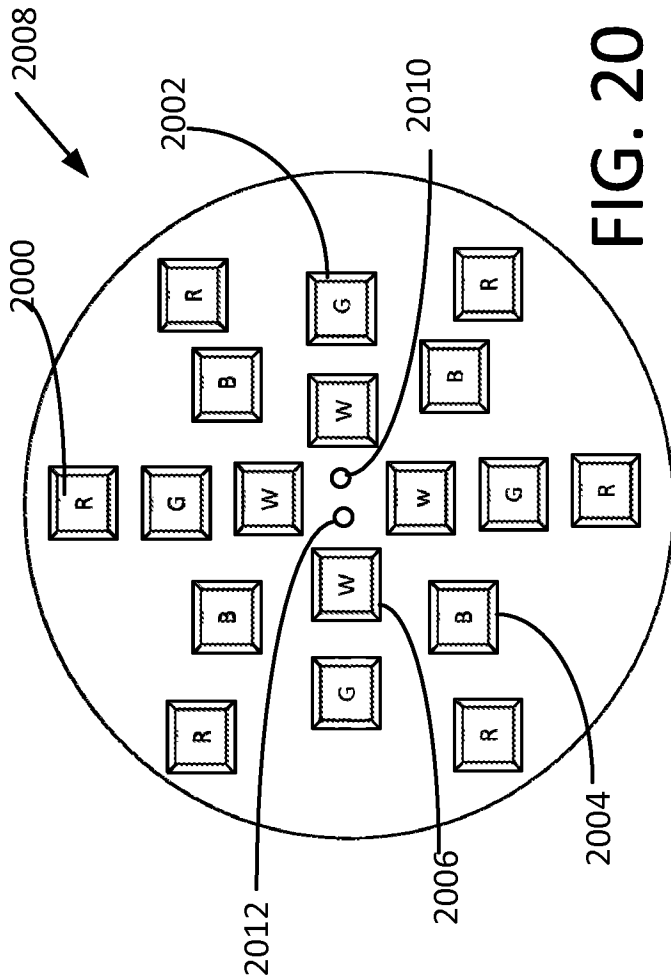
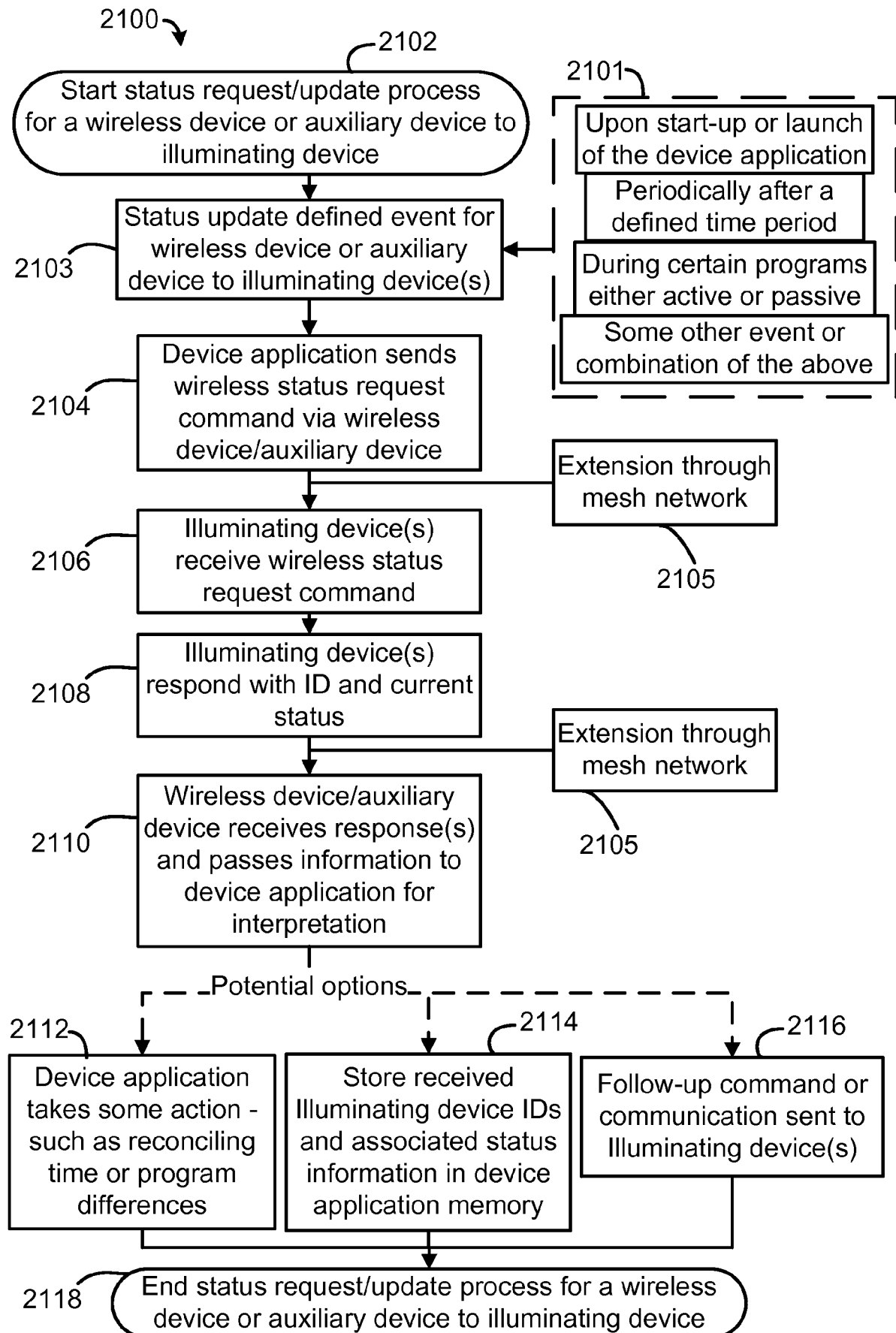


FIG. 21



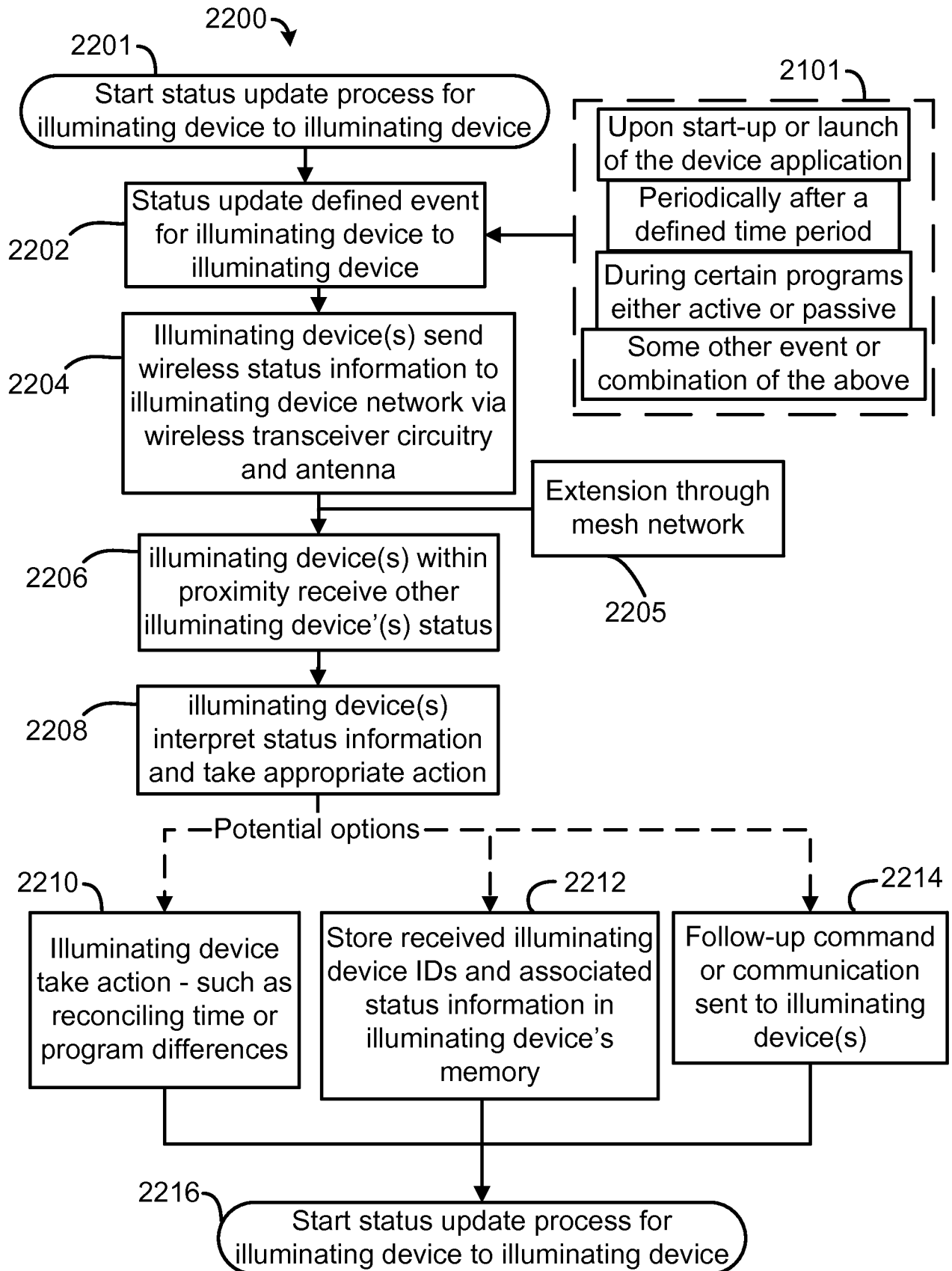


FIG. 22

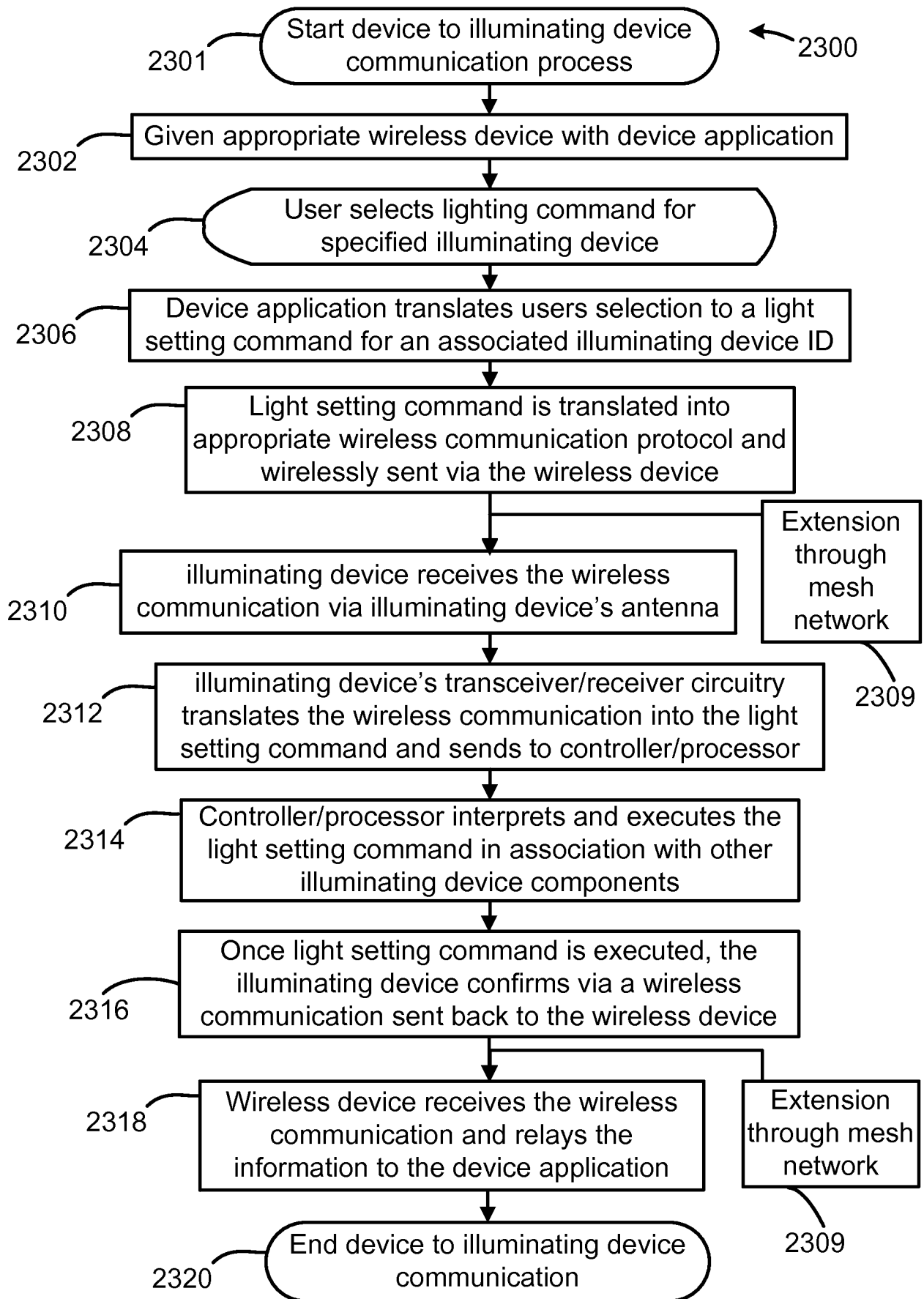


FIG. 23

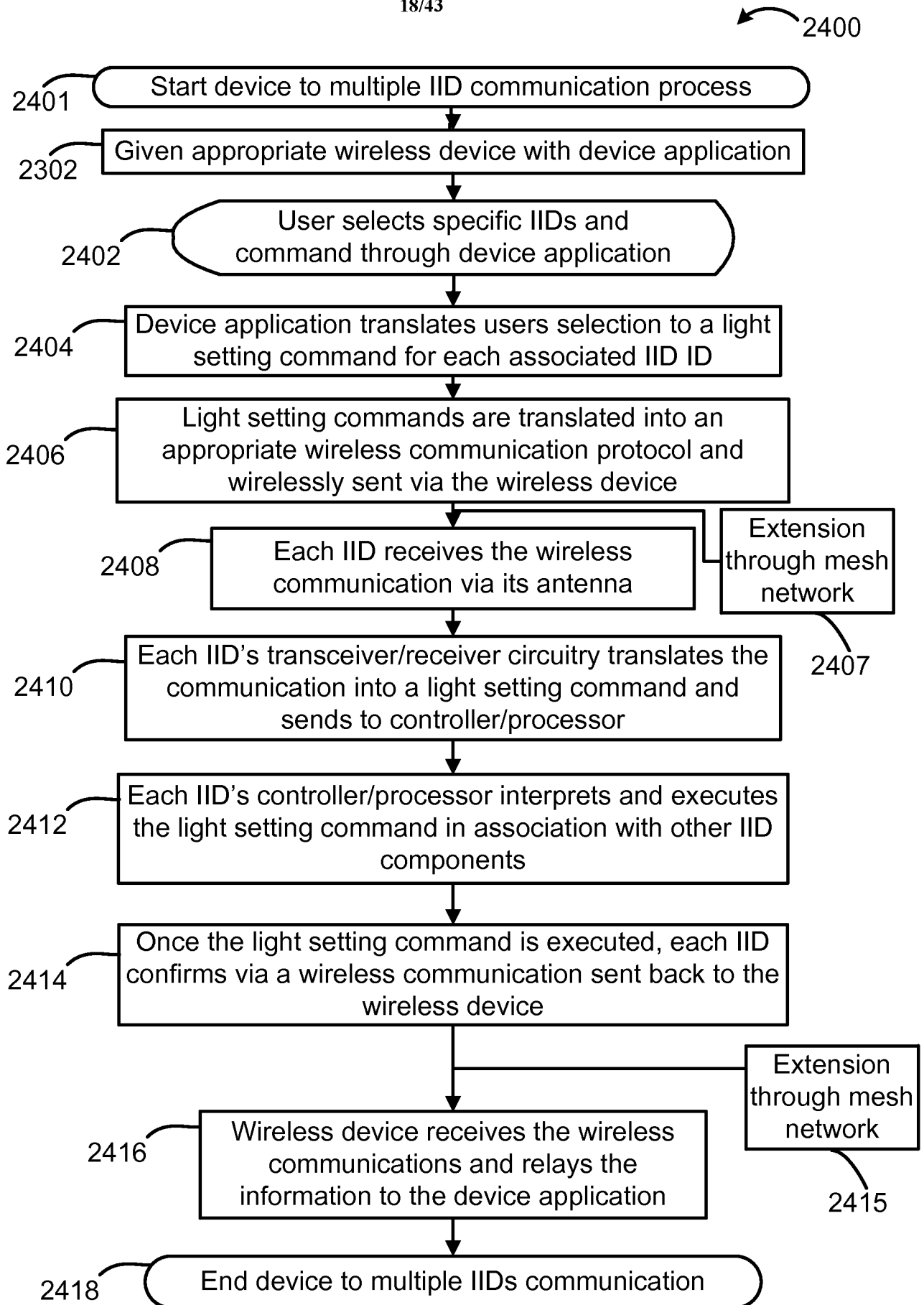
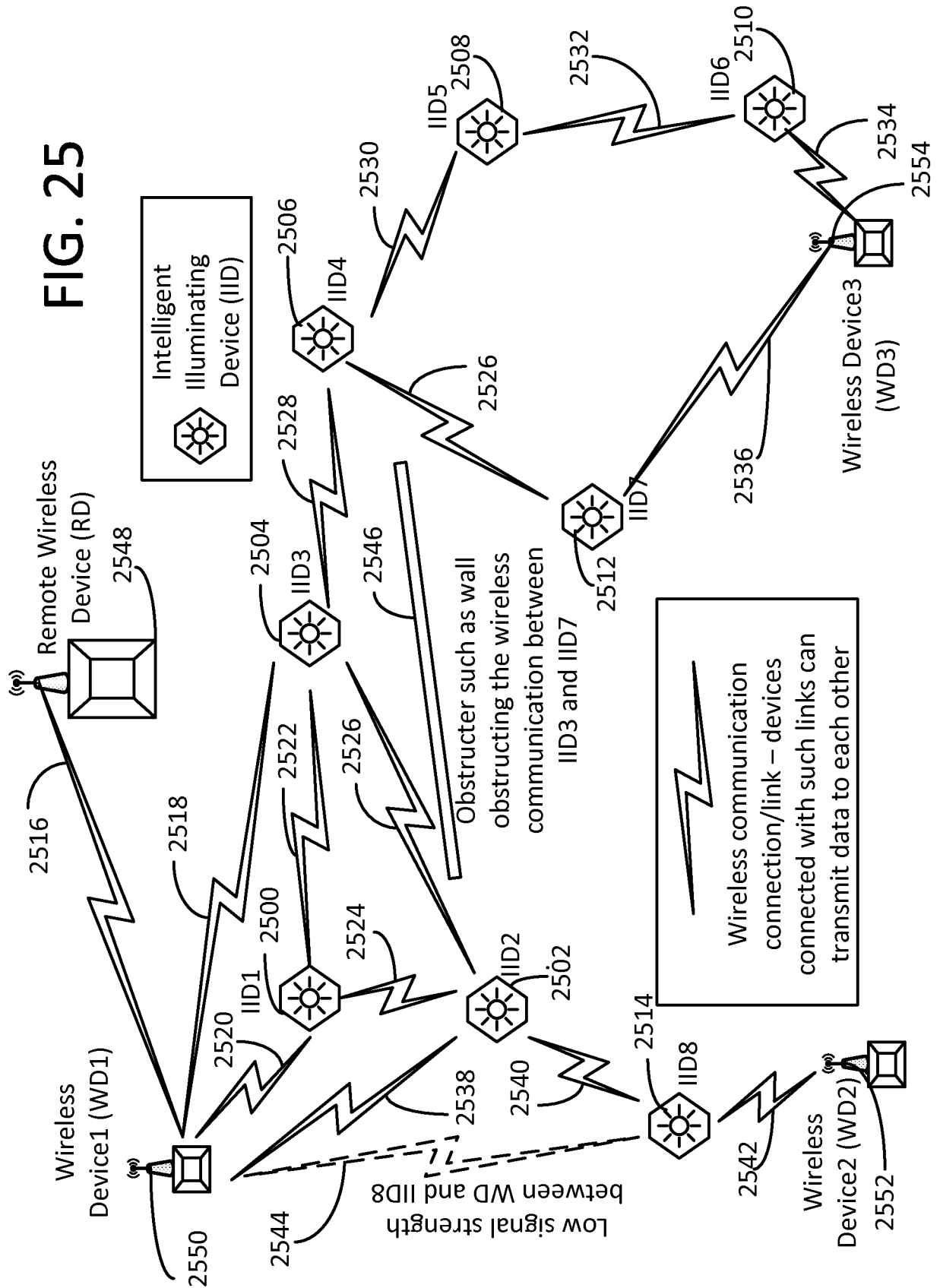


FIG. 24

FIG. 25



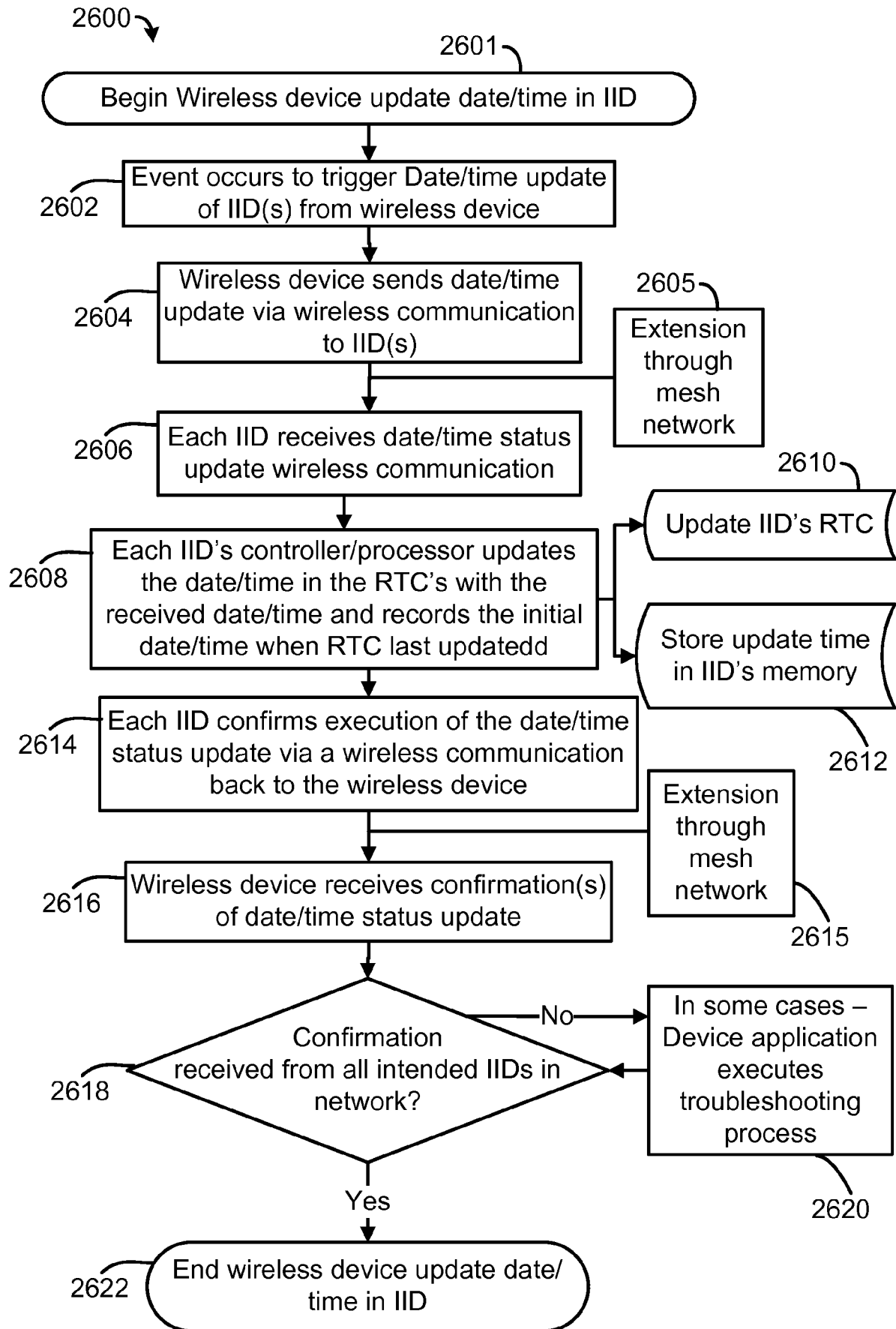


FIG. 26

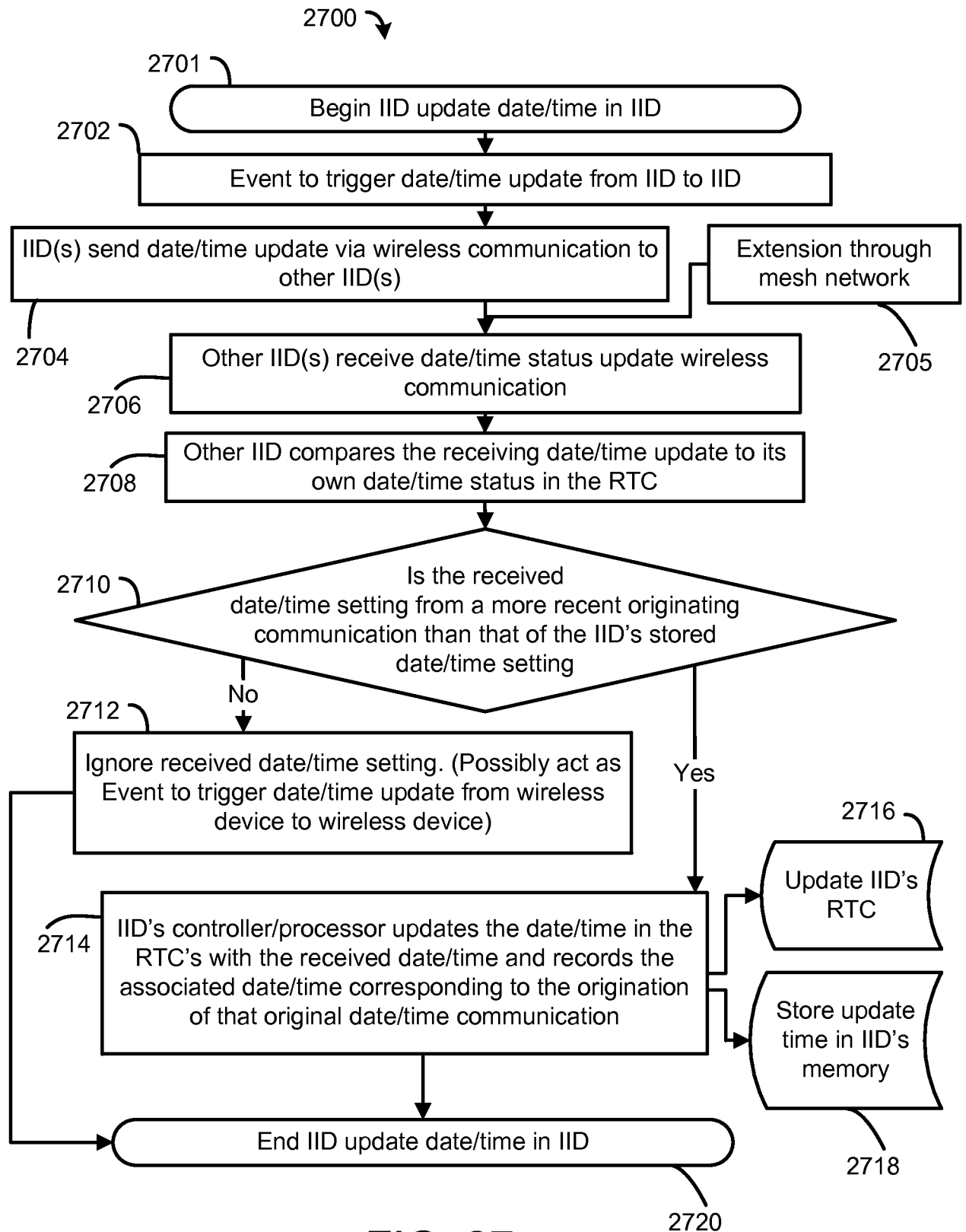


FIG. 27

FIG. 28

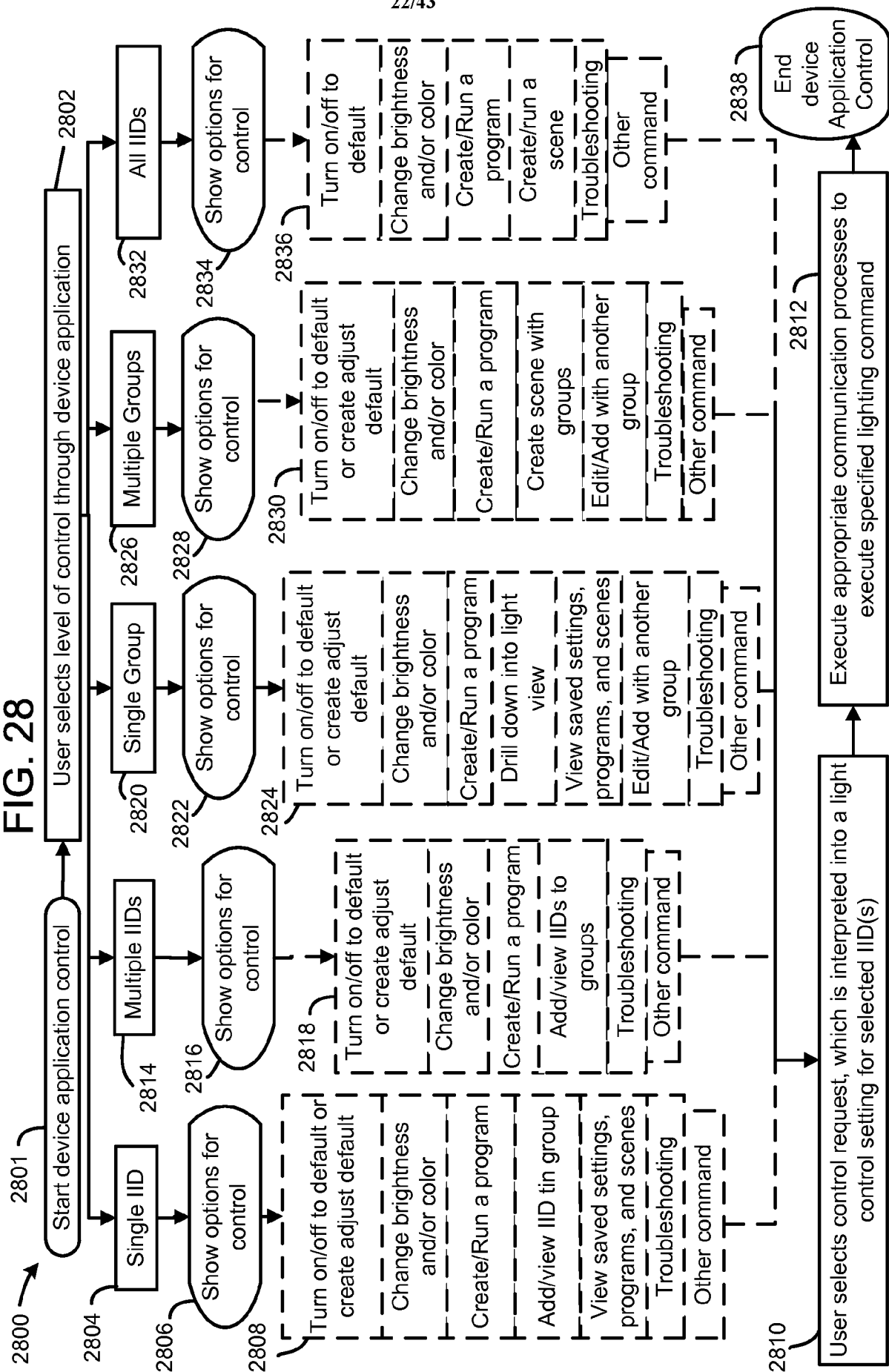
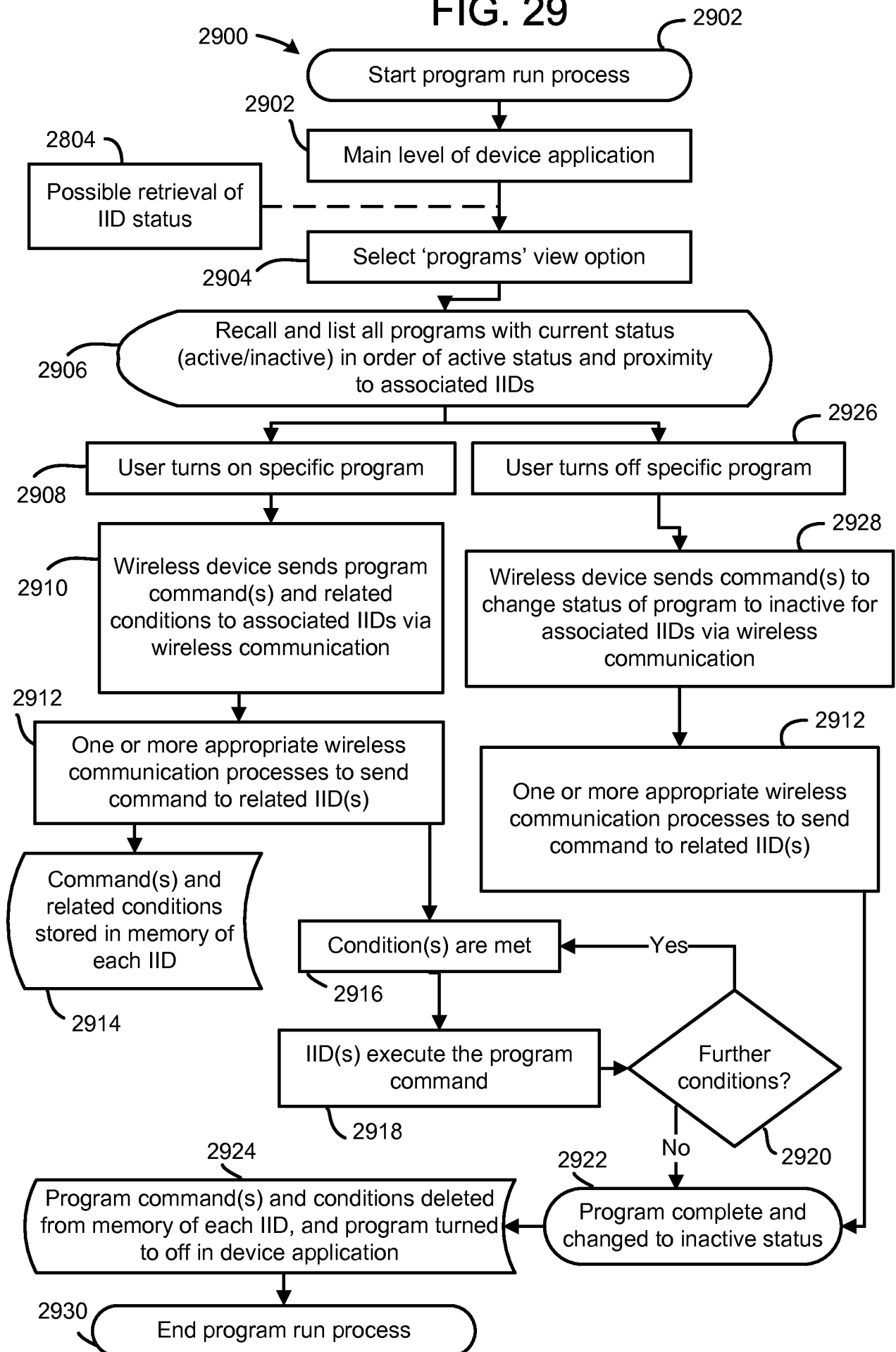


FIG. 29



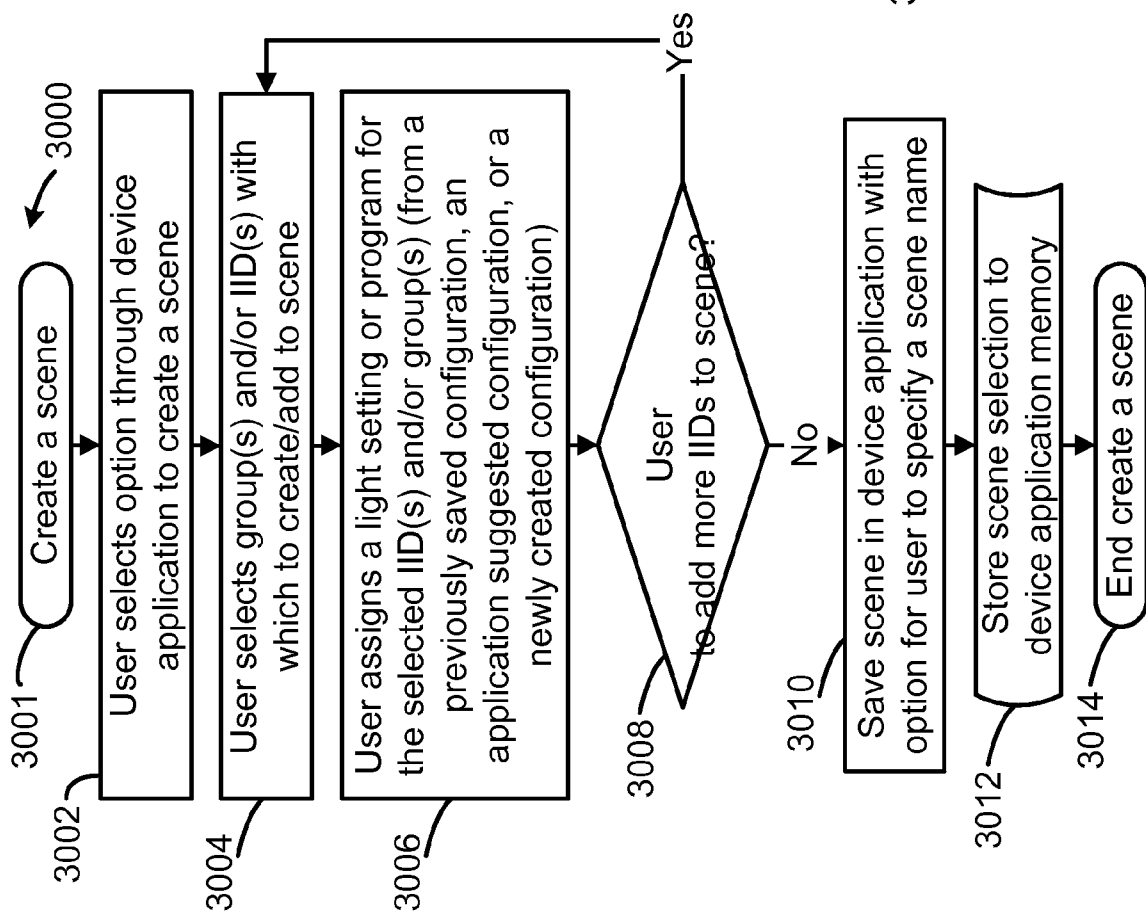


FIG. 30

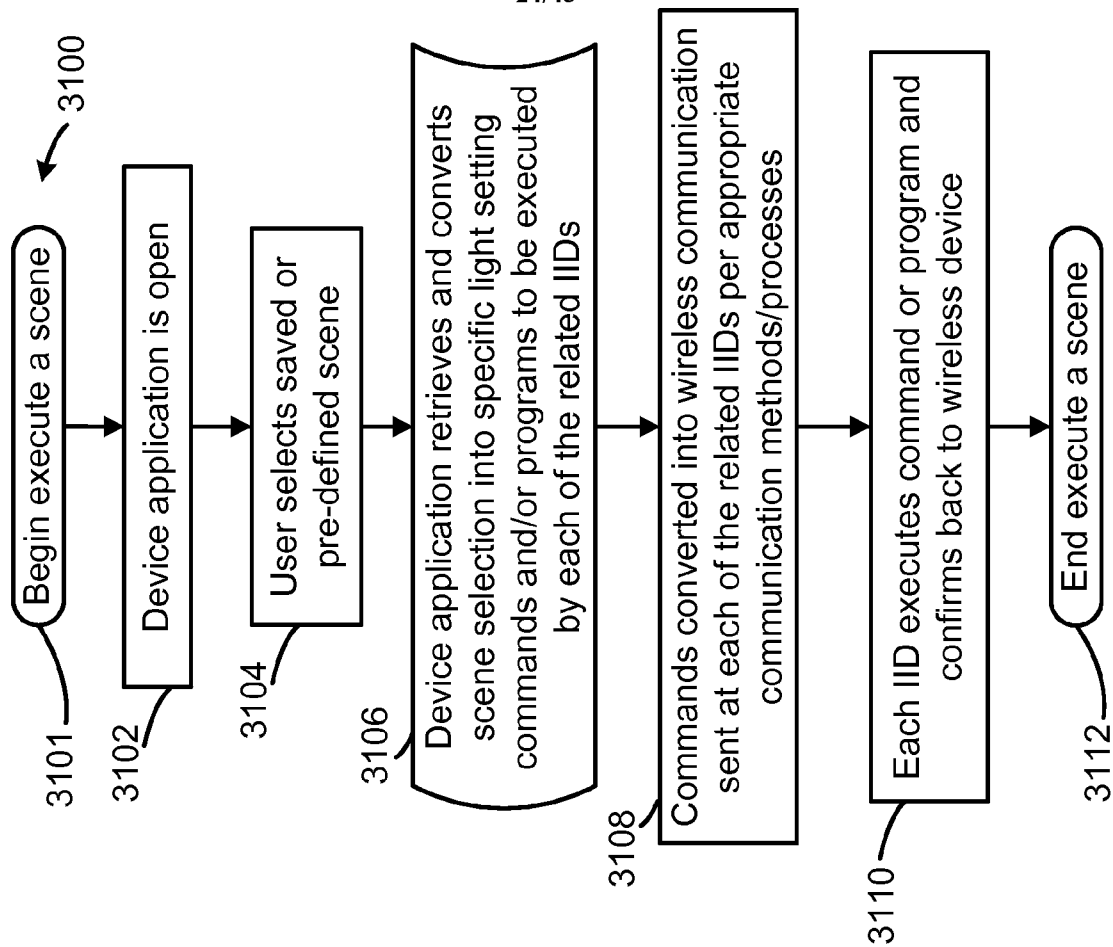


FIG. 31

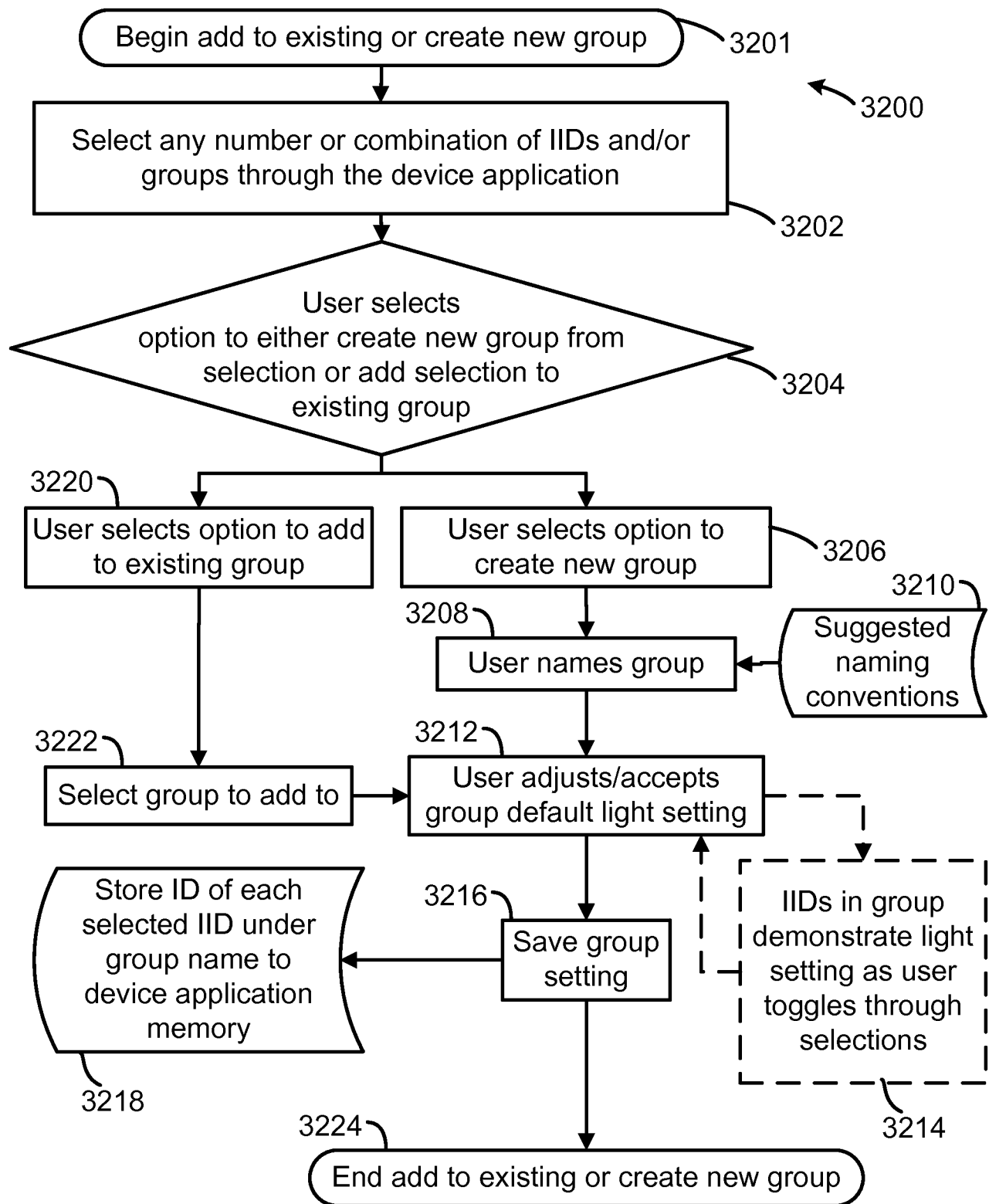
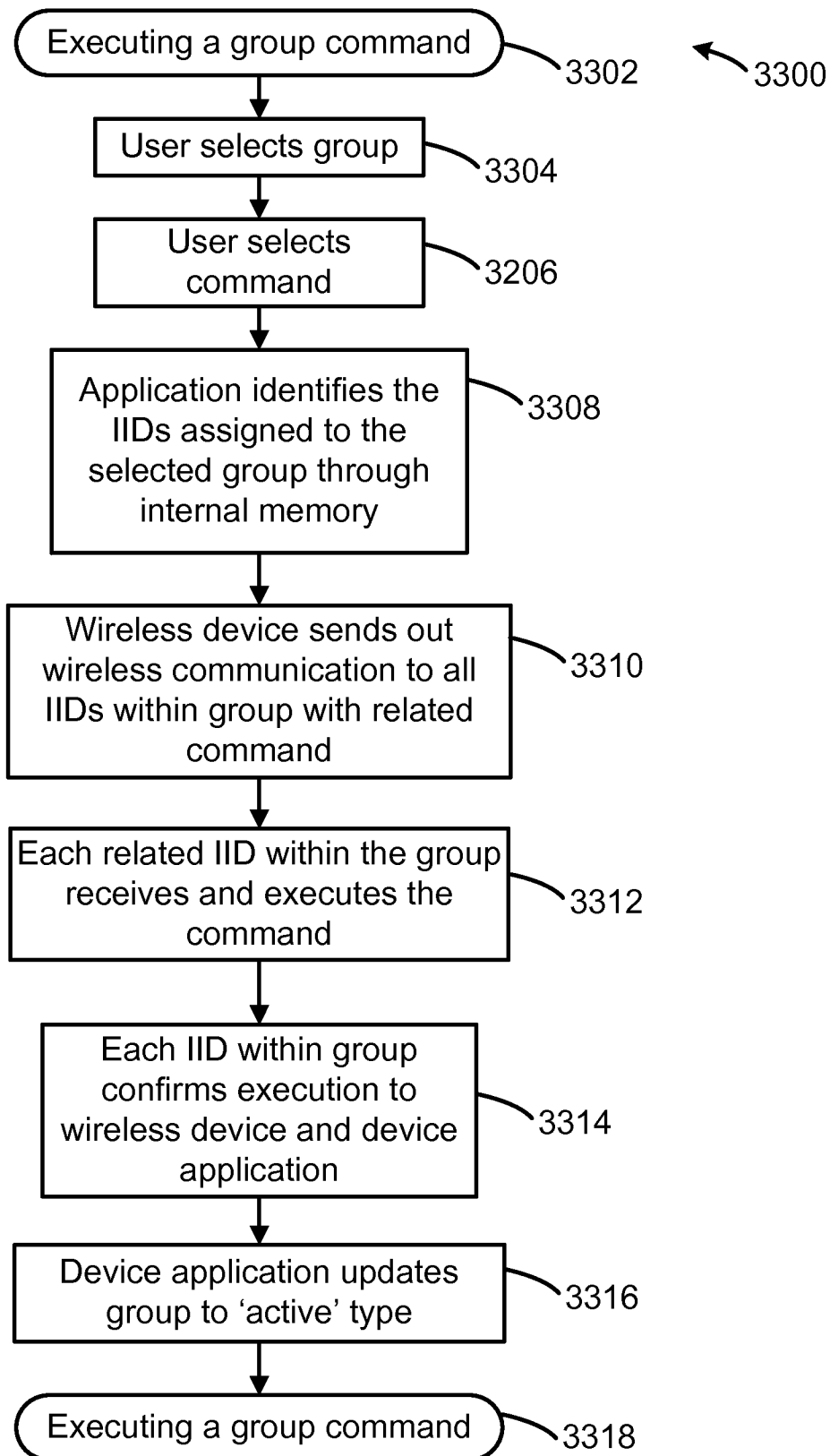


FIG. 32

**FIG. 33**

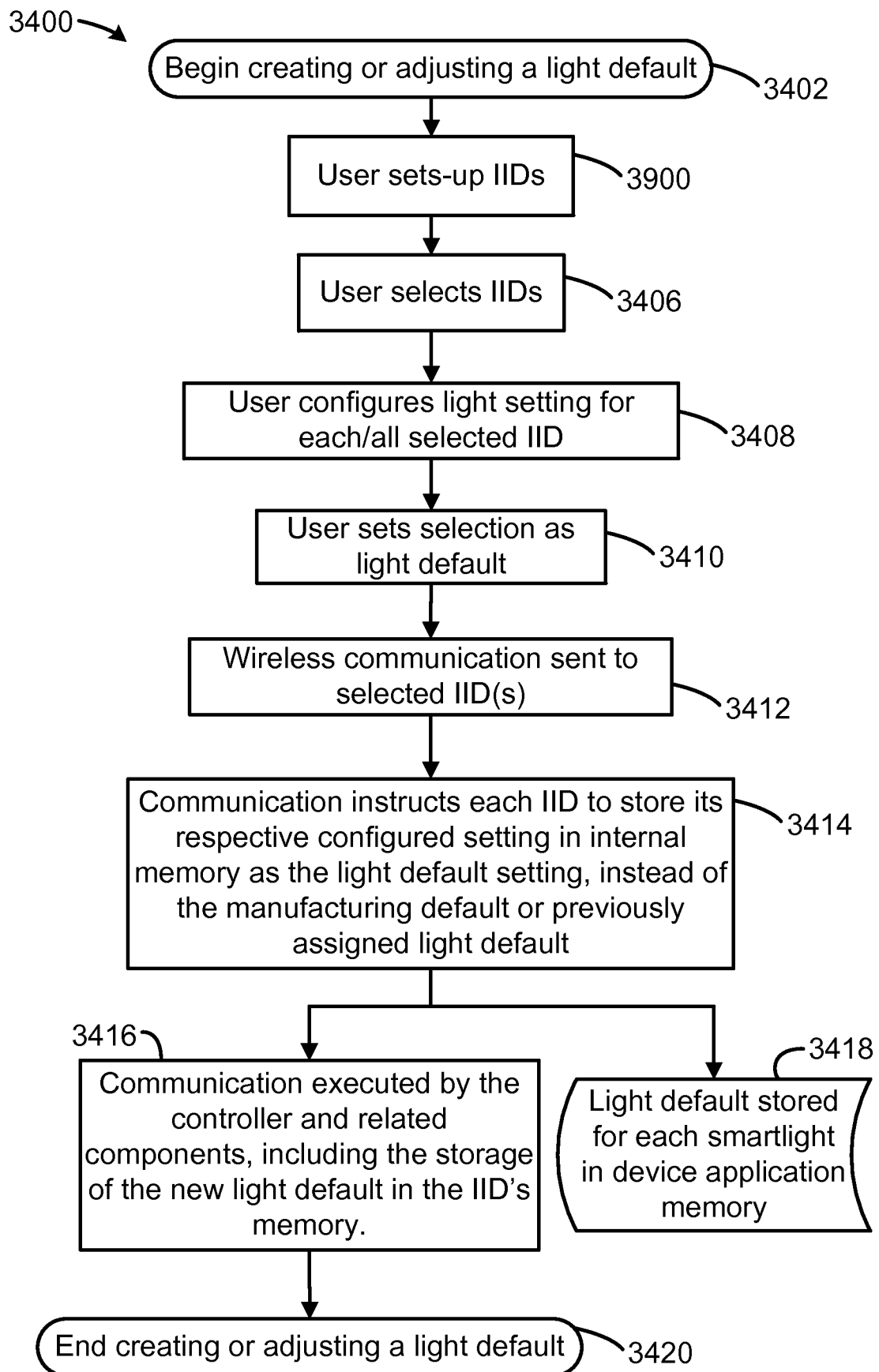


FIG. 34

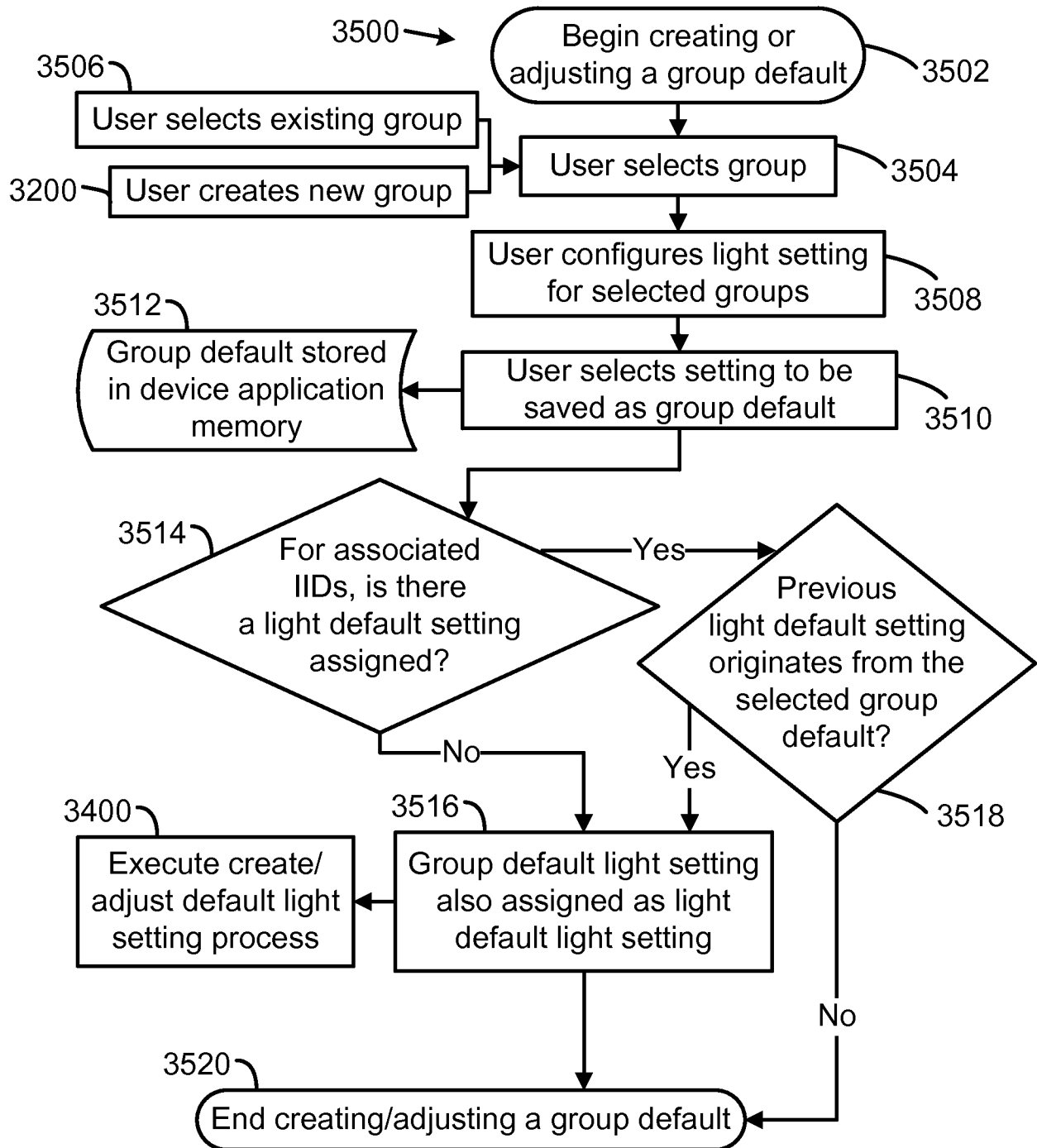
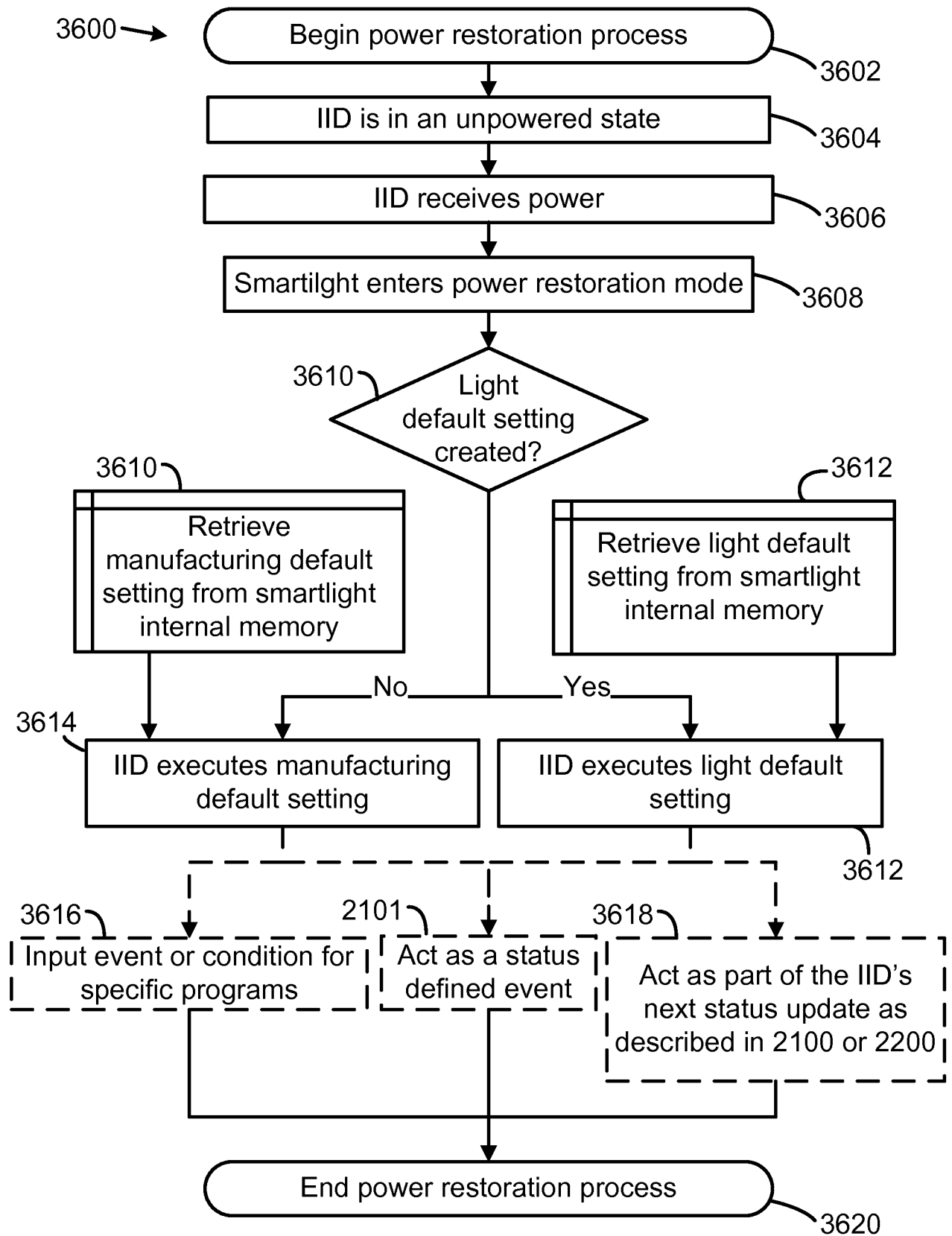


FIG. 35

FIG. 36



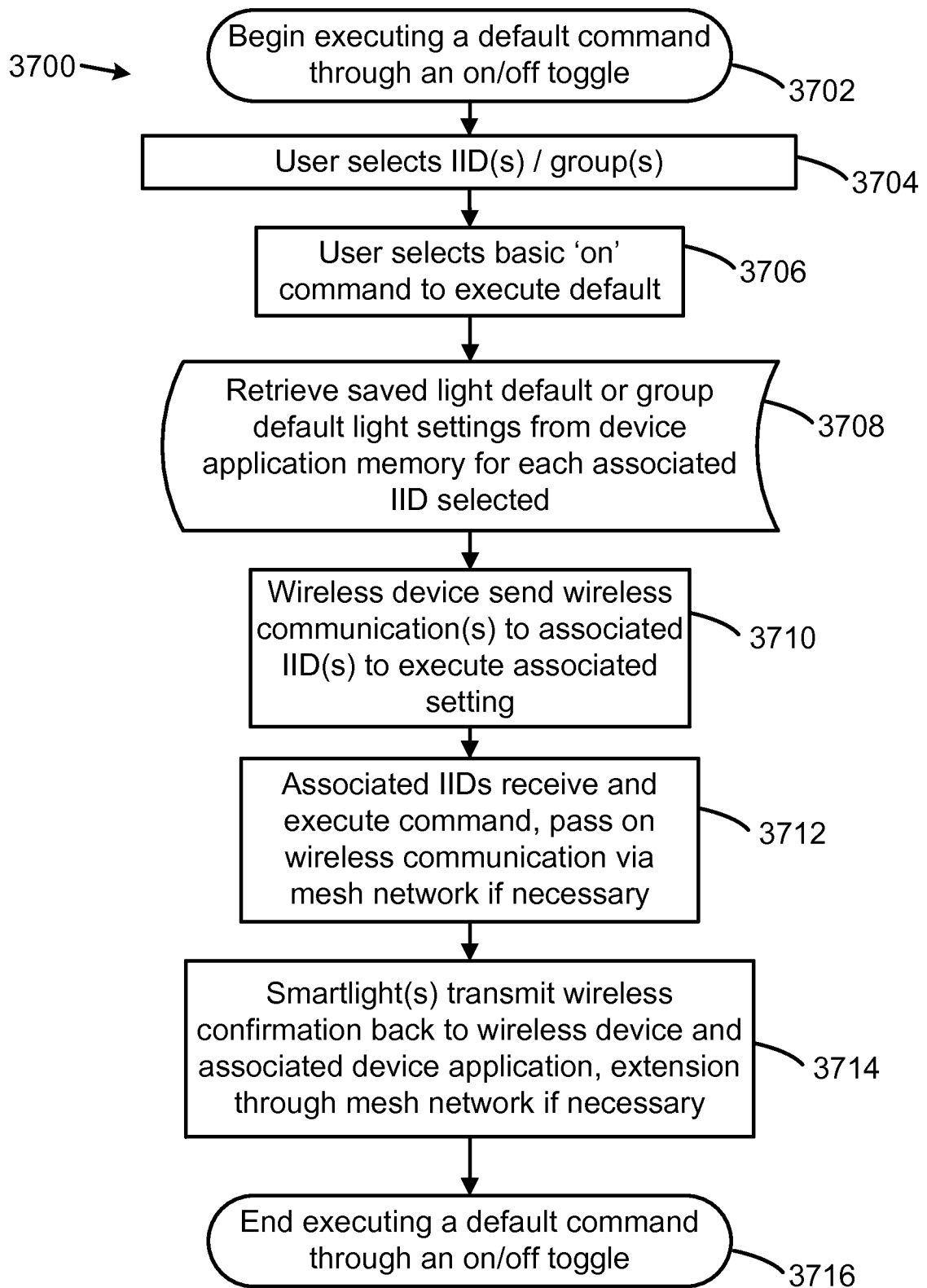


FIG. 37

FIG. 38A

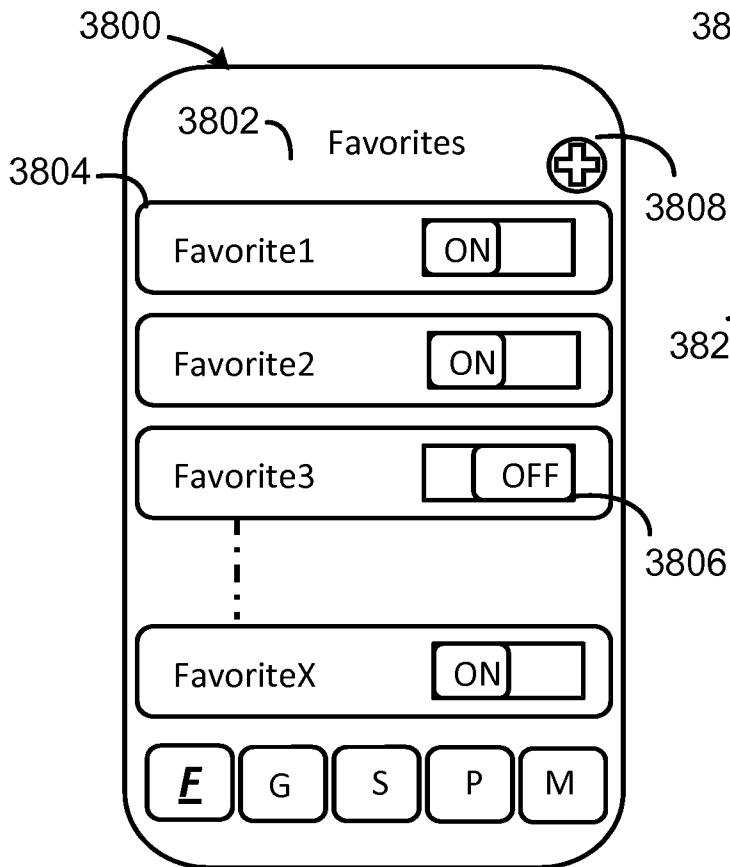


FIG. 38B

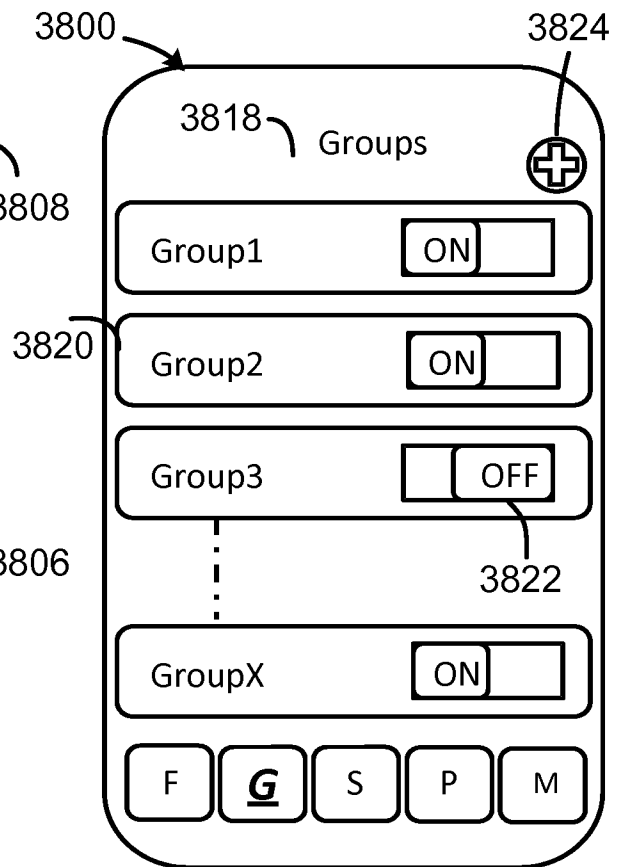


FIG. 38C

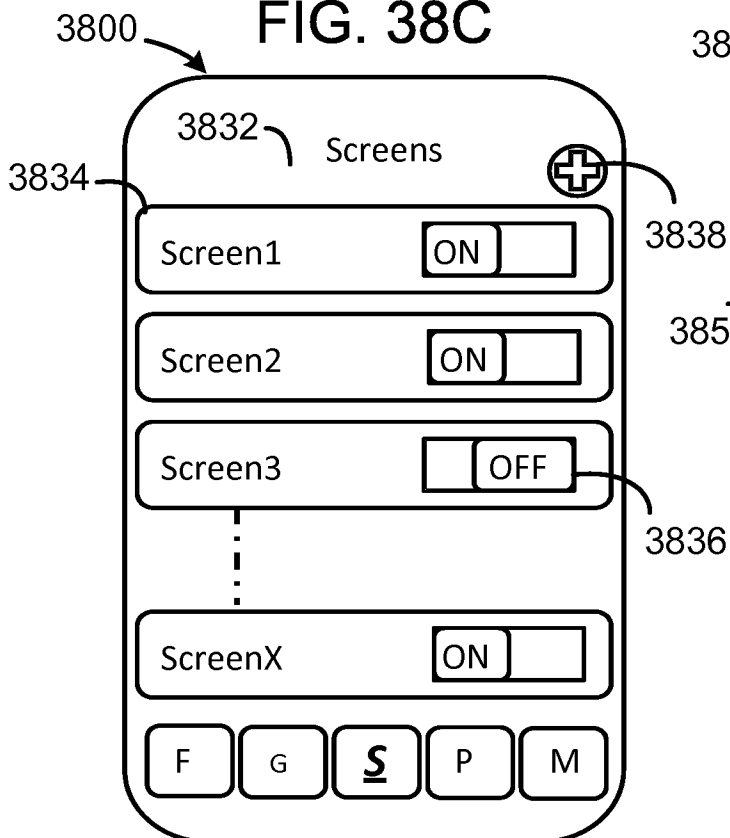
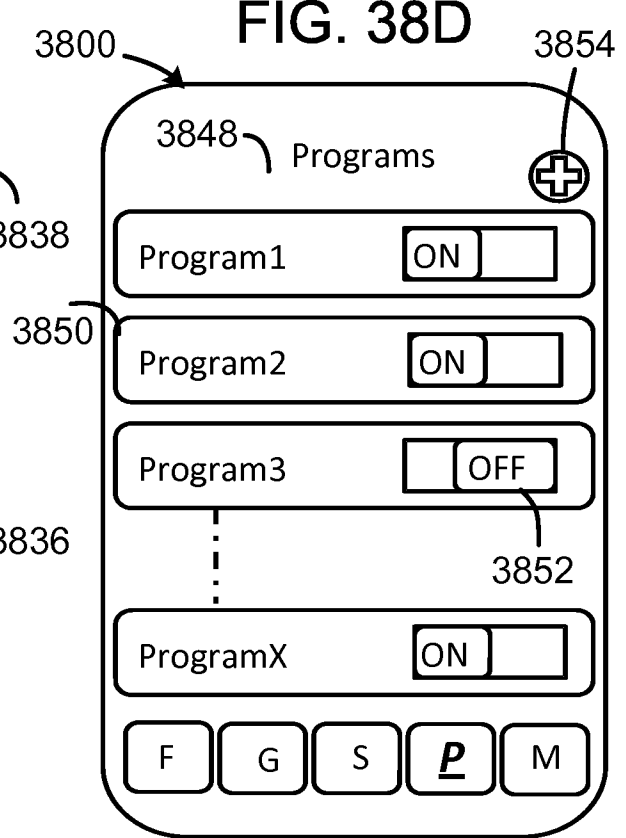


FIG. 38D



F: Favorites, G: Groups, S:
Screens, P: Programs, M: More

FIG. 38E

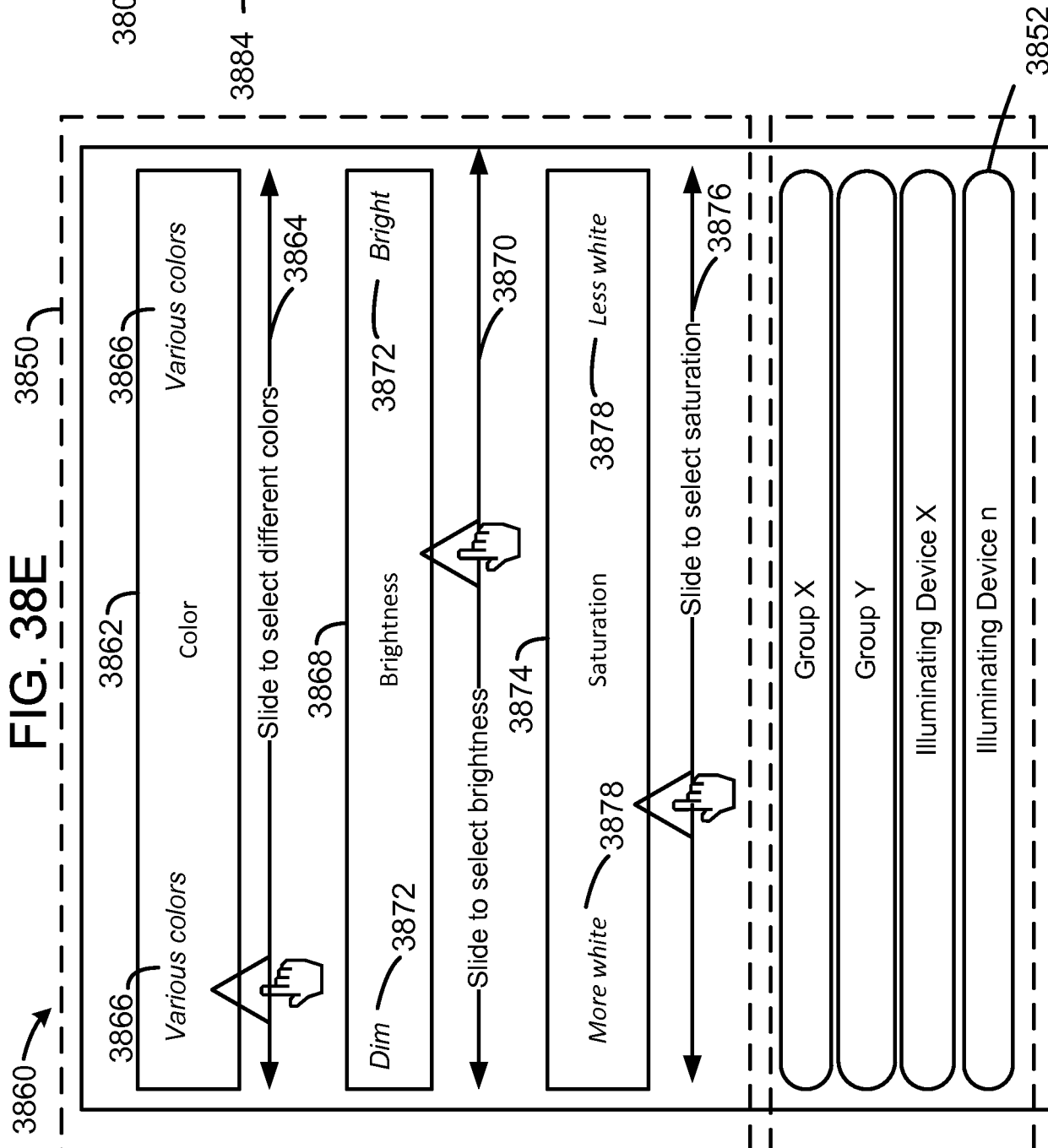
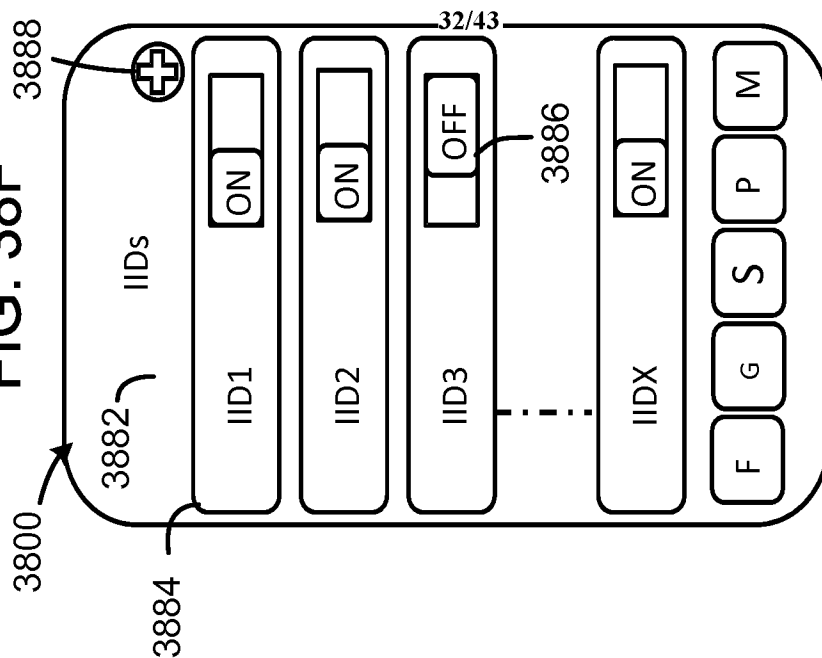
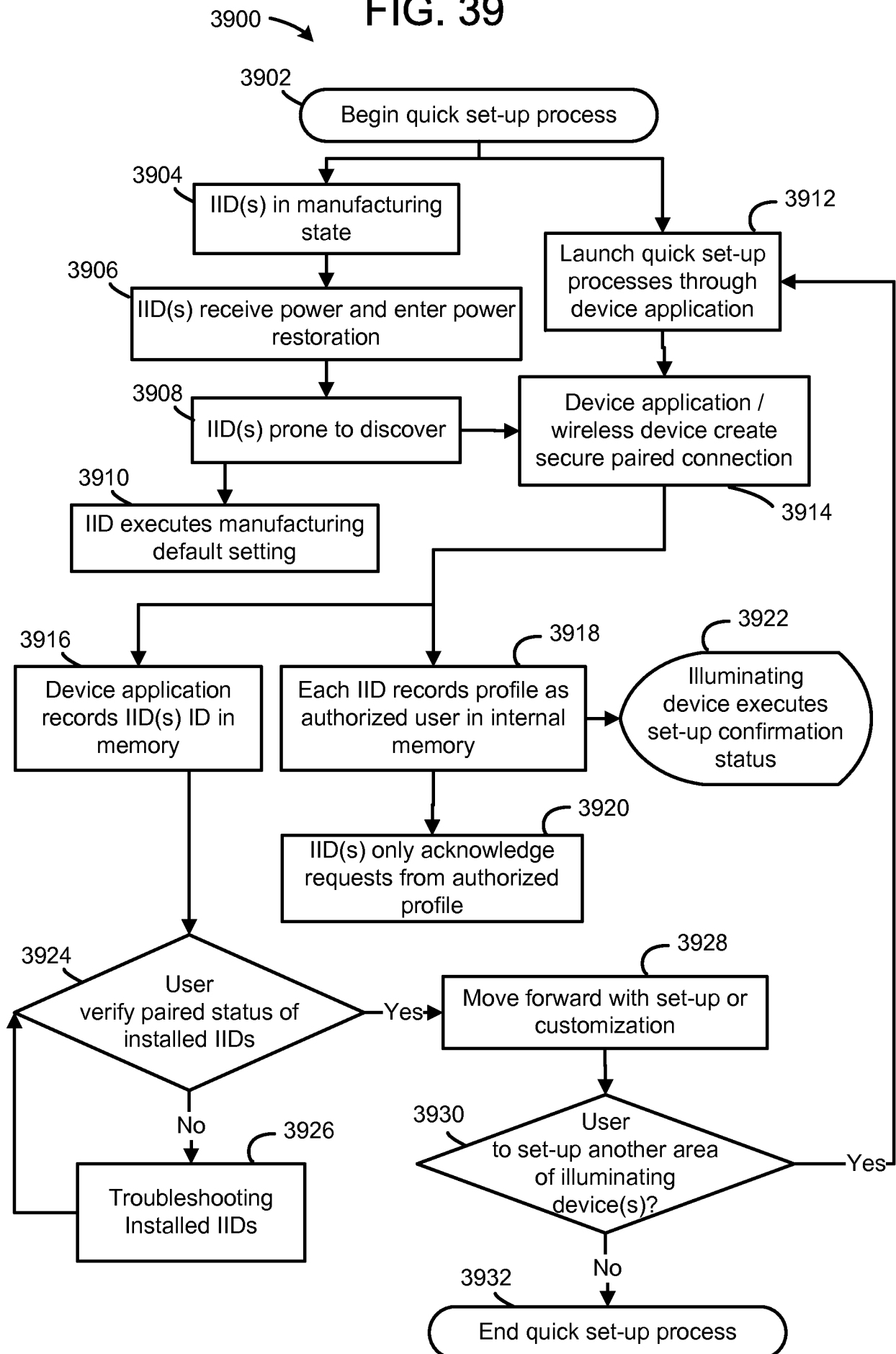


FIG. 38F



F: Favorites,
G: Groups,
S: Screens,
P: Programs,
M: More

FIG. 39



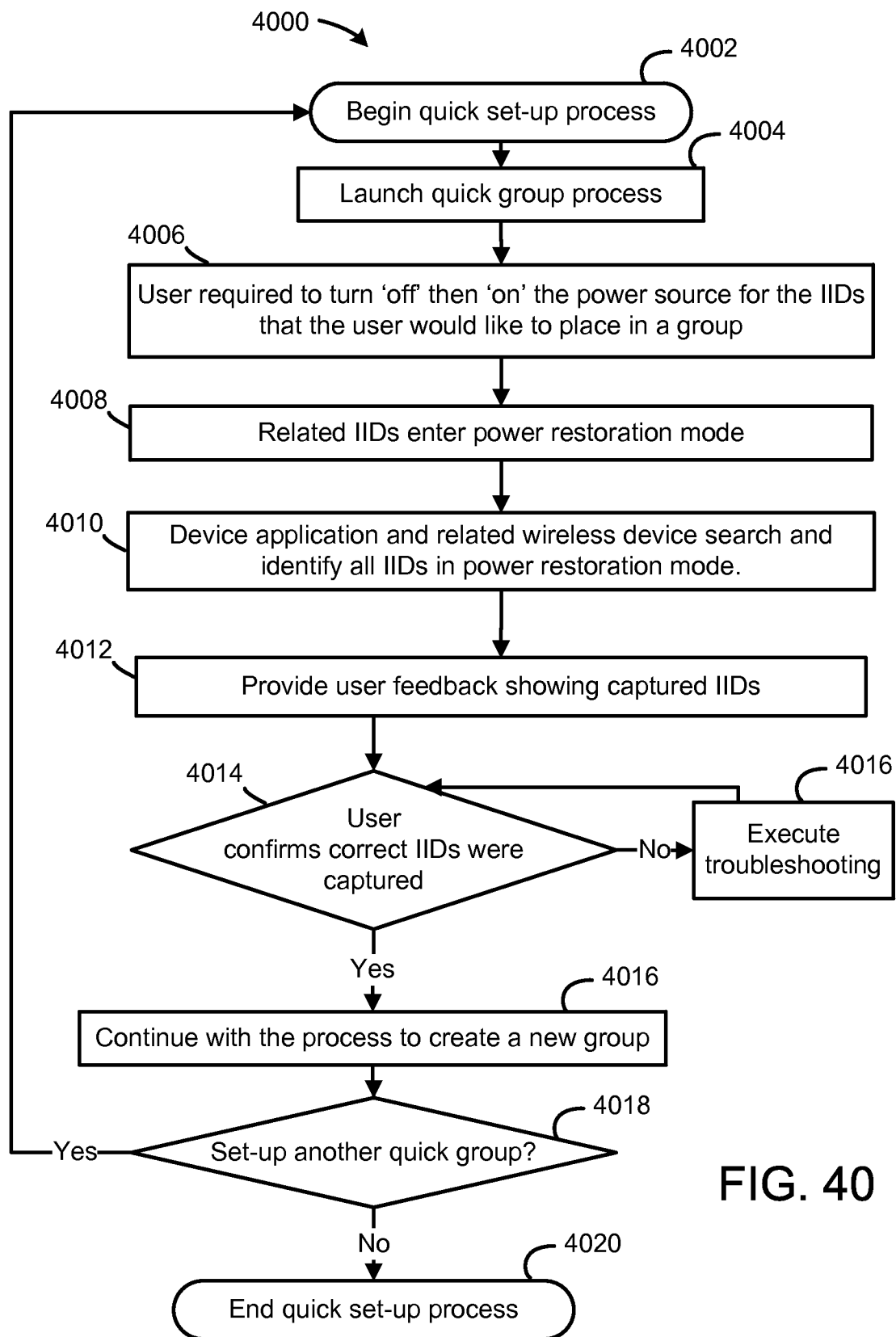


FIG. 40

FIG. 41

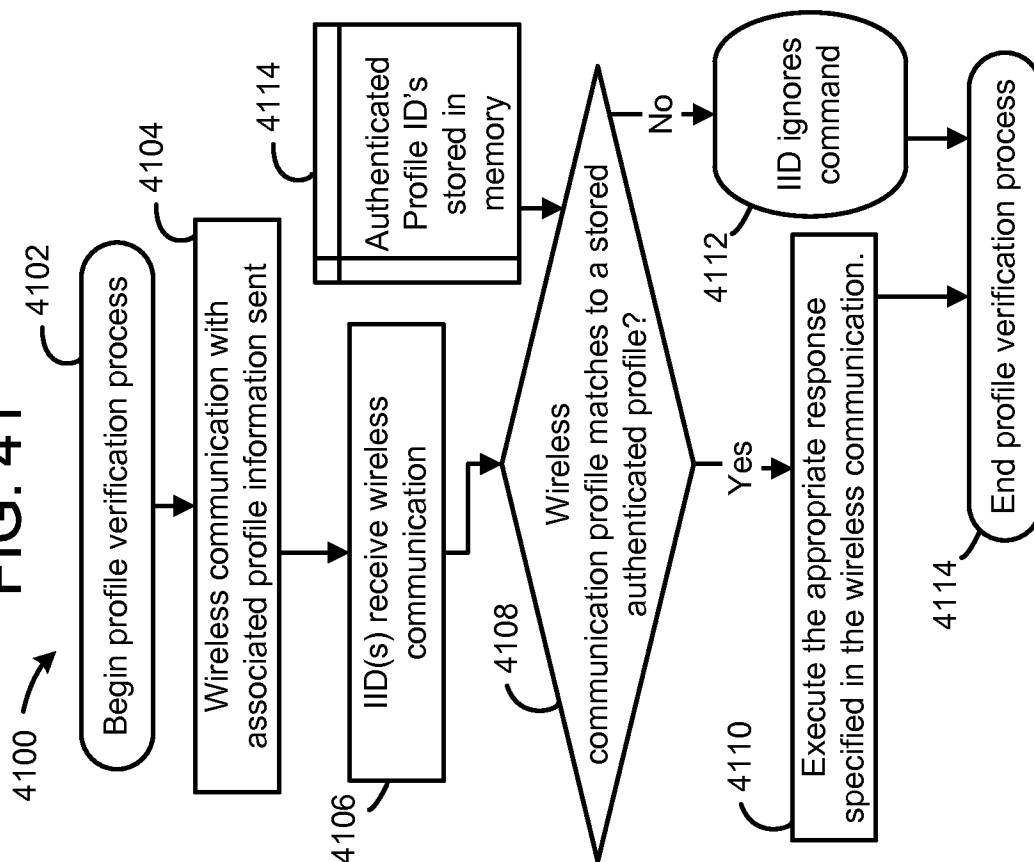
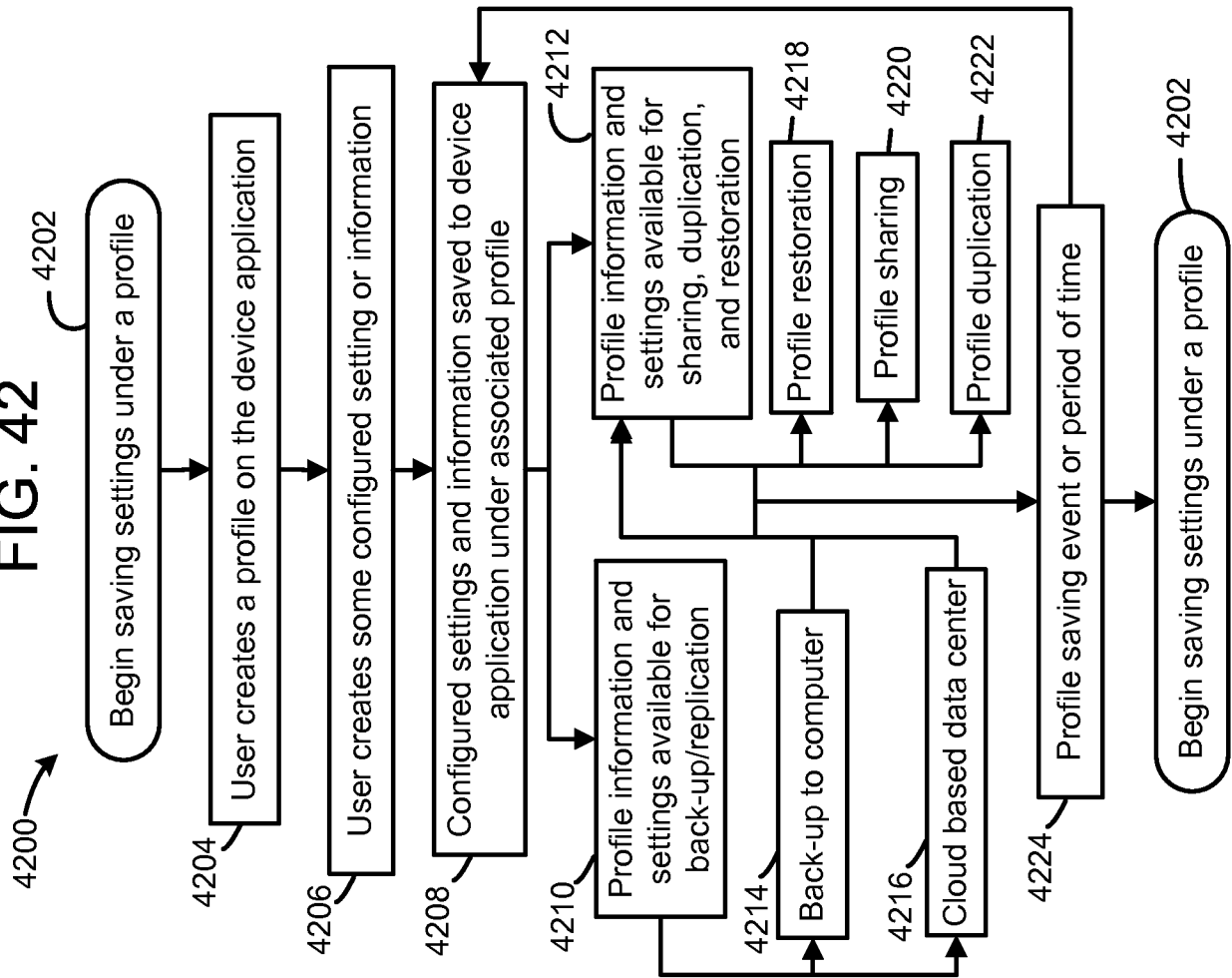


FIG. 42



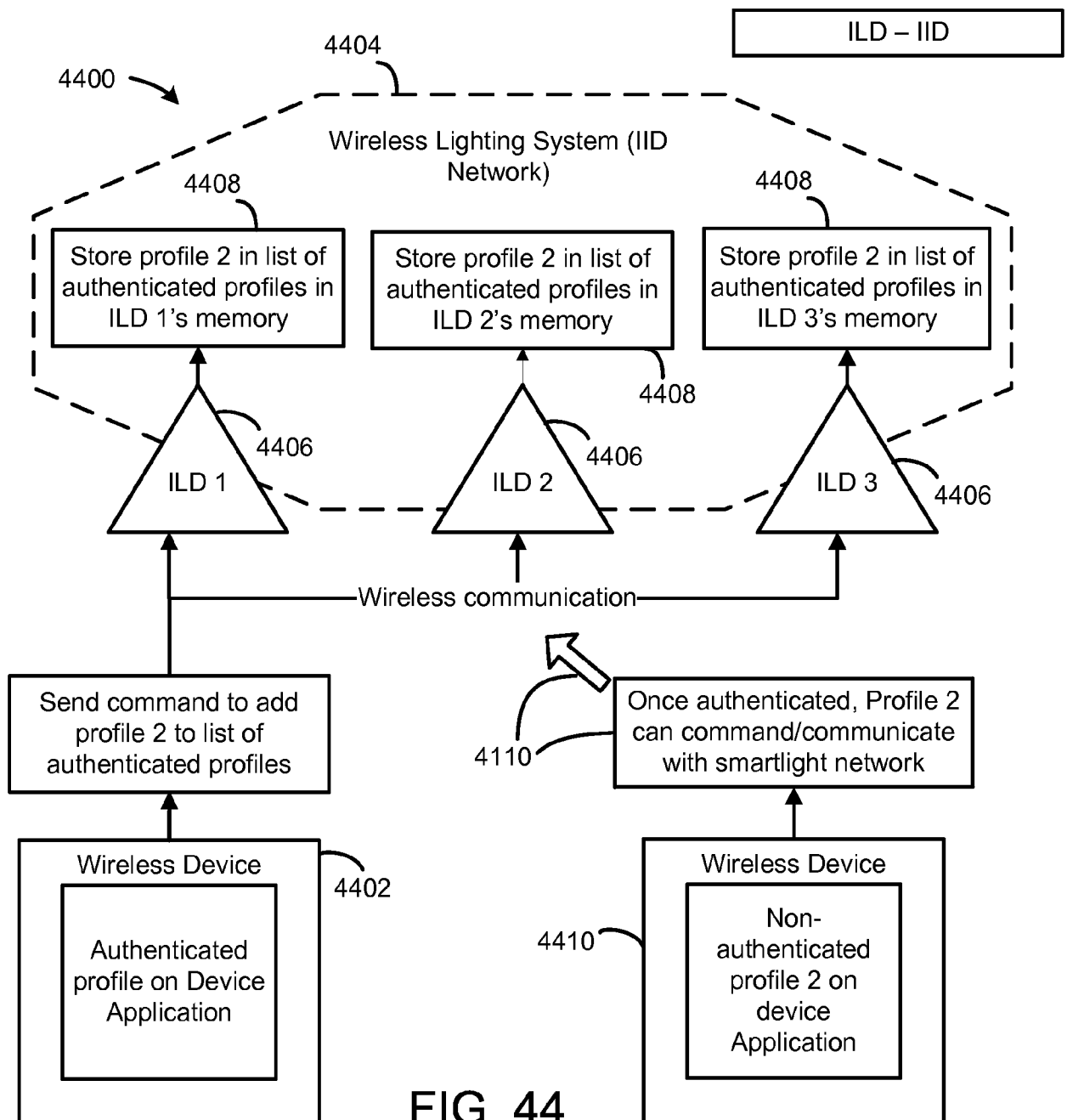
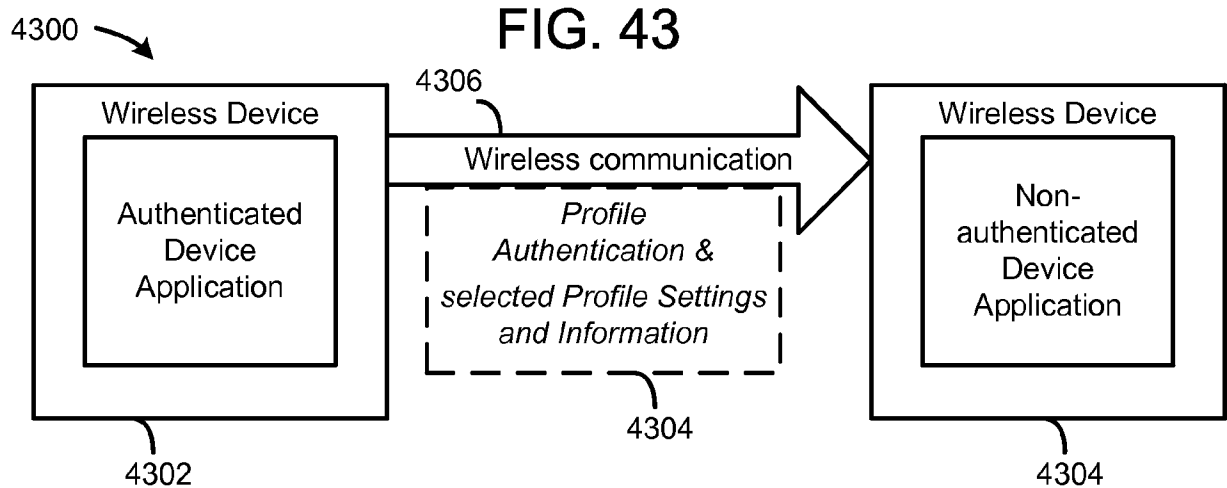


FIG. 45

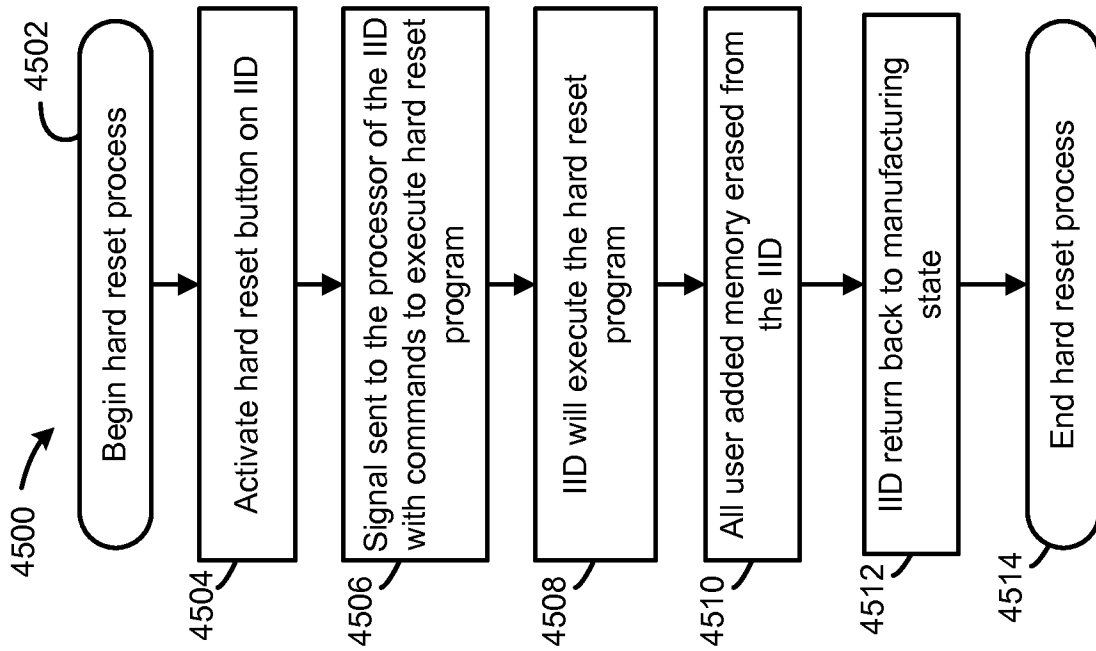


FIG. 46

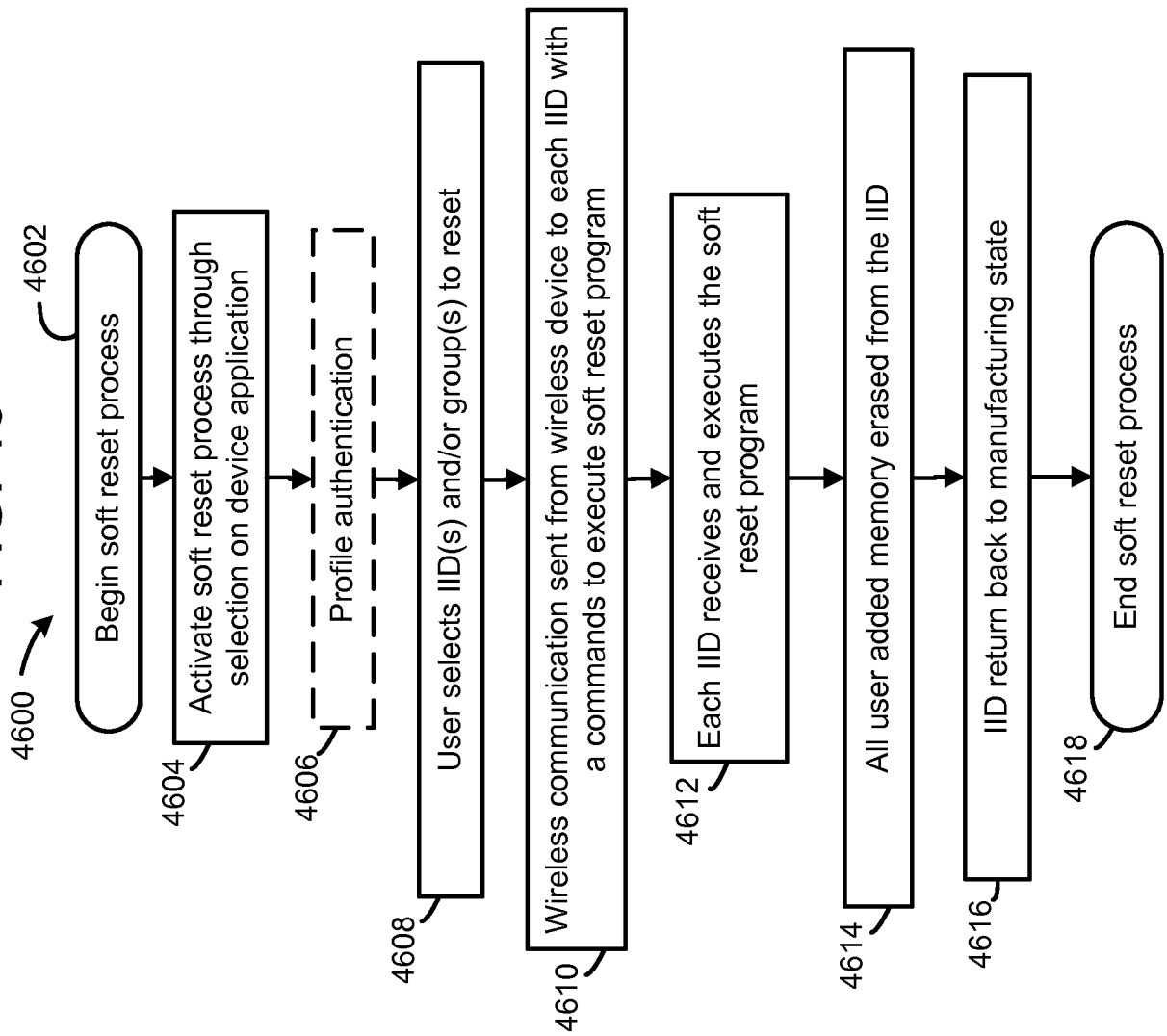


FIG. 47

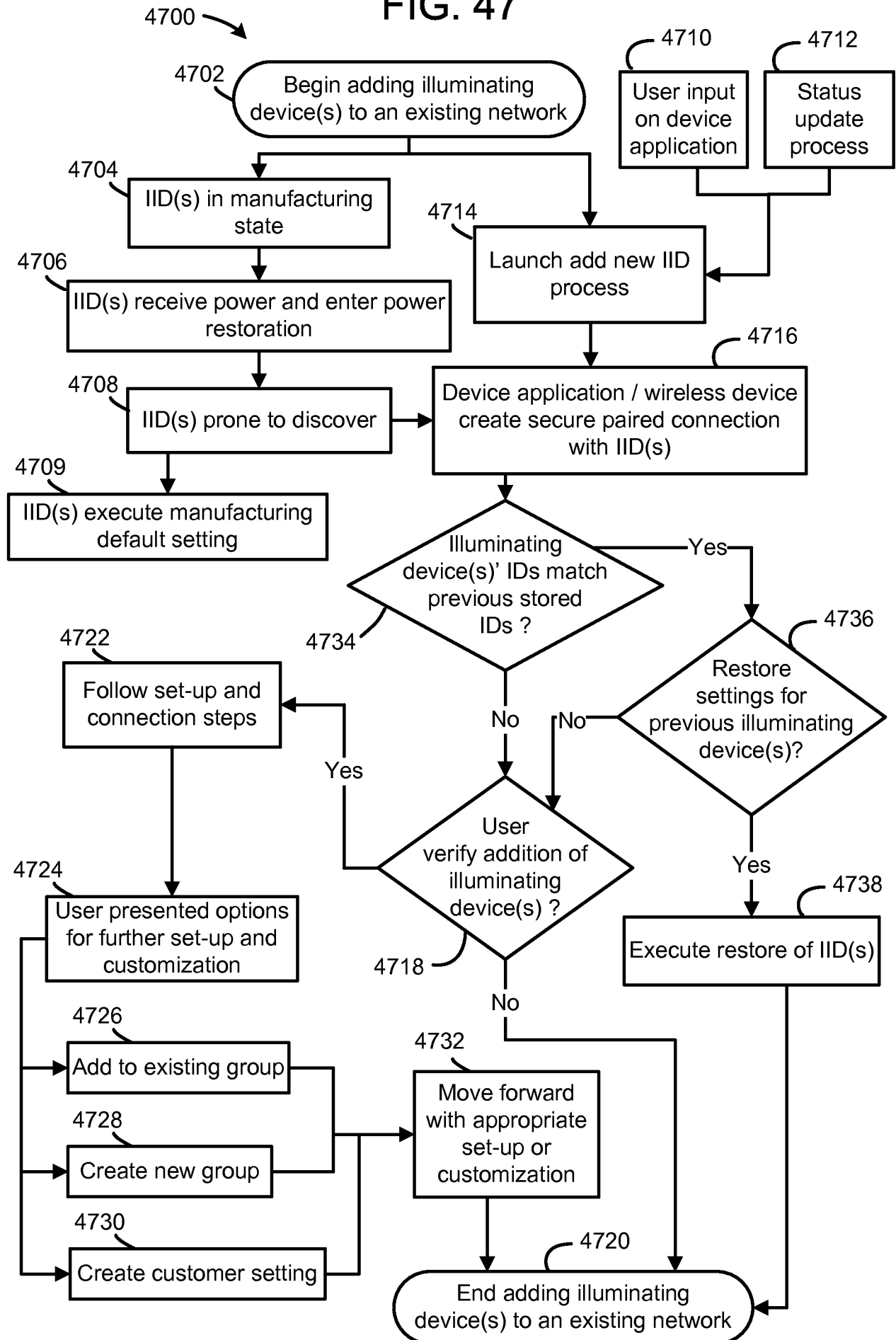


FIG. 49

4900

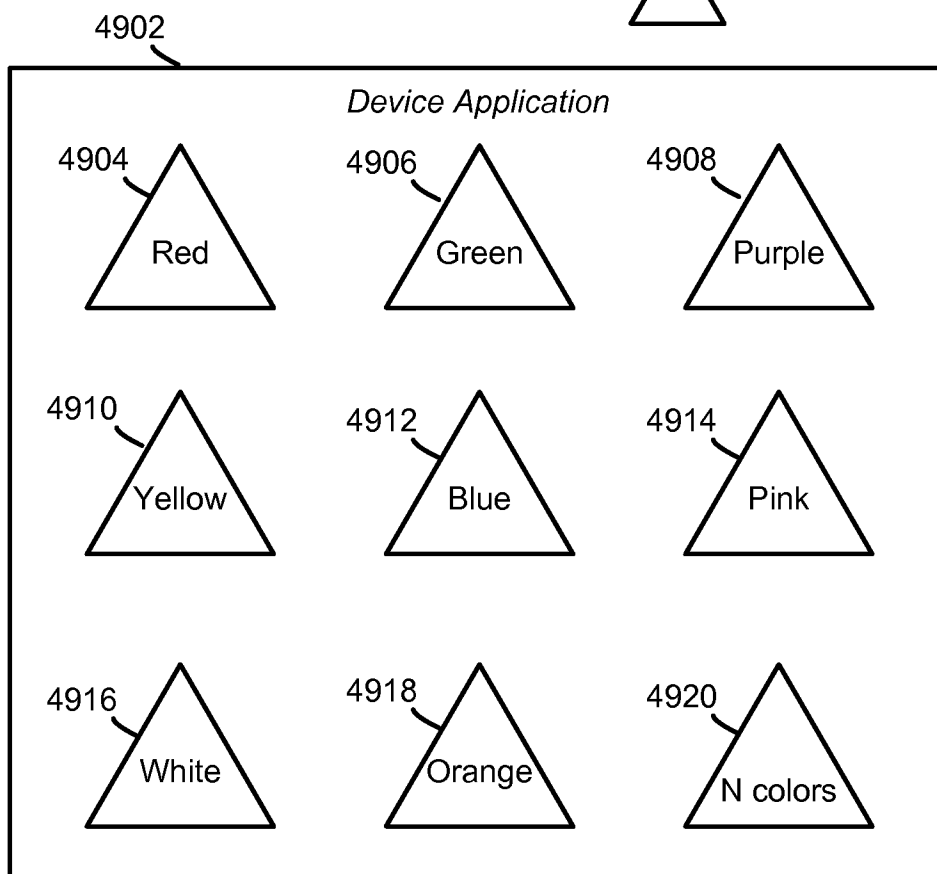


FIG. 50

5000

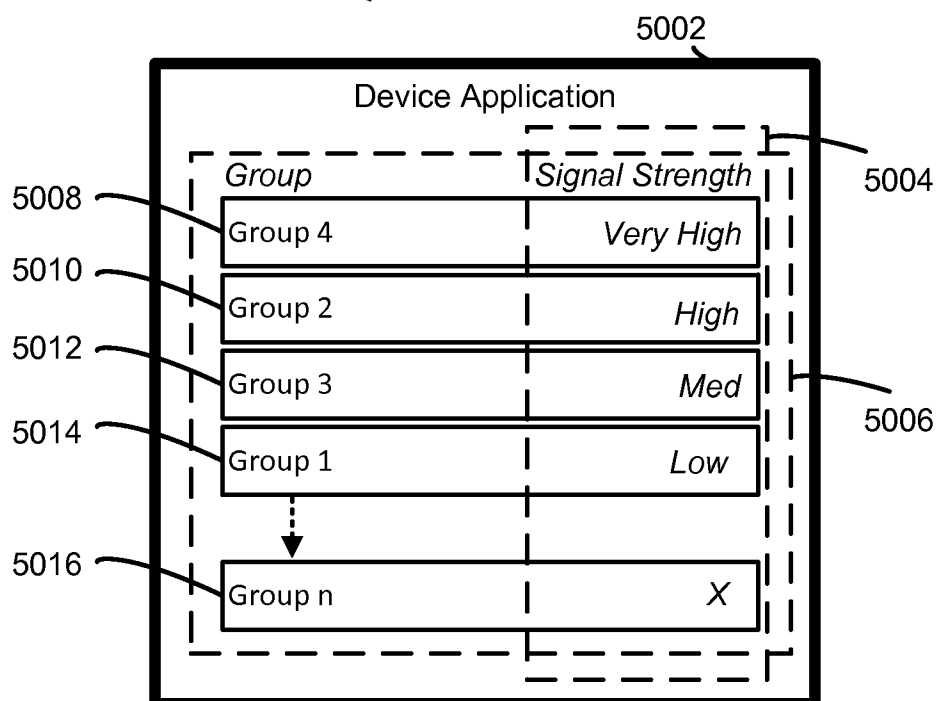


FIG. 51

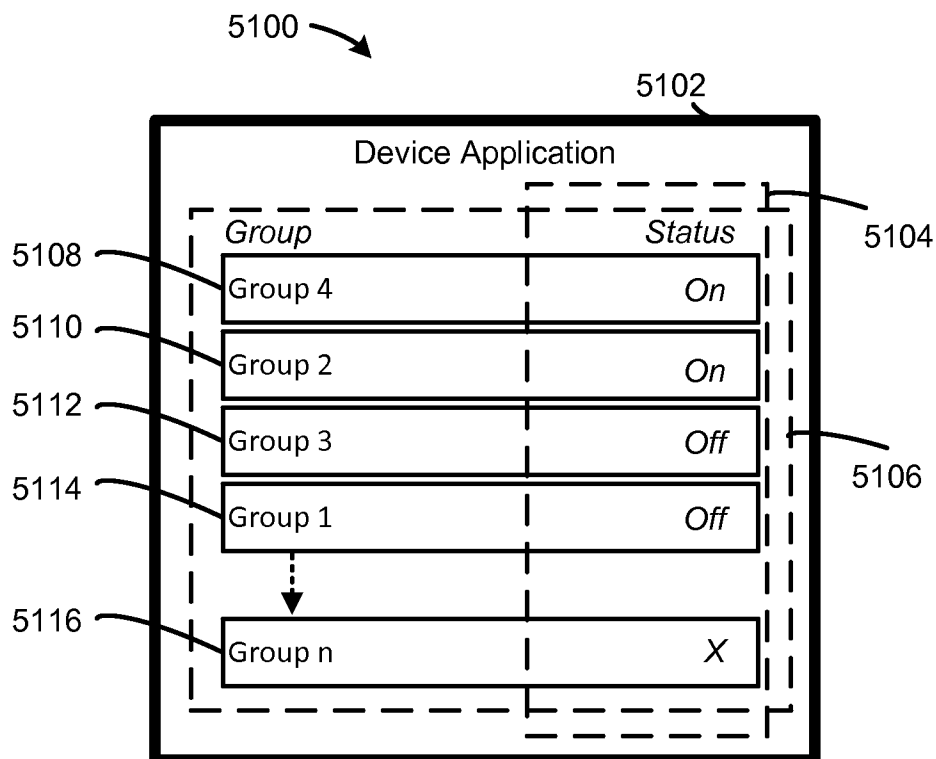
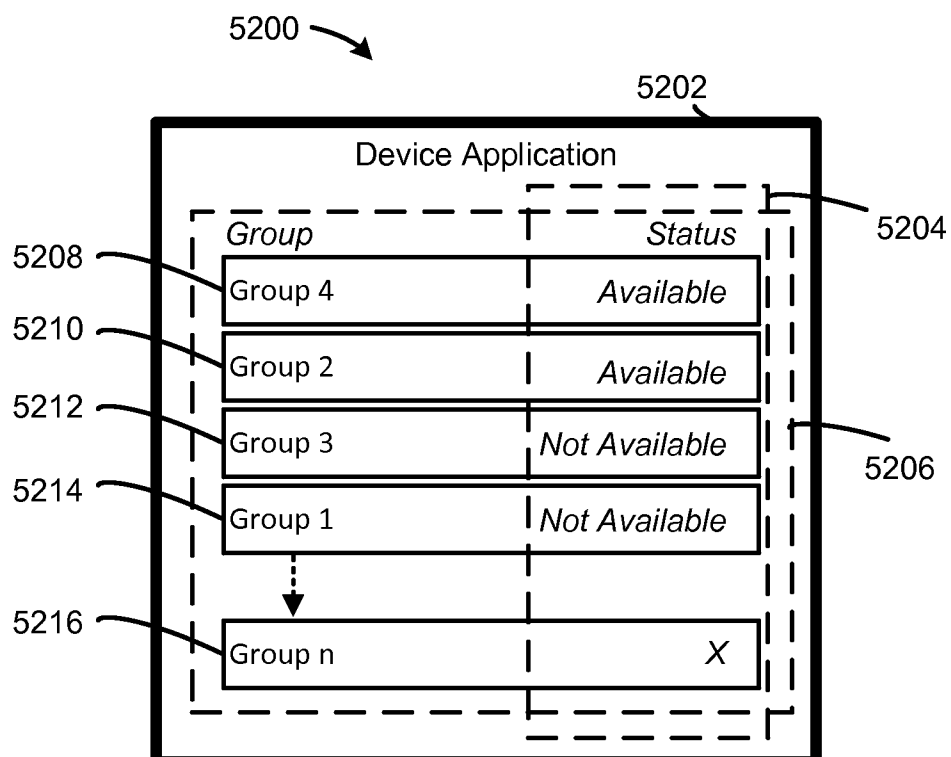


FIG. 52



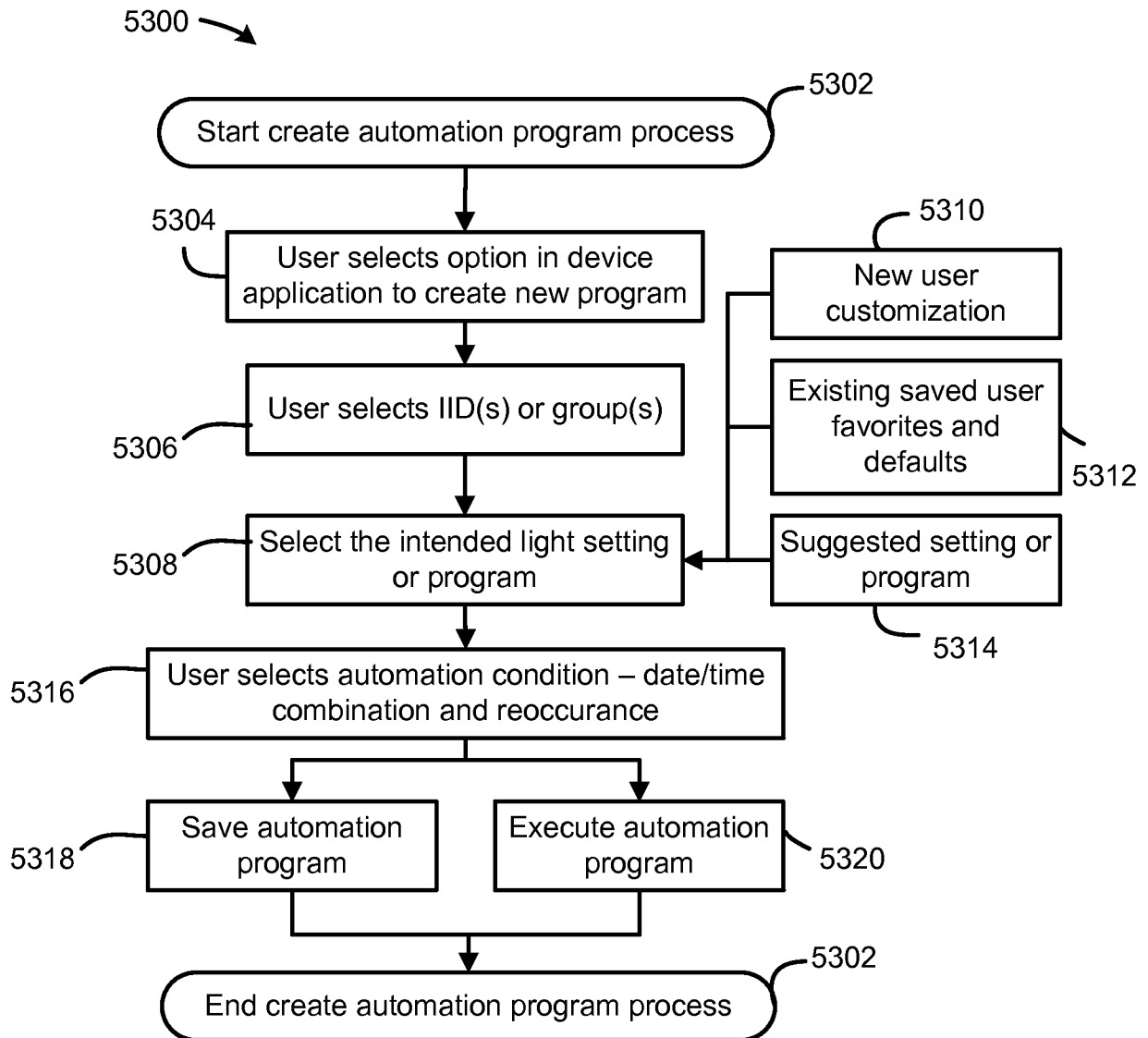
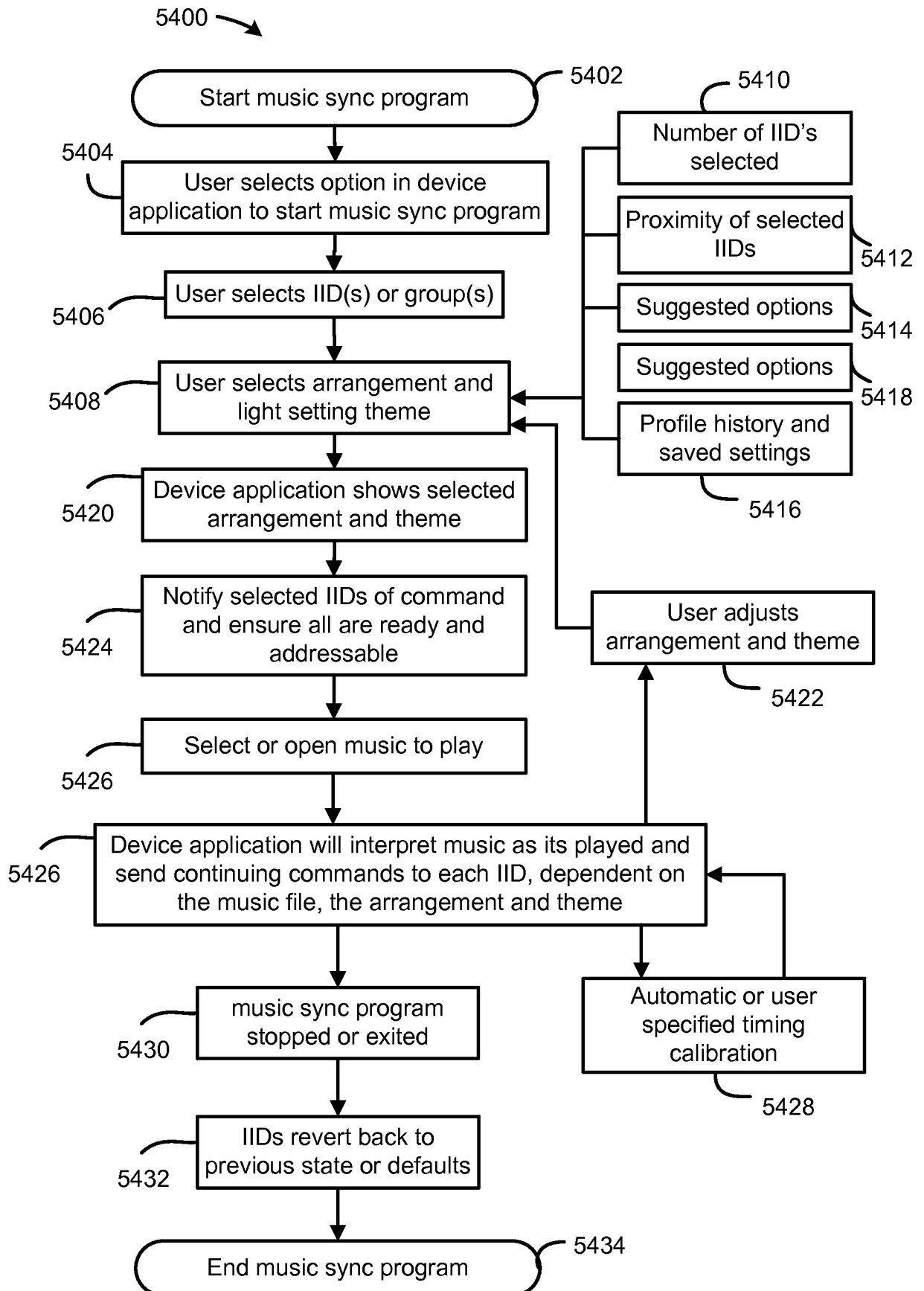


FIG. 53

FIG. 54



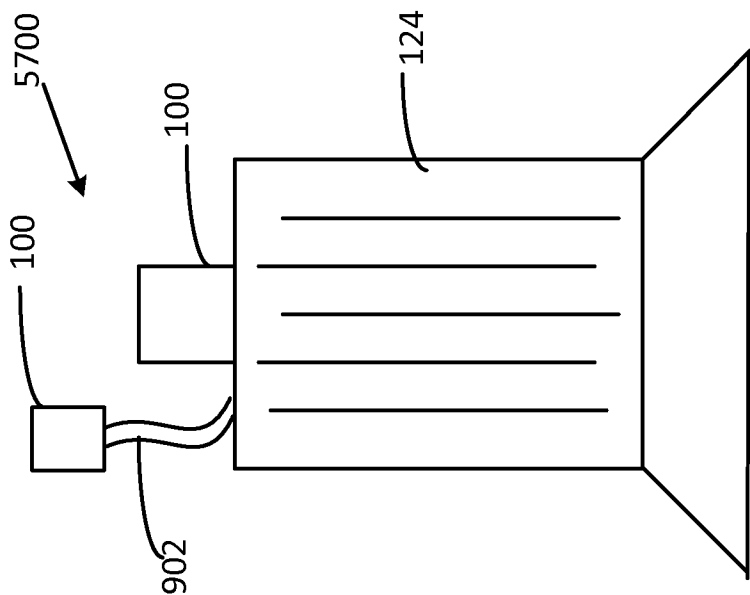


FIG. 57

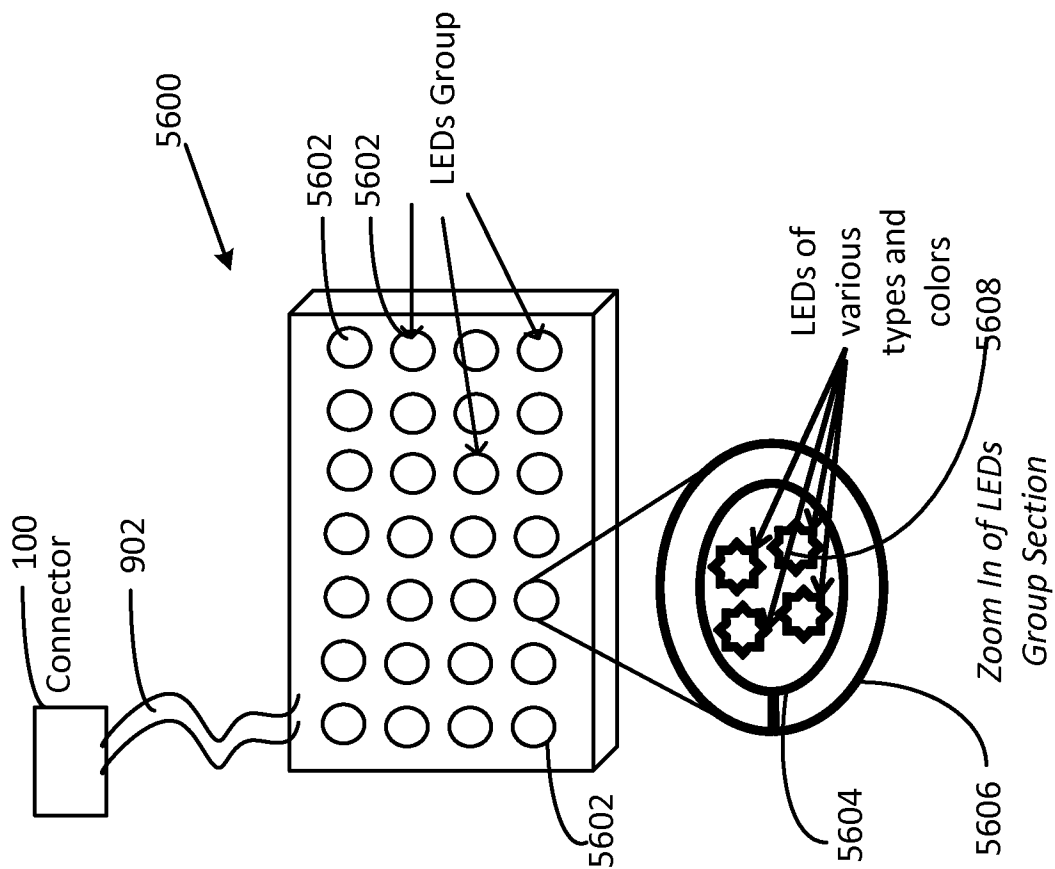


FIG. 56