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(54) **MULTI-DWELLING UNIT MULTIPURPOSE SIGNAL DISTRIBUTION APPARATUS**

(76) Inventor: **Timothy Frederick Summers**, Hickory, NC (US)

Correspondence Address:
CORNING INCORPORATED
SP-TI-3-1
CORNING, NY 14831

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(57) **ABSTRACT**

A multi-dwelling unit multipurpose signal distribution apparatus includes a housing adapted to be disposed in a multi-dwelling unit room, an optical network terminal and at least one additional electrical device disposed in the housing. The at least one additional electrical device is configured for electrical connection with an electrical power source of the multi-dwelling unit room, and the optical network terminal is configured of optical connection to a fiber optic drop cable.

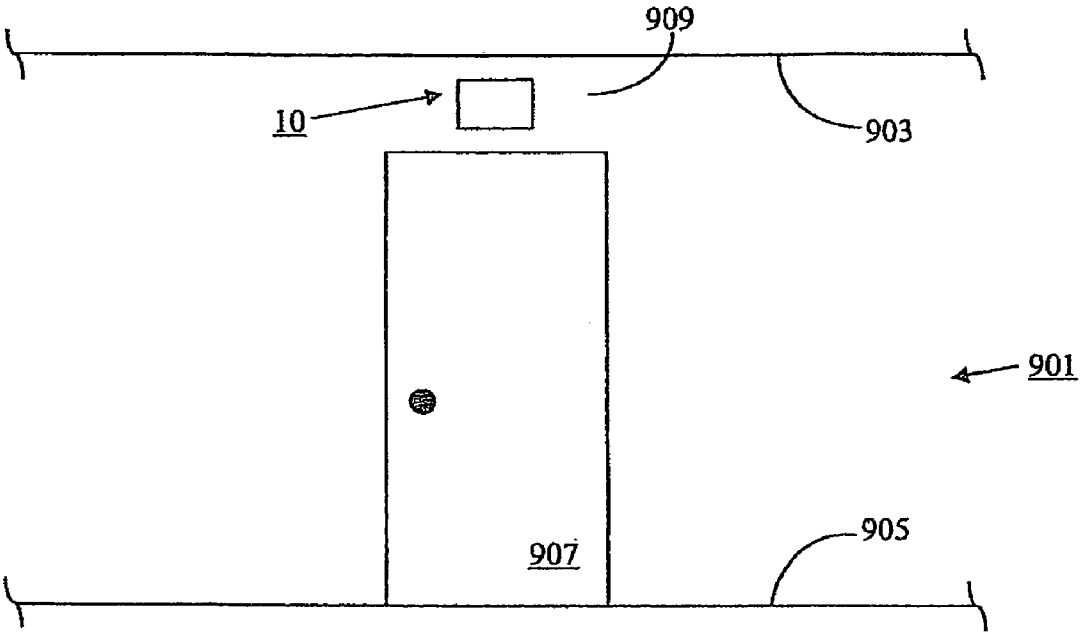


FIGURE 1

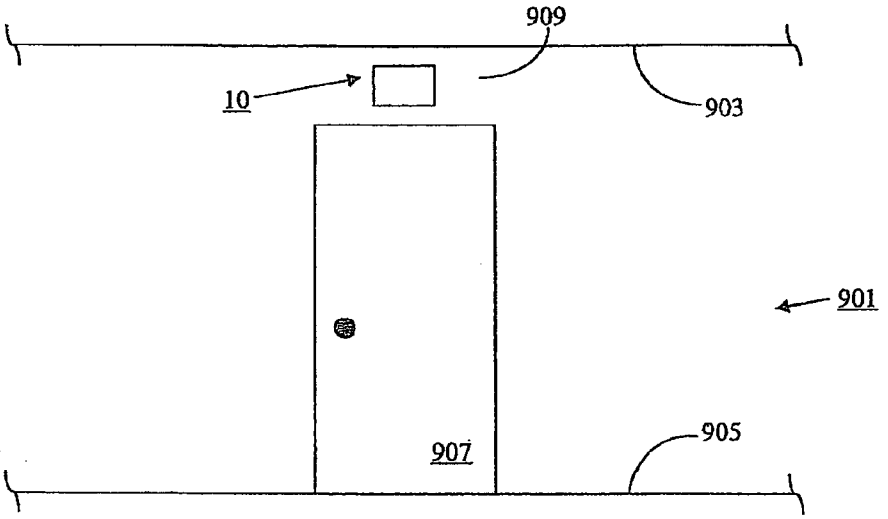


FIGURE 2

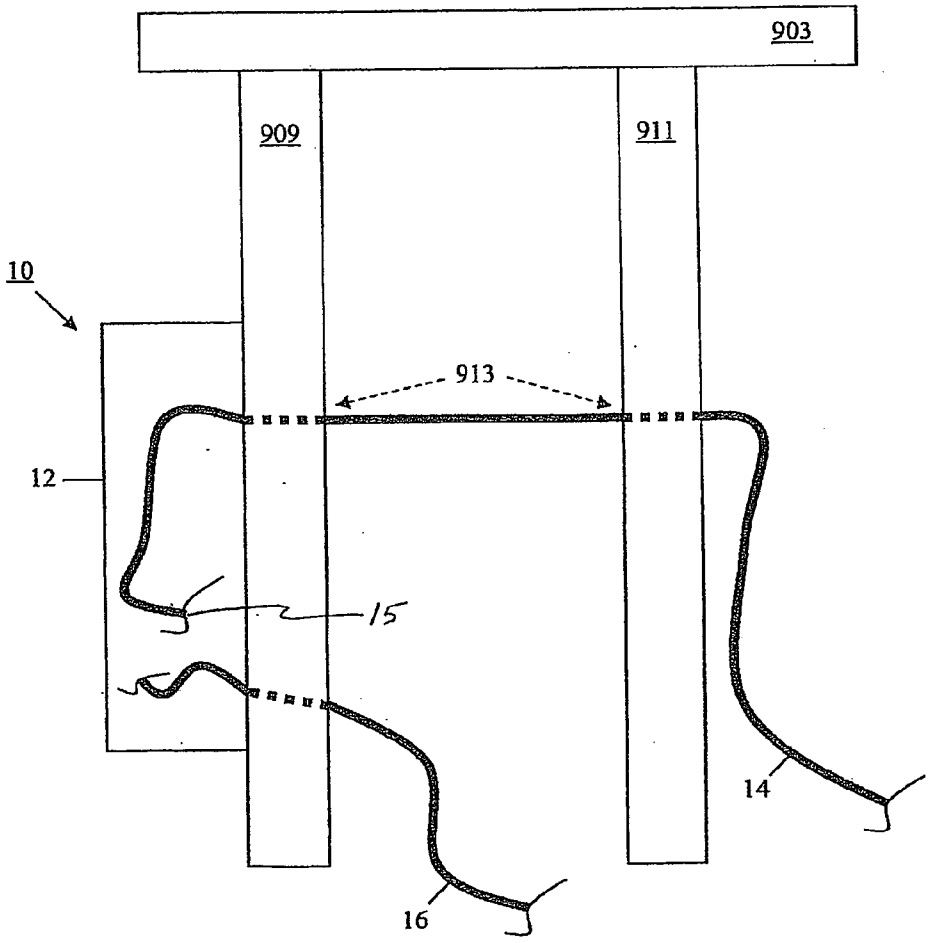


FIGURE 3

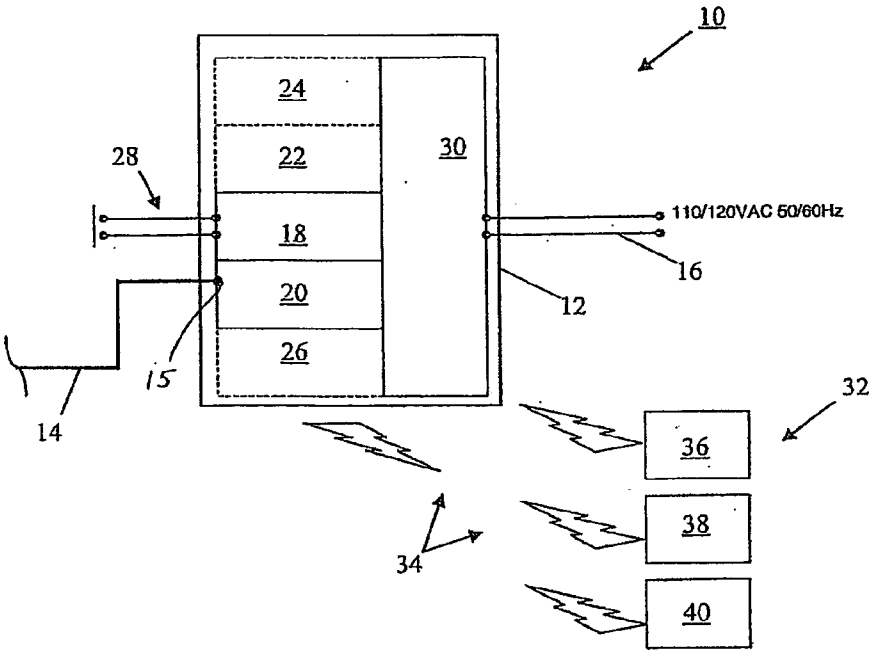
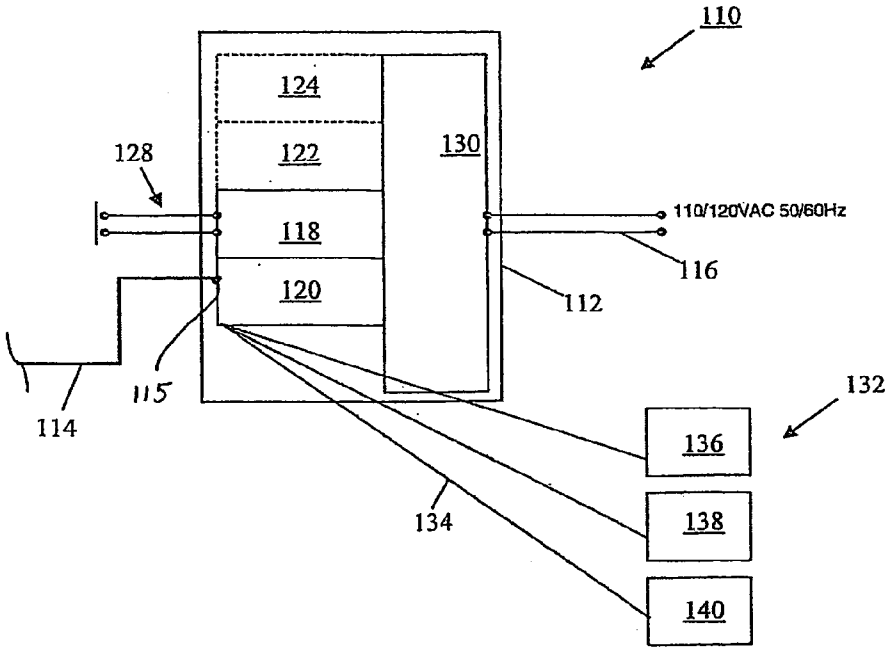


FIGURE 4



MULTI-DWELLING UNIT MULTIPURPOSE SIGNAL DISTRIBUTION APPARATUS

BACKGROUND

[0001] Installing optical fiber in an apartment or condominium complex, i.e., a multi-dwelling unit (MDU), presents various obstacles. One of the more serious obstacles is how to enter an existing MDU apartment and install a network interface device (NID) and optical network terminal (ONT) without disturbing the aesthetics inside the apartment since it is often difficult to find a place inside the apartment to easily connect the NID/ONT to electric power. Typically, a fiber optic drop cable is routed from a fiber distribution terminal (FDT) and/or a local convergence point (LCP) and inserted through a wall of the apartment. The fiber optic cable is extended to the NID/ONT somewhere in the apartment, usually into an additional housing that must be installed in the apartment to accommodate the NID/ONT. Cabling usually also extends from the NID/ONT to various devices in the subscribing apartment such as to computers, televisions, television set top boxes, telephones, etc. to provide telecommunications and broadband service from a service provider to the apartment.

[0002] United States Patent Application 2007/0052531 to Mathews et al., incorporated by reference herein, describes systems that utilize existing wiring of a conventional door chime system, including an adapter for configuring a door chime wiring circuit for use with a data communications device. Specifically, Mathews et al. disclose converting a low voltage alternating current (AC) wiring circuit to a high speed data communications link, comprising a primary coupling circuit and a secondary coupling circuit. The primary circuit provides low voltage AC power to the low voltage wiring circuit and couples data signals between the low voltage AC wiring circuit and the high voltage AC power line. The secondary circuit provides low voltage AC power to the data communications device and couples high speed data signals between the data device and the low voltage AC wiring circuit. Therefore, according to Mathews et al., low voltage AC, control or signaling circuits found in typical residences, such as used in a door chime, a home security system, or an HVAC system, may be converted to a high speed data communications link. However, Mathews et al. does not address or offer solutions to the problems of installing multiple NID/ONTs in multi-dwelling units, especially in situations in which apartment landlords do not want to disturb multiple tenants by adding a NID/ONT housing in each living unit.

[0003] Minimizing cabling by exploiting existing electrical power and devices inside existing multi-dwelling units and avoiding installation of additional housings or electrical devices in individual rooms of an MDU would be desirable in the industry.

SUMMARY

[0004] In general, the various exemplary embodiments described herein and their equivalents leverage existing electrical devices in MDUs and MDU rooms, such as door chimes, security systems and the like, to provide unobtrusive NIDs. Thus, the embodiments may use a footprint similar to the footprint of a door chime for an apartment's NID by combining the door chime with the NID/ONT and other components into a unitary, low-profile system.

[0005] In one embodiment, a multi-dwelling unit multipurpose signal distribution apparatus includes a housing adapted to be disposed in a multi-dwelling unit room, an optical network terminal, and at least one additional electrical device disposed in the housing, wherein the at least one additional electrical device is configured for electrical connection with an electrical power source of the multi-dwelling unit room, and wherein the optical network terminal is configured for optical connection to a fiber optic drop cable.

[0006] In another embodiment, a multi-dwelling unit multipurpose signal distribution apparatus includes a housing adapted to be disposed in a multi-dwelling unit room; a door chime disposed in the housing, the door chime configured for electrical connection with an electrical power source of the multi-dwelling unit room; and an optical network terminal disposed in the housing proximate the door chime, the optical network terminal configured for electrical connection with the electrical power source and configured for optical connection with a fiber optic cable.

[0007] In yet another embodiment, a method of replacing an existing multi-dwelling unit electrical device with a multipurpose signal distribution apparatus may include routing an optical fiber drop cable to a multi-dwelling unit room; locating an existing electrical device in an interior of the multi-dwelling unit room, the existing electrical device powered by a multi-dwelling unit room power source; installing a multipurpose signal distribution apparatus in place of the existing electrical device, the multipurpose signal distribution apparatus including optical network terminal; and connecting the optical network terminal to the fiber optic drop cable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The foregoing and other features and aspects of the present disclosure may be better understood when the following detailed description is read with reference to the accompanying drawings, in which:

[0009] FIG. **1** is a schematic elevational view of a portion of a room in a multi-dwelling unit, particularly showing a multipurpose signal distribution apparatus constructed in accordance with an exemplary embodiment;

[0010] FIG. **2** is a schematic, partial cross-sectional side view of the multipurpose signal distribution apparatus in accordance with the embodiment of FIG. **1**;

[0011] FIG. **3** is a schematic view of the multipurpose signal distribution apparatus in accordance with the embodiment of FIG. **1**; and

[0012] FIG. **4** is a schematic view of a multipurpose signal distribution apparatus constructed in accordance with another exemplary embodiment.

DETAILED DESCRIPTION

[0013] Reference will now be made in detail to the accompanying drawings in which exemplary embodiments are shown. However, aspects of the embodiments described in this disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. These exemplary embodiments are provided so that this disclosure will be both thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. Like reference numbers refer to like elements throughout the various drawings.

[0014] As used herein, the term "multi-dwelling unit" or "MDU" includes not only apartment and condominium complexes, but also office buildings, retail or commercial centers, industrial facilities, and any other general concentration of end users (such as customers or subscribers, to provide non-limiting examples) of an optical network. Also, the term "multi-dwelling unit room" or "MDU room" includes not only individual apartments or condominiums, but also individual offices, retail stores, commercial operation, industrial component, or other location to which fiber optic cables may be routed. It should be appreciated that some multi-dwelling unit rooms may have only one fiber optic cable routed to it, whereas other multi-dwelling unit rooms may have two or more fiber optic cables routed to it, based upon the particular needs and/or functions of the particular multi-dwelling unit.

[0015] As used herein, the term "network interface device" or "NID" includes, but is not limited to, network interface devices or network interface units that comprise a housing, that may or may not include a selectively pivotable and/or removable cover, in which may be disposed one or more fiber optic connections (including, but not limited to, splices, splice holders, splice trays, and/or connector-connector interfaces using an adapter or the like), cable slack storage, and/or ONTs. The NID acts as a physical demarcation point between a service provider and a subscriber.

[0016] As used herein, the term "optical network terminal" or "ONT" includes, but is not limited to, optical network terminals and/or optical network units that enable voice, video, data, and other services to be delivered to customer premises over one or more optical fibers. In general, the ONT converts a light signal over a fiber optic cable into an electrical signal, and vise versa. ONTs of some embodiments include an optical-to-electrical converter and/or an electrical-to-optical converter in addition to other standard ONT components. A NID may include an ONT, or the ONT may be used separately from the NID. As used herein, the term "NID/ONT" refers to a NID alone, a NID with an ONT, or an ONT alone.

[0017] As used herein, the term "drop cable" refers to a final length of a cable that is used to connect to a user's location from a fiber distribution terminal of a distribution or branch cable, and is intended to include a fiber optic cable containing one or more optical fibers. As used herein, the terms "distribution cable" and "branch cable" are intended to include any type of fiber optic cable having an optical fiber count greater than or equal to that of the drop cable(s) feeding therefrom. As used herein, the term "optical fiber" is intended to include all types of single mode and multi-mode light waveguides, including one or more optical fibers or any other expedient of a medium for transmitting light signals.

[0018] The present disclosure generally provides various embodiments of a multipurpose signal distribution apparatus (MSDA) for use in a multi-dwelling unit (MDU). The MSDA consolidates multiple devices into a single housing of an electrical device. In some embodiments, the housing comprises a network interface device (NID), such as a NID of the types available from Corning Cable Systems LLC of Hickory, North Carolina, to provide one non-limiting example. In some embodiments, the housing is the existing housing of the electrical device, such as the housing of an existing door chime, an existing thermostat, an existing security system, or an existing smoke detector, to provide several non-limiting examples. In other embodiments the housing of the MSDA replaces the housing of the electrical device, and the electrical device, either with or without the electrical device housing, is disposed with the housing of the MSDA along with other components of the MSDA, such as an optical network terminal (ONT). The consolidated devices disposed within the MSDA may include, but are not limited to, a door chime, a smoke detector, a fire alarm, a security system or components thereof (including but not limited to components designed to monitor, detect, observe or communicate about activity that may pose a security threat), a video monitoring unit, a network router, a wireless network access device, a clock, a thermostat, and the like. Accordingly, the MSDA of some embodiments does not require installation of additional space-consuming devices within an MDU room since the MSDA utilizes, more or less, an existing footprint of the door chime or other existing electrical devices that are present in the MDU room. However, MSDAs of further embodiments may be larger or smaller than the existing footprints or may be installed at an alternative location from the previous footprint of the door chime or other existing electrical devices. In some embodiments, the existing electrical devices are on interior walls or ceilings of the MDU room.

[0019] The MSDA of some embodiments reduces the amount of cabling inside of MDUs and MDU rooms by exploiting the presence of electric power at the locations of existing electrical devices (such as, for example, door chimes) within the MDUs and MDU rooms, as described more fully below. Additionally, the MSDA eliminates unnecessary cabling from the drop cable point-of-entry in the apartment to the NID/ONT and may further eliminate obtrusive cabling from the NID/ONT to various remote devices in the MDU room such as computers, televisions, telephones and the like by using a wireless connection between the NID/ONT and these devices.

[0020] Referring now to FIG. **1**, an MSDA for use in a room **901** of an MDU is designated in general by reference number **10**. As shown, the MDU room **901** includes a ceiling **903**, a floor **905**, a door **907** and an interior wall **909**. As used herein, an "interior wall" refers to a wall surface within an MDU room, and "exterior wall" refers to a wall surface outside of an MDU room. An "exterior wall" as used herein may be interior or exterior to the MDU itself.

[0021] By way of brief introduction and described in greater detail below, a drop cable from a fiber distribution terminal(not shown) may be routed along an exterior or a common-use area of the MDU, such as a hallway (not shown), until the drop cable reaches the area outside of the intended MDU room, such as the room **901**. In the exemplary implementation of FIG. **1**, an existing door chime within MDU room **901** is replaced by the MSDA **10** which includes a door chime, a NID/ONT and/or other components as described below. In one embodiment, the MSDA **10** includes a wireless access device(s) such that no cabling is required within the MDU room from the NID/ONT to, for example, a computer, a television, a telephone and the like. In other embodiments, the housing of the existing electrical device (e.g., the housing of the existing door chime in the exemplary implementation) may be modified to include the NID/ONT and/or other components. These and other embodiments and their equivalents may be better understood from the following discussion.

[0022] Turning now to FIG. **2**, an installer of the MSDA will locate an existing conveniently located electrical device having an associated existing power line **16** within the MDU room **901** (e.g., a door chime on the interior wall **909** in the exemplary implementation). The existing electrical device is preferably near a common-use area of the MDU, such as a

hallway leading to room **901**, or other area that can be accessed without disturbing occupants of room **901**. In this example, the installer will drill a hole **913** through the interior wall **909** within the footprint of the existing electrical device. The installer may also have to drill a similar hole **913** through an exterior wall **911**, depending on the building construction of the MDU. Once the holes **913** are formed, a drop cable **14** is routed through holes **913** in walls **909**, **911** into room **901**, with drop cable **14** entering room **901** within the approximate footprint of the electrical device already existing in room **901**.

[0023] Those skilled in the art will understand that the exemplary illustration of the location of the existing electrical device in room **901** is not limiting. For example, in other implementations the existing electrical device (e.g., a door chime) may be located on the ceiling **903**, or nearer floor **905** than ceiling **903**. Those skilled in the art will further understand the drop cable **14** could transit the walls **909**, **911**, ceiling **903** or floor **905** at some points other than directly behind the footprint of the existing electrical device and then be routed to the MSDA **10**, such as between the walls **909** and **911**, above ceiling **903**, below floor **905**, or along an interior surface of wall **909**, ceiling **903**, or floor **905** Thus, the exact location of MSDA **10** and the routing of the drop cable **14** as illustrated in FIG. **2** is not intended to be limiting.

[0024] After drop cable **14** is routed proximate the footprint of the existing electrical device, the existing electrical device (e.g., a door chime) is converted into the MDSA **10** by the inclusion of an NID/ONT therein, or alternatively the existing electrical device is replaced with the MSDA **10** having its own cover or housing **12** as shown. In one embodiment, when the existing electrical device is replaced with the MSDA **10**, the MSDA **10** includes a new electrical device that provides the functionality of the replaced electrical device. For example, if the MSDA **10** replaces an existing door chime, the MSDA **10** includes an additional electrical device that provides the functionality of a door chime. The NID/ONT is connected to drop cable **14** at fiber optic connection **15** and the NID/ONT and any other electrical components of the MSDA are powered, as necessary, by the power line **16**. As noted above, fiber optic connection **15** may comprise any suitable fiber optic connection (including, but not limited to, mechanical and fusion splices and/or connector-connector interfaces using an adapter or the like).

[0025] FIG. **3** shows one embodiment of the MSDA **10**. The housing **12** may encompass a plurality of electrical devices **18**, **20**, **22**, **24**, **26**. By way of example and without limitation, the electrical devices may be a door chime **18**, an ONT **20**, a router **22**, a video monitoring unit **24**, and/or a wireless access device **26**. Those skilled in the art will recognize different and/or additional components and devices could be encompassed within housing **12**, such as, without limitation, a smoke detector, a fire alarm, a security system or components thereof (including but not limited to components designed to monitor, detect, observe or communicate about activity that may pose a security threat), a clock, a thermostat, and the like.

[0026] As shown in the exemplary embodiment of FIG. **3**, the door chime **18** is connected to a door chime switch **28**. The door chime **18** may run on 8, 16, 24 VAC, 9 VDC, or other usable voltage AC or DC, which is stepped down from standard household voltage, e.g., 110/120 VAC 50/60 Hz, as discussed below. The door chime switch **28** is activated in a known manner on the exterior wall **911** near the door **907**. The ONT **20** may run off 9 VDC, 12 VDC, 18 VDC, 48 VDC, or other usable voltage AC or DC and is likewise stepped down from the household voltage. By way of example but not of limitation, an exemplary NID/ONT for use as the ONT **20** is Tellabs 1600 Optical Network Terminal Series available from Tellabs of Naperville, Ill. (ONT).

[0027] As noted above, although the figures show the MSDA **10** installed on wall **909** above the door **907**, the skilled artisan will appreciate that the MSDA **10** may be located anywhere in the room **901**; however, the MSDA **10** is intended to leverage an existing footprint of an existing door chime or other electrical device, e.g., on the wall **909** (see FIG. **1**) that already has electric power (e.g., power line **16**) to avoid adding an additional enclosure or housing on the wall **909** or other wall or ceiling within the room **901** thereby having to run electrical power to that additional housing.

[0028] FIG. **3** further shows that the housing **12** may include a transformer **30** that is connected to the existing power line **16**. Although some electrical devices (e.g., a smoke detector) may run off the household voltage, e.g., 110/120 VAC 50/60 Hz, provided by the power line **16**, voltages for other devices in the housing **12** may range from 8 to 48 VDC or VAC as briefly introduced above. Such devices therefore may require use of the transformer **30** to step down the household voltage to the required device voltages. If the transformer **30** is not part of the MSDA **10** but located elsewhere in the room **901**, or elsewhere in the MDU as a whole, there would only be one voltage available at the MSDA **10** and additional wiring and transformers may be needed to accommodate the various step down voltages of some devices in the MSDA **10**.

[0029] FIG. **3** also shows that the wireless access device **26** is in wireless communication with various remote devices in the room **901** or elsewhere within the MDU. Specifically, wireless signals **34**, which may be of any suitable technology and format, for example, Wi-Fi®, Bluetooth® or ultra wide band technology (3.1-10.6 GHz) and the like, are sent from the wireless access device **26** to wireless units **32** such as a television or television set top box **36**, a telephone **38**, a wireless equipped personal computer **40**, and/or other remote devices in the room **901**. These wireless units **32** likewise send wireless signals **34** to the wireless access device **26** for communication with the ONT **20** to transfer their respective signals in a known matter.

[0030] With reference now to FIG. **4**, another embodiment according to the disclosure includes an MSDA **110**, which is similar in some ways to the previously described embodiment of MSDA **10**. Many components, aspects and materials of the illustrated embodiment of MSDA **110** are the same or similar to the foregoing embodiments of MSDA **10**, and have reference numbers incremented by 100 from the reference numbers of FIG. **3**. Accordingly, only select features and components of the present embodiment of MSDA **110** are described below for clarity and brevity. Reference is therefore made to the foregoing embodiments to provide a full and enabling disclosure where like or similar features are not expressly described.

[0031] FIG. **4** particularly shows that units **132**, such as a television or television set top box **136**, a telephone **138** and a personal computer **140** may be hardwired by one or more wires or cables **134** to an ONT **120** contained in a housing **112** of the MSDA **110**.

[0032] The foregoing is a description of various embodiments of the disclosure that are provided here by way of example only. Although the multipurpose signal distribution apparatus has been described with reference to presently preferred embodiments and examples thereof, other embodiments and examples may perform similar functions and/or achieve similar results in multi-dwelling units. All such equivalent embodiments and examples are within the spirit and scope of the present disclosure and are intended to be

covered by the appended claims. Moreover, although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed:

1. A multi-dwelling unit multipurpose signal distribution apparatus, comprising:

a housing adapted to be disposed in a multi-dwelling unit room; and

an optical network terminal and at least one additional electrical device disposed in the housing, wherein the at least one additional electrical device is configured for electrical connection with an electrical power source of the multi-dwelling unit room, and wherein the optical network terminal is configured for optical connection to a fiber optic drop cable.

2. The multipurpose signal distribution apparatus as in claim **1**, wherein the at least one additional electrical device comprises at least one of a door chime, a smoke detector, a fire alarm, a security system, a security system component, a video monitoring unit, a network router, a wireless network access device, a clock, and a thermostat.

3. The multipurpose signal distribution apparatus as in claim **1**, further comprising a step down transformer within the housing for managing voltages within the multipurpose signal distribution apparatus.

4. The multipurpose signal distribution apparatus as in claim **1**, wherein the housing comprises a network interface device.

5. The multipurpose signal distribution apparatus as in claim **1**, wherein the housing comprises one of a) a replacement housing having a footprint substantially similar to a footprint of an existing housing of an electrical device in the multi-dwelling unit room, and b) the existing housing of the electrical device in the multi-dwelling unit room.

6. A multi-dwelling unit multipurpose signal distribution apparatus, comprising:

a housing adapted to be disposed in a multi-dwelling unit room;

a door chime disposed in the housing, the door chime configured for electrical connection with an electrical power source of the multi-dwelling unit room; and

an optical network terminal disposed in the housing proximate the door chime, the optical network terminal configured for electrical connection with the electrical power source and configured for optical connection with a fiber optic cable.

7. The multipurpose signal distribution apparatus as in claim **6**, wherein the housing comprises a network interface device.

8. The multipurpose signal distribution apparatus as in claim **7**, wherein the optical network terminal is configured to be hardwired to a remote device in the multi-dwelling unit room.

9. The multipurpose signal distribution apparatus as in claim **8**, wherein the remote device is at least one of a television, a television set-top box, a computer, and a telephone.

10. The multipurpose signal distribution apparatus as in claim **6**, wherein the electrical power source of the multi-dwelling unit room comprises at least one of an AC power line and a DC power line configured to be connected to at least one of the door chime and the optical network terminal to provide electrical power to at least one of the door chime and the optical network terminal.

11. The multipurpose signal distribution apparatus as in claim **10**, wherein the electrical power source of the multi-dwelling unit room comprises the AC power line and a step down transformer coupled to the AC power line.

12. The multipurpose signal distribution apparatus as in claim **6**, further comprising at least one additional electrical device disposed in the housing, the at least one additional electrical device comprising at least one of a smoke detector, a fire alarm, a security system, a security system component, a video monitoring unit, a network router, a wireless network access device, a clock, and a thermostat.

13. A method of replacing an existing multi-dwelling unit electrical device with a multipurpose signal distribution apparatus, the method comprising:

routing an optical fiber drop cable to a multi-dwelling unit room;

locating an existing electrical device in an interior of the multi-dwelling unit room, the existing electrical device powered by a multi-dwelling unit room power source;

installing a multipurpose signal distribution apparatus in place of the existing electrical device, the multipurpose signal distribution apparatus including an optical network terminal; and

connecting the optical network terminal to the fiber optic drop cable.

14. The method as in claim **13**, wherein the existing electrical device is one of a door chime, a smoke detector, a fire alarm, a security system, a security system component, a video monitoring unit, a network router, a wireless network access device, a clock, and a thermostat.

15. The method as in claim **13**, wherein the optical network terminal is configured to be hardwired to at least one of a television, a television set-top box, a computer, and a telephone in the multi-dwelling unit room.

16. The method as in claim **13**, wherein installing a multipurpose signal distribution apparatus comprises converting a housing of the existing electrical device into a housing defining a network interface device in which the existing electrical device and optical network terminal are disposed.

17. The method as in claim **13** further including forming a hole into the multi-dwelling unit room proximate a footprint of the existing electrical device for routing the fiber optic drop cable therethrough.

18. The method as in claim **13**, wherein the multi-dwelling unit room power source comprises a power line coupled to a step down transformer, the step down transformer being interposed between the multipurpose signal distribution apparatus and power line to manage voltages within the multipurpose signal distribution apparatus.

19. The method as in claim **13**, wherein installing a multipurpose signal distribution apparatus in place of the existing electrical device comprises one of:

a) installing an optical network terminal within a housing of the existing electrical device; and

b) replacing the existing electrical device with a new housing containing an optical network terminal and a new electrical device.

20. The method as in claim **19**, wherein the new electrical device is configured to provide the functionality of the replaced existing electrical device.

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