# WITS

# Wildlife Interactive Training System®

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Web: www.SpotsAndStripesForever.org

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## ABSTRACT

WITS - WILDLIFE INTERACTIVE TRAINING SYSTEM® is a multi-nodal distributed operant conditioning system consisting of a user node and one or more networked subject nodes. A user audience at a user node engages in operant conditioning with a subject at a networked subject node by observing real time image data of the subject and effecting operant conditioning signals to the subject in response to operantly offered behaviors by the subject. The multi-nodal, distributed nature provides for interactive uses by a user audience such as in educational or entertainment settings.

## GLOSSARY

**Conditioning** - In the field of psychology, a process of learning, training, habituation, or behavior modification in subjects.

**Classical conditioning** - Also called respondent conditioning, or Pavlovian conditioning, the conditioning of behaviors which are reflexive responses to stimuli from the environment.

**Operant conditioning** - A type of learning in which the likelihood of a particular behavior occurring in the future increases or decreases based on the consequences following the behavior. Unlike classical conditioning, the subject offers behaviors voluntarily, not reflexively. In so doing the subject operates on the environment, as opposed to the environment operating on the subject.

**Reinforcement** - A consequence to a behavior that causes the likelihood of the behavior occurring in the future to increase.

**Positive reinforcement** – A consequence to a behavior which is the presentation (i.e., addition) of something favorable or pleasant, thereby increasing the likelihood of that behavior occurring in the future.

**Negative reinforcement** - A consequence to a behavior which is a removal (i.e., subtraction) of an aversive or unpleasant stimulus, thereby increasing the likelihood of that behavior occurring in the future.

**Punishment** - A consequence to a behavior that causes the likelihood of the behavior occurring in the future to decrease. A punishment, like reinforcement, is termed positive (i.e., something added or presented) or negative (i.e., something subtracted or removed).

**Primary reinforcer** - (Or Primary positive reinforcer, more precisely as used herein unless denoted otherwise) – Also known as an unconditioned reinforcer.

**Unconditioned reinforcer** - Something always wanted by a subject, without learning or conditioning. For example: food, water, praise, petting, or the opportunity to play with a favorite toy.

**Conditioned reinforcer** - (Or Conditioned positive reinforcer, more precisely as used herein unless denoted otherwise) - Also known as a secondary reinforcer, it signals that a primary reinforcer is coming through the subject having learned to associate the conditioned reinforcer with the primary reinforcer. A perceptible stimulus from any sensory mode can become a conditioned reinforcer (e.g., light, sound, smell, tactile, etc.). One example of a conditioned reinforcer for humans is money; another is a school bell signaling recess.

- In operant conditioning a conditioned reinforcer can serve as a marker signal.

**Marker signal** - Also known a bridge or bridging signal, it is a precisely timed conditioned reinforcer, a signal to an subject or organism (a sound, light, gesture or the like) containing the information that a primary reinforcer is coming as a consequence of the behavior the subject was performing at the moment of the signal. Some examples are the voiced phrase “Good Boy” or “Good Girl” or the more precise and distinctive sounds of a metallic clicker, whistle, buzzer or the like. Marker signals serve as event markers, bridging time between a marked behavior event and the eventual reinforcement of that behavior.

**Shaping** – Training a behavior with successive approximation towards a goal. Voluntary actions by the subject which tend towards or increasingly approximate a given target behavior are successively reinforced with the marker signal until the subject has reached the target behavior.

**Variable reinforcement** – Delivery of the primary reinforcer on a variable schedule as opposed to following every marker signal with the food treat. The element of randomness is known to increase the subject’s level of interest and excitement, particularly when the amount and/or type of food treat is varied in such a way that occasionally it is a highly desired “jackpot” to the subject. This unpredictability yields inherently surprising and unexpected results. The subject can get another cue instead of the primary reinforcer, which can lead to building behavior chains.

**Command** - In traditional training, a command tells a subject what to do. A command may often be followed by an aversive stimulus if the command is not followed. For example, the command “Halt” may be followed by a jerk on a leash or pressure on a bit or harness if not obeyed. The command in traditional training is contrasted with the use of a cue as used in operant conditioning.

**Cue** - A Cue as used in operant conditioning is an indicator to the subject of an opportunity to earn reinforcement by the subject's own voluntary actions. The cue is some particular stimulus such as a spoken word, hand gesture, or other perceptible signal which identifies to a subject exactly which previously learned behavior will earn positive reinforcement in response to this particular cue at this particular time.

**Cue control** – A behavior is under cue control when the subject voluntarily offers the behavior in response to the cue, and only in response to the cue. This can be achieved by reinforcing the behavior only when given in response to the cue.

# FIGURES

WITS - WILDLIFE INTERACTIVE TRAINING SYSTEM® is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which:

FIG. **1** is a high-level view of an example distributed operant conditioning system, showing a user node in communication with multiple subject nodes.

FIG. **1**A shows the user node in communication with a single example subject node using networking means.

FIG. **2** shows an example of a user audience at the user node with the display means.

FIGS. **3**A, **3**B, **3**C & **3**D illustrate a fundamental paradigm and principles for use of the embodiments.

FIG. **4** shows a high-level view of an example embodiment of a user node and a subject node with audio networking means and video networking means between nodes.

FIG. **4**A shows finer detail of the example embodiment.

FIGS. **4**B, **4**C & **4**D illustrate example embodiments of audio networking means between user and subject nodes.

FIGS. **4**E & **4**F illustrate example embodiments of video networking means between user and subject nodes.

FIG. **5** shows a high-level view of an example embodiment of a user node and a subject node with signal networking means and audio-visual networking means between nodes.

FIG. **5**A shows finer detail of the example embodiment.

FIGS. **5**B **-** **5**K show additional example embodiments communicating signals from the user node to the subject node through signal networking means:

FIG. **5**B shows the use of a DTMF (Dual Tone Multi-Frequency) telephone with the Public Switched Telephone Network (PSTN).

FIG. **5**C shows the use of a DTMF capable cellular phone with the PSTN network.

FIG. **5**D shows the use of a computer with the IP (Internet Protocol) network.

FIG. **5**E shows the use of a web enabled cellular phone with the IP network.

FIGS. **5**F, **5**G, **5**H & **5I** show additional example embodiments for use where the subject node may lack internet access throughout.

FIGS. **5**J & **5**K show the use of VoIP (Voice over Internet Protocol) over the internet.

FIGS. **6**A, **6**B, **6**C & **6**D show additional example embodiments of audio-visual networking means over the internet from user to subject nodes.

FIGS. **7**, **7**A, **7**B, **7**C, **7**D, **7**E & **7**F show example embodiments for use where the example subject is an animal in a vast habitat and/or the subject node may lack internet access throughout.

FIGS. **8**A, **8**B, **8**C & **8**D show example embodiments for delivery of a primary reinforcer at the subject node.

FIGS. **9**, **9**A & **9**B show example embodiments for use where the example subject is an aquatic animal and/or the subject node is an aquarium.

FIG. **10** is a high-level illustration of some example modes of operation of the embodiments.

FIG. **11** is a flowchart showing steps by which the user audience can use the embodiments to shape a behavior in the subject.

FIG. **12** is a flowchart showing steps by which the user audience can use the embodiments to shape a behavior in the subject under cue control.

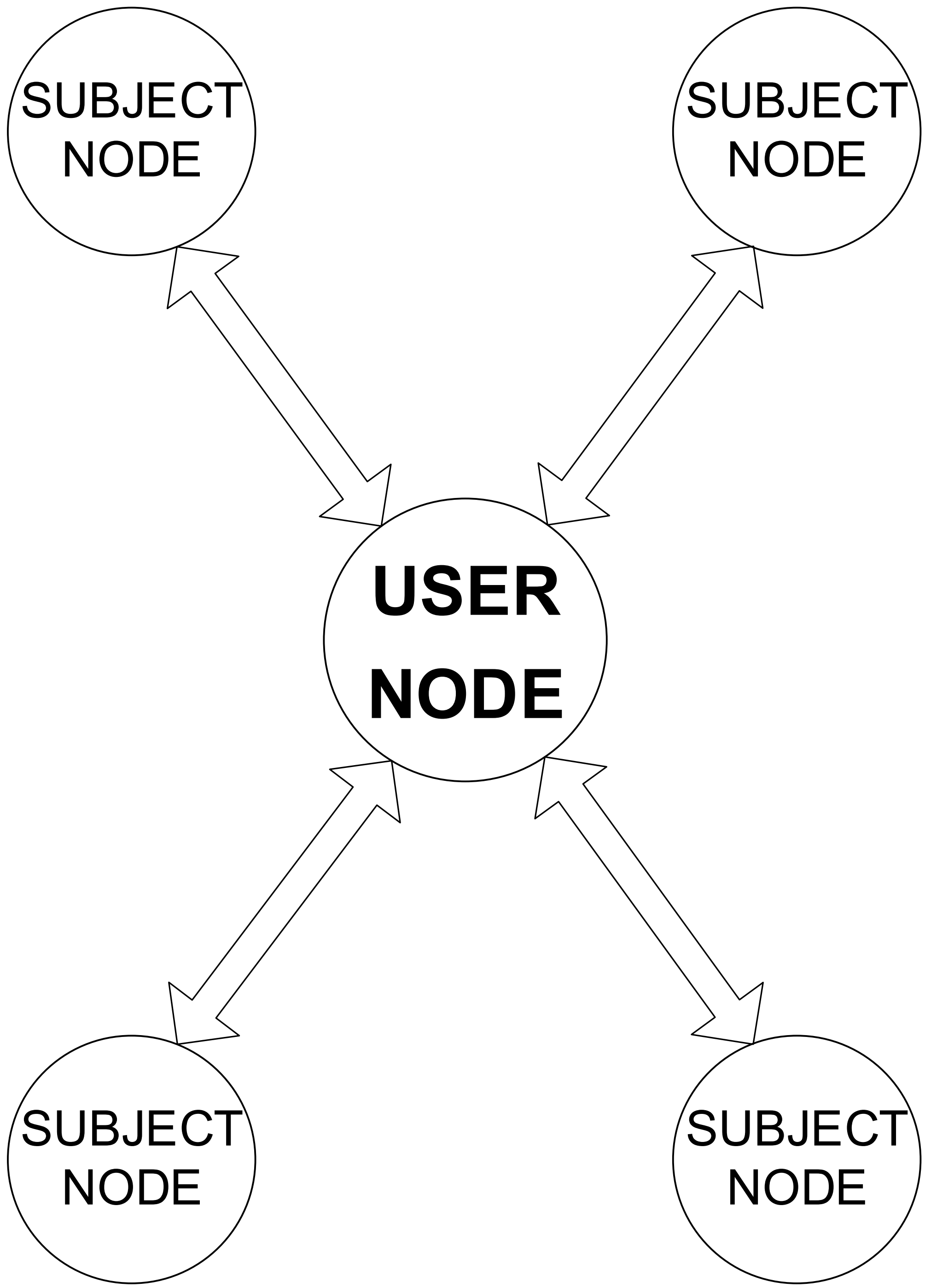

SUBJECT
NODE
SUBJECT
NODE
USER
NODE
SUBJECT
NODE
SUBJECT
NODE

**FIG. 1 - System**

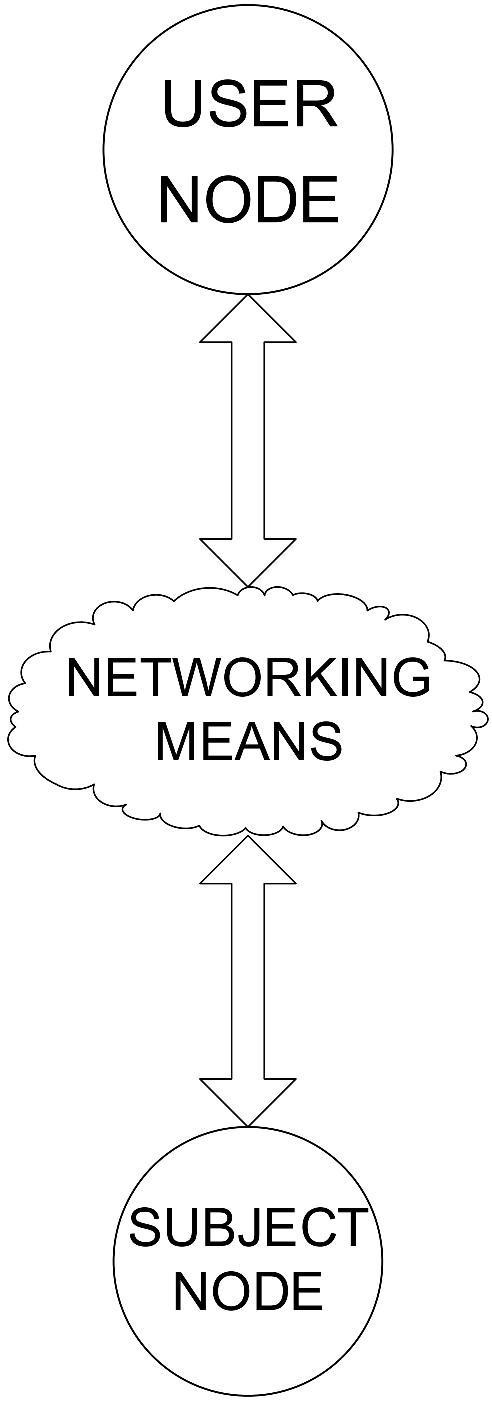



**FIG. 1A - Nodes**

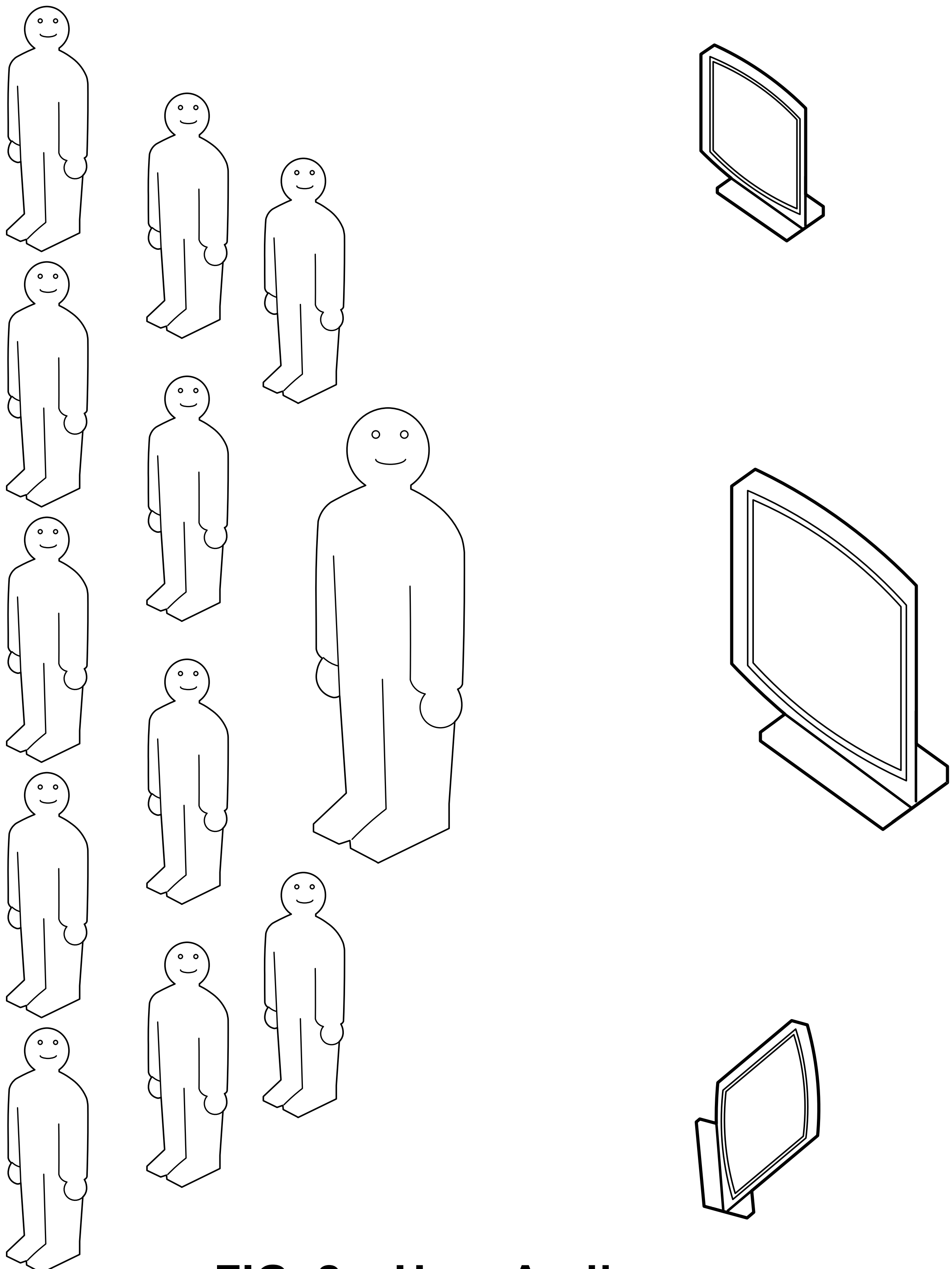


**FIG. 2 – User Audience**

# PARADIGM & PRINCIPLES

FIG. 3A

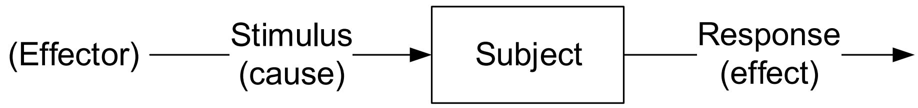



FIG. 3B

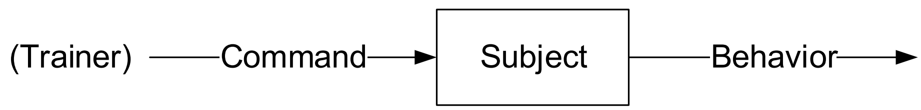



FIG. 3C

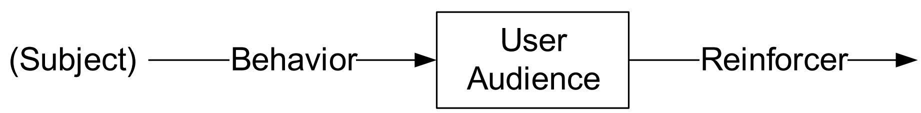
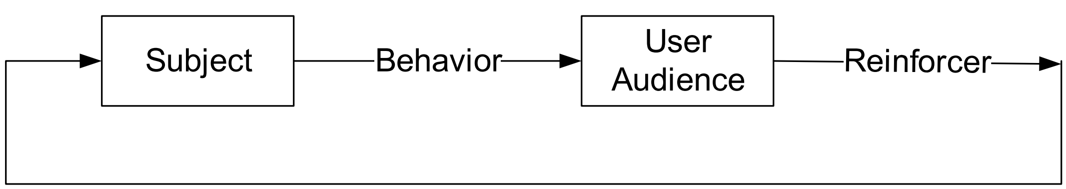



FIG. 3D



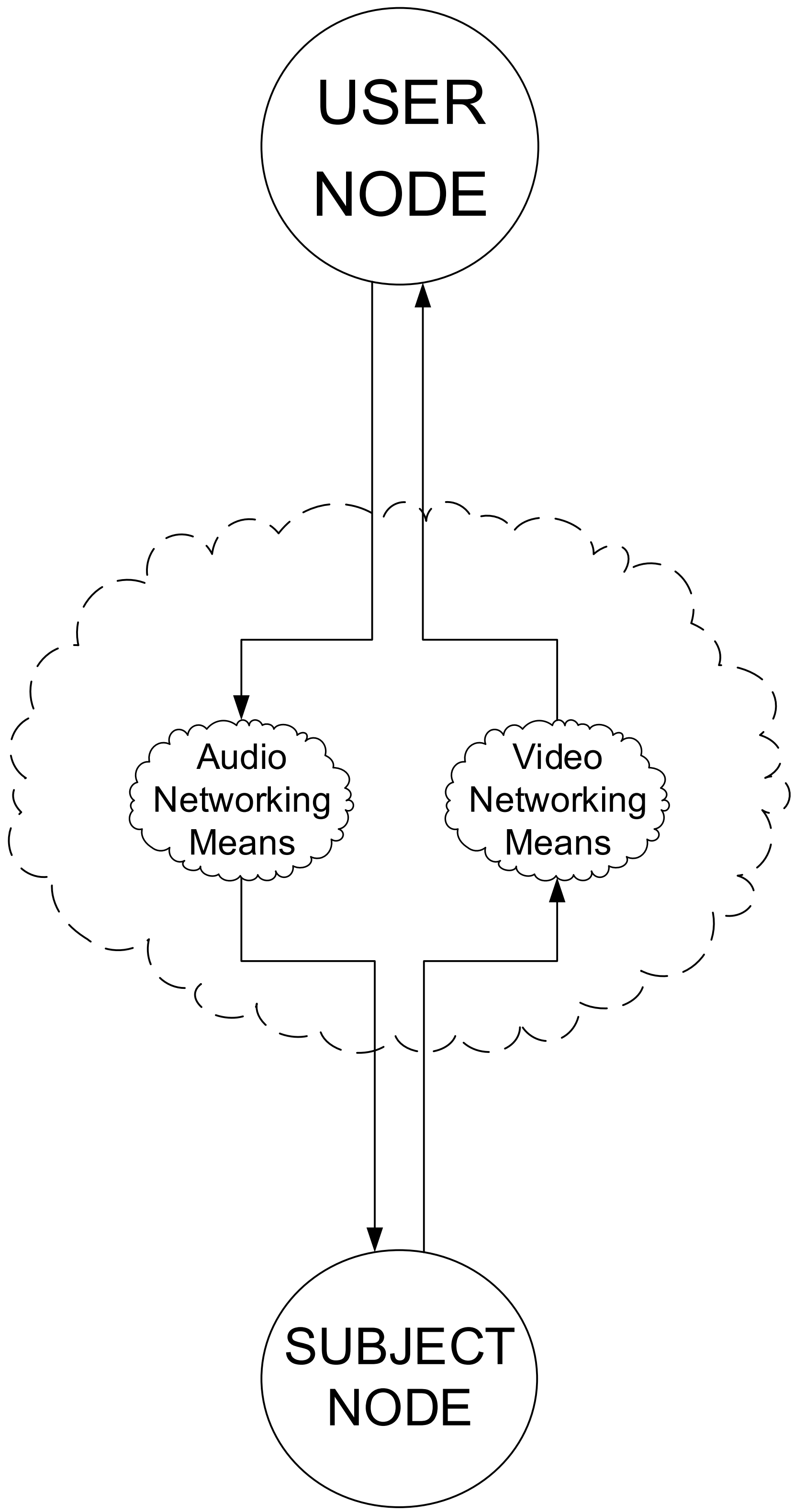
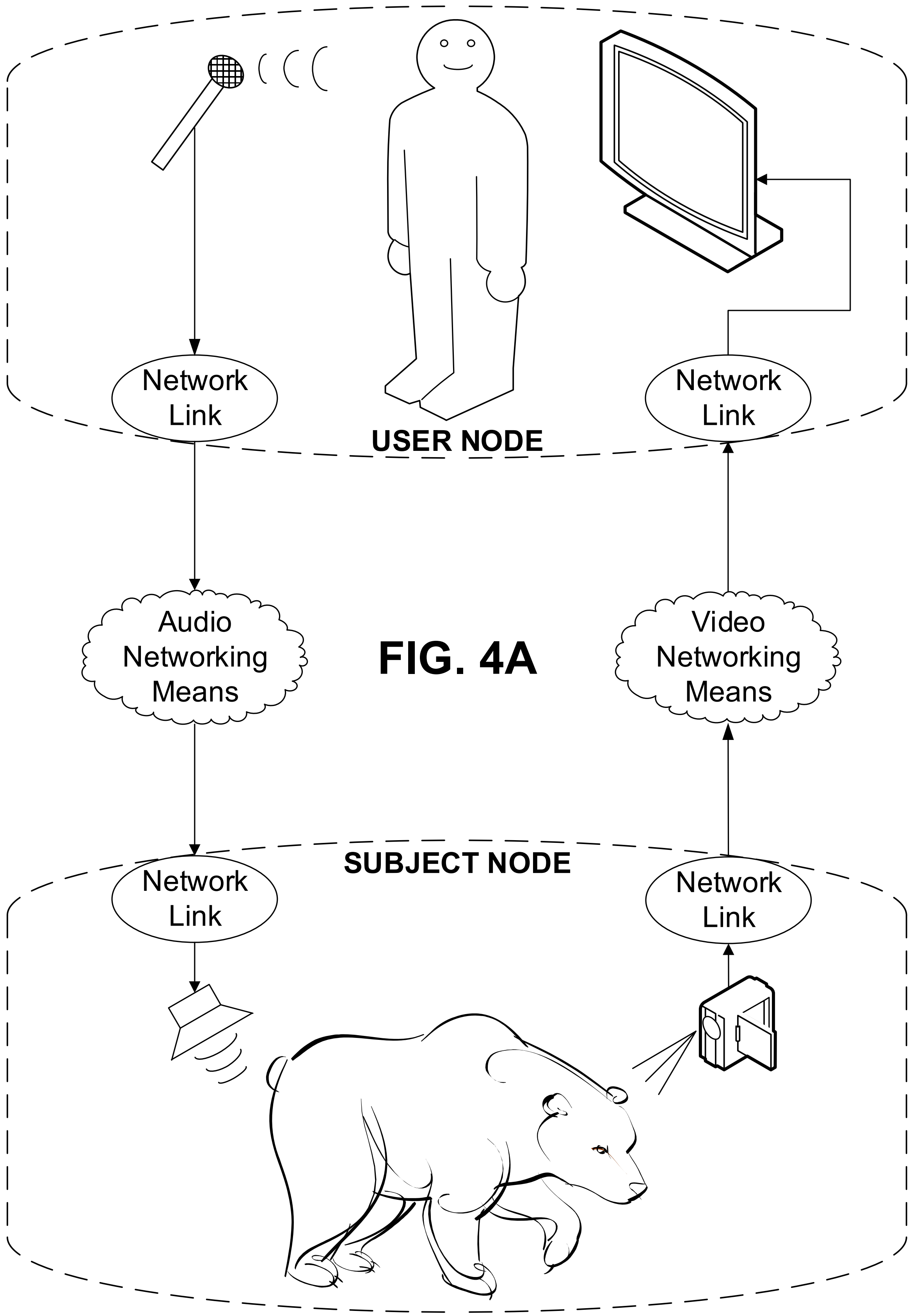



**FIG. 4 – Audio & Visual Networking**



Network Link
USER NODE
Network Link
Audio Networking Means
Video Networking Means
Network Link
SUBJECT NODE
Network Link


FIG. 4A

# AUDIO

FIG. 4B

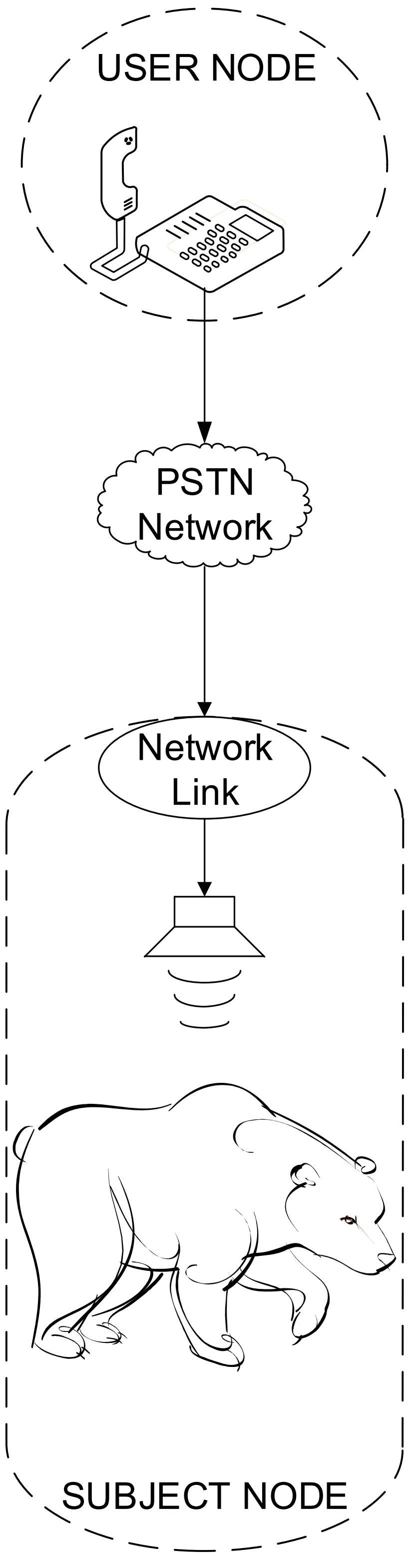



FIG. 4C

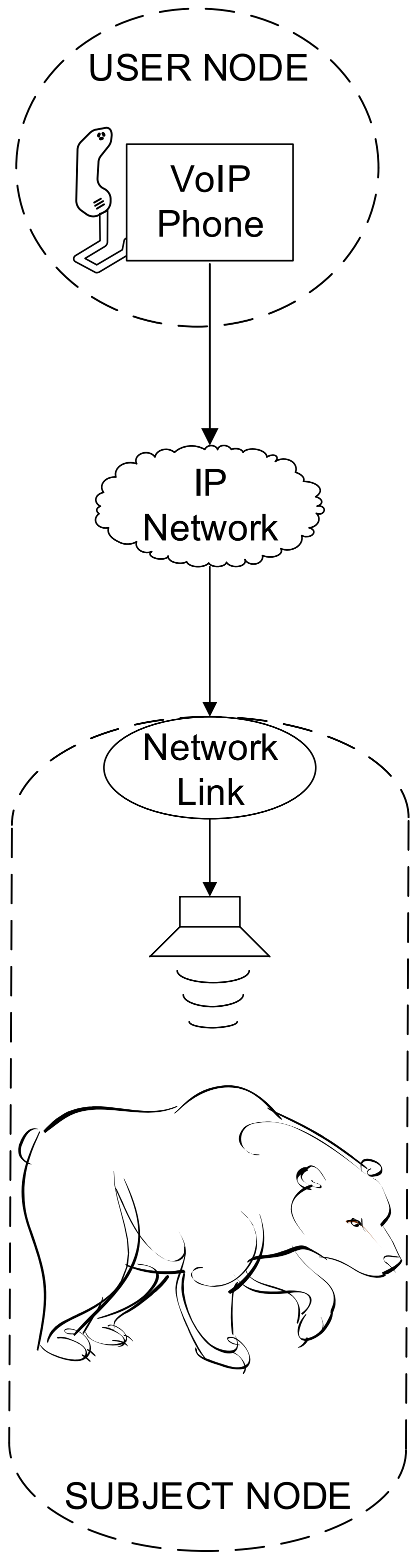
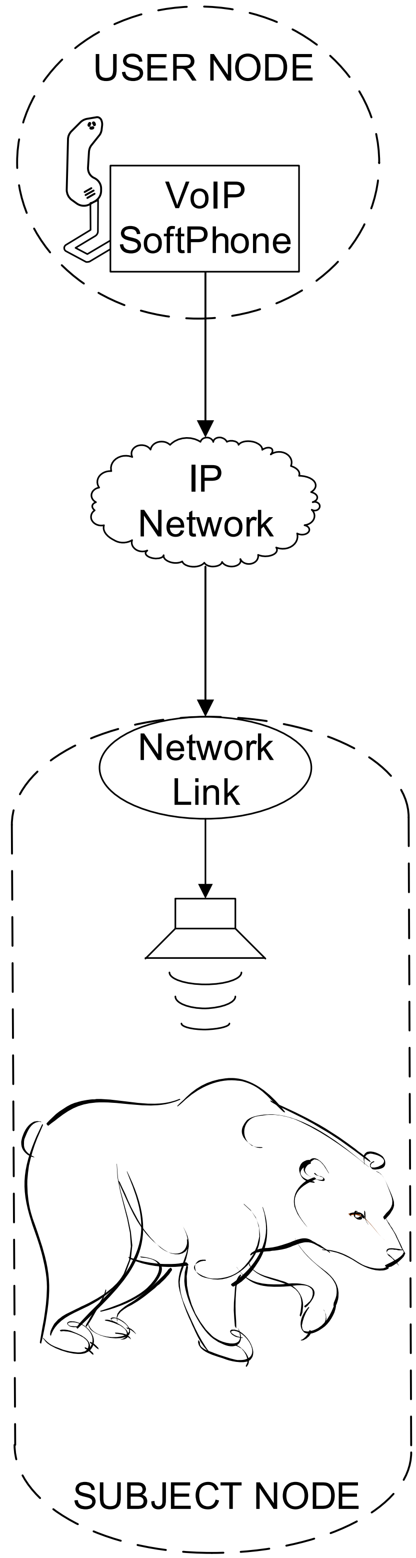



FIG. 4D



# VIDEO

FIG. 4E

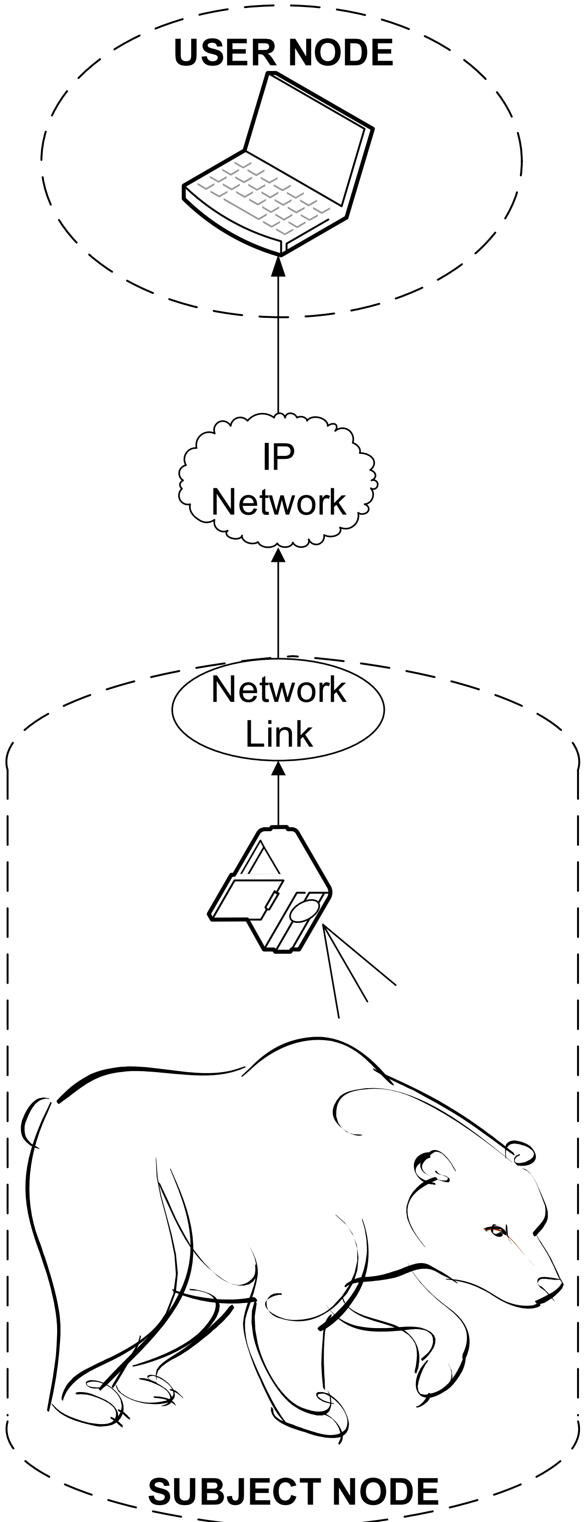
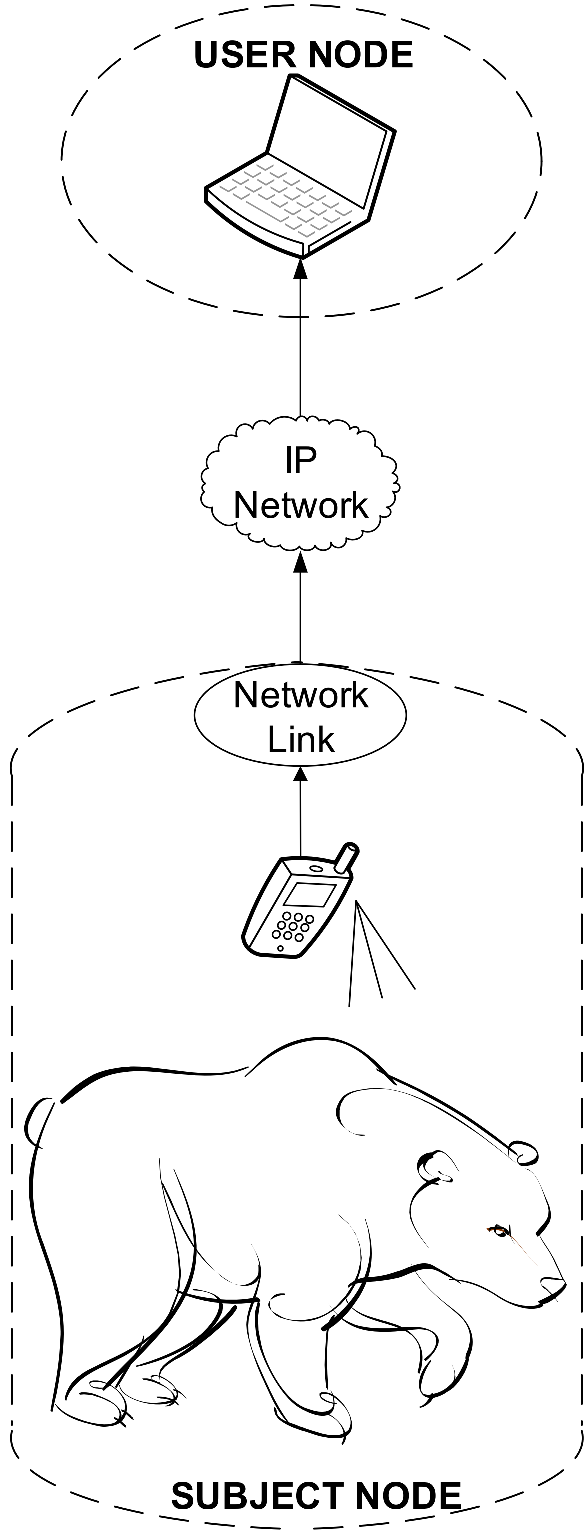



FIG. 4F



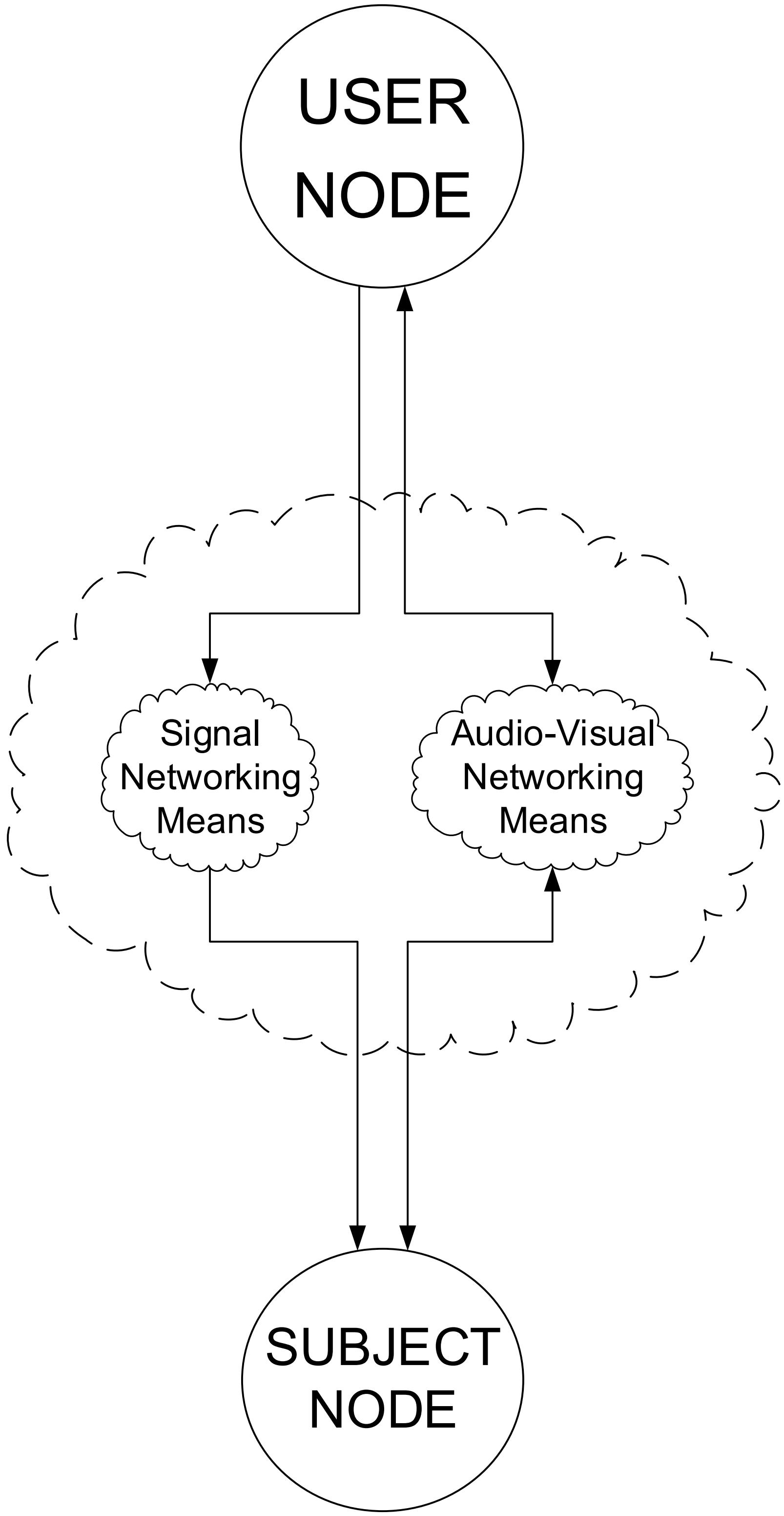



**FIG. 5 – Signal & Audio-Visual**

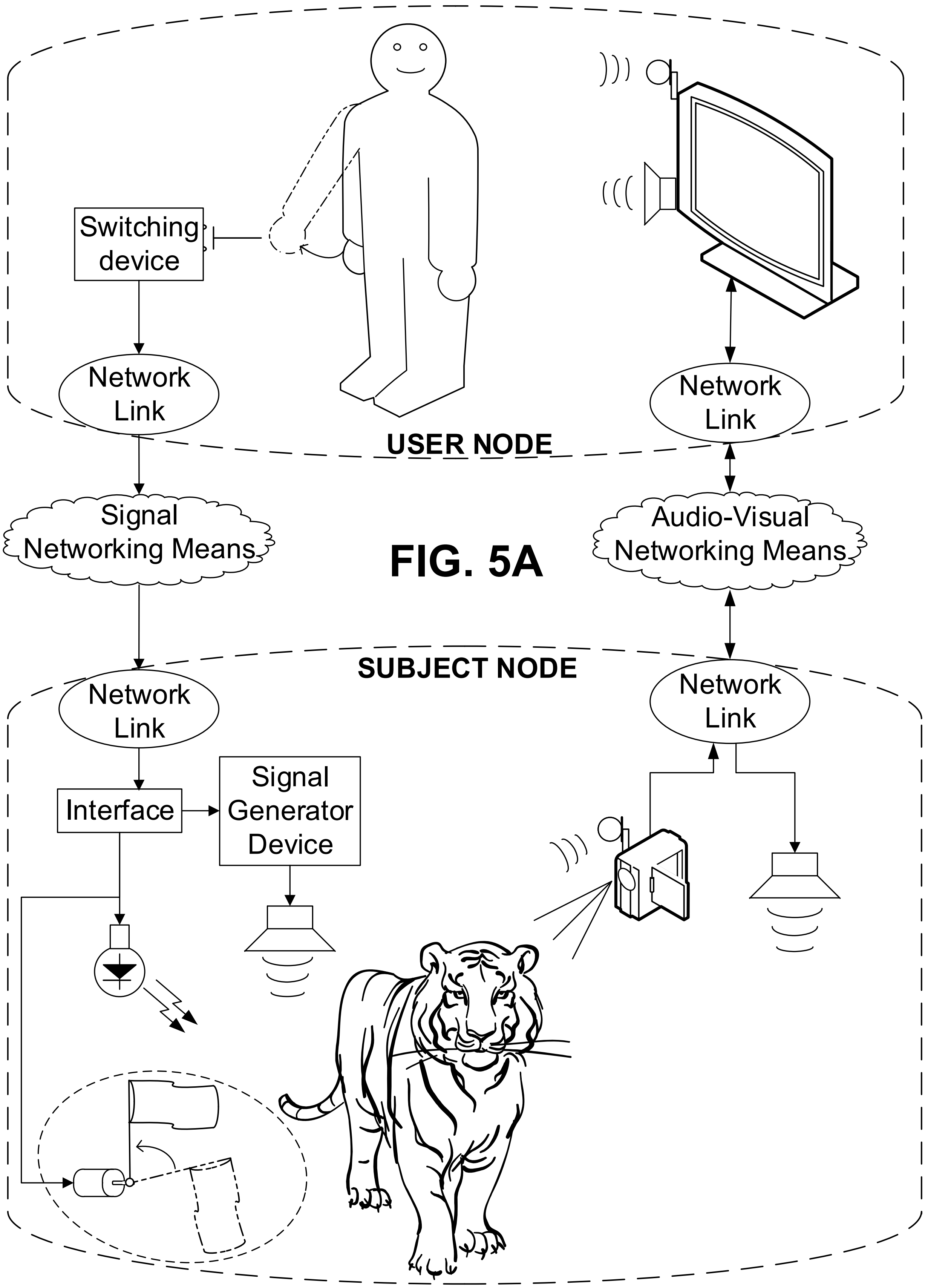

Switching device
Network Link
USER NODE
Network Link
Signal Networking Means
Audio-Visual Networking Means
SUBJECT NODE
Network Link
Network Link
Interface
Signal Generator Device

FIG. 5A

FIG. 5B

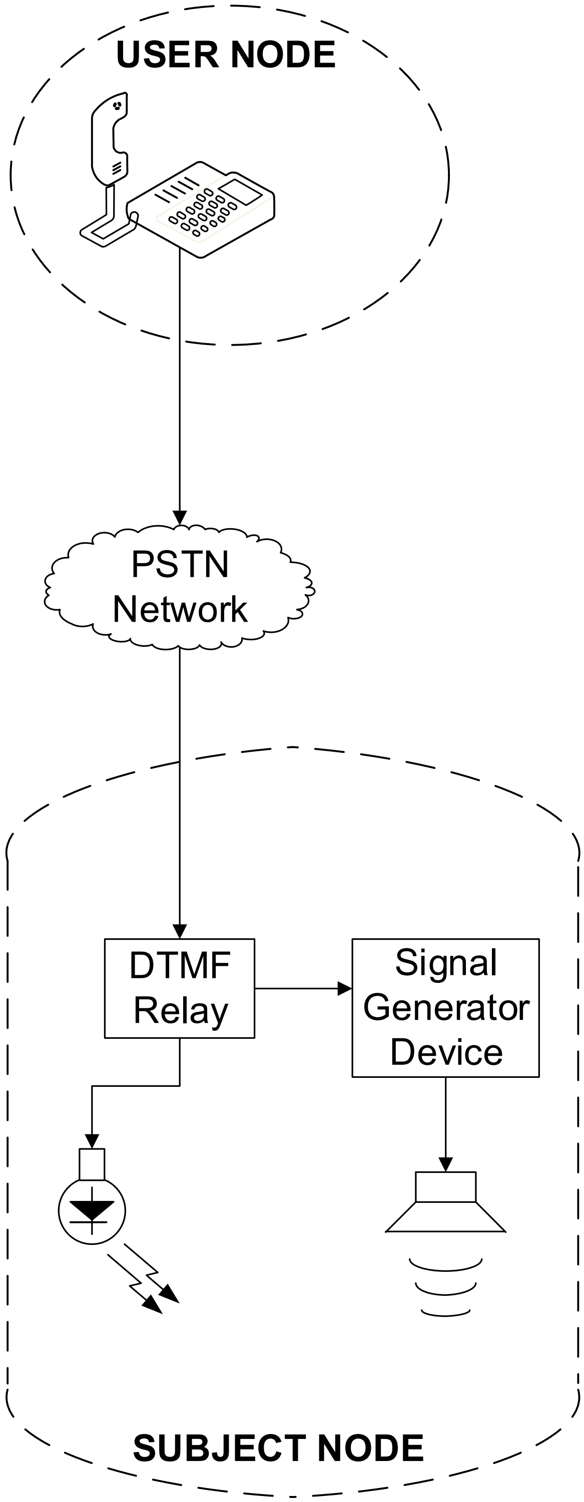

USER NODE
PSTN
Network
DTMF
Relay
Signal
Generator
Device
SUBJECT NODE

FIG. 5C

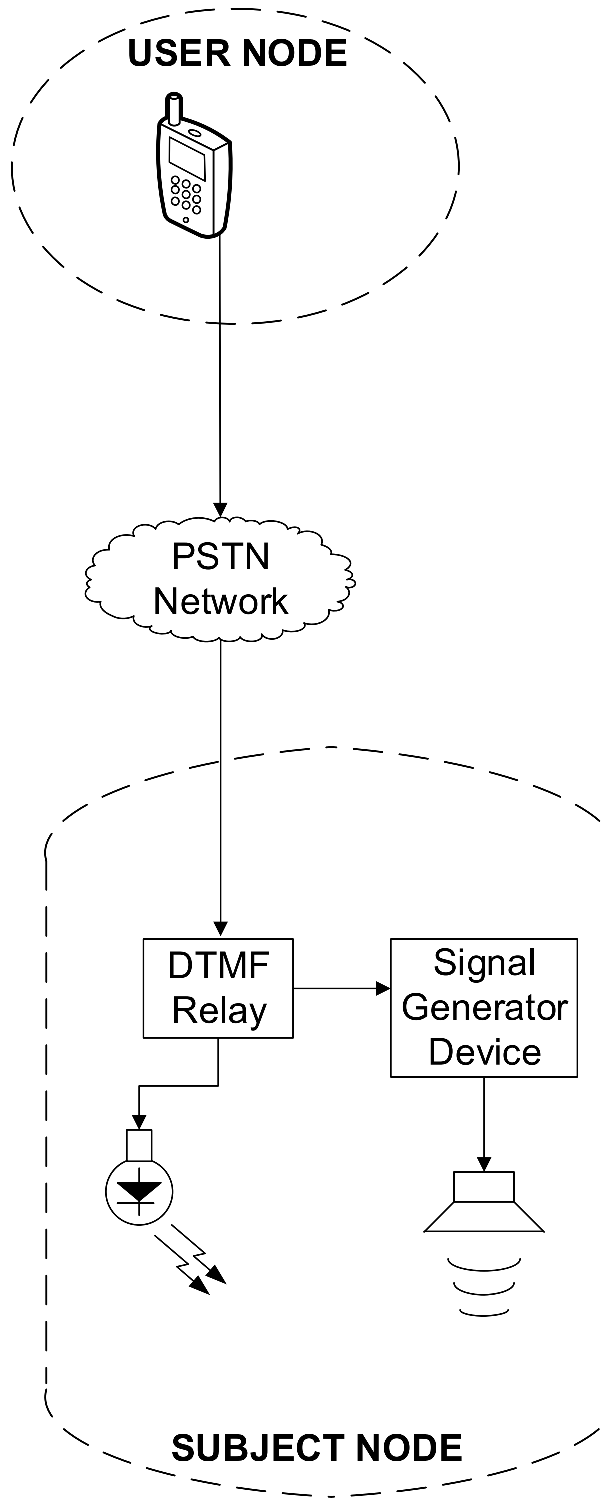

USER NODE
PSTN
Network
DTMF
Relay
Signal
Generator
Device
SUBJECT NODE

FIG. 5D

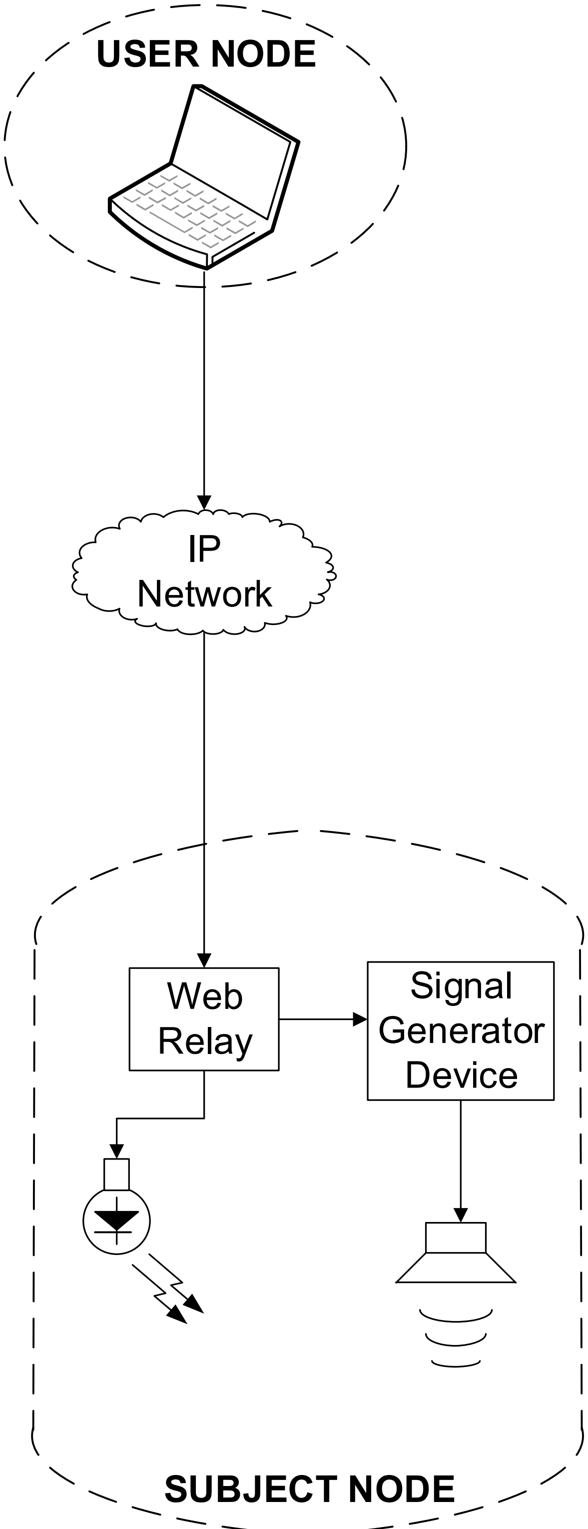

USER NODE
IP
Network
Web
Relay
Signal
Generator
Device
SUBJECT NODE

FIG. 5E

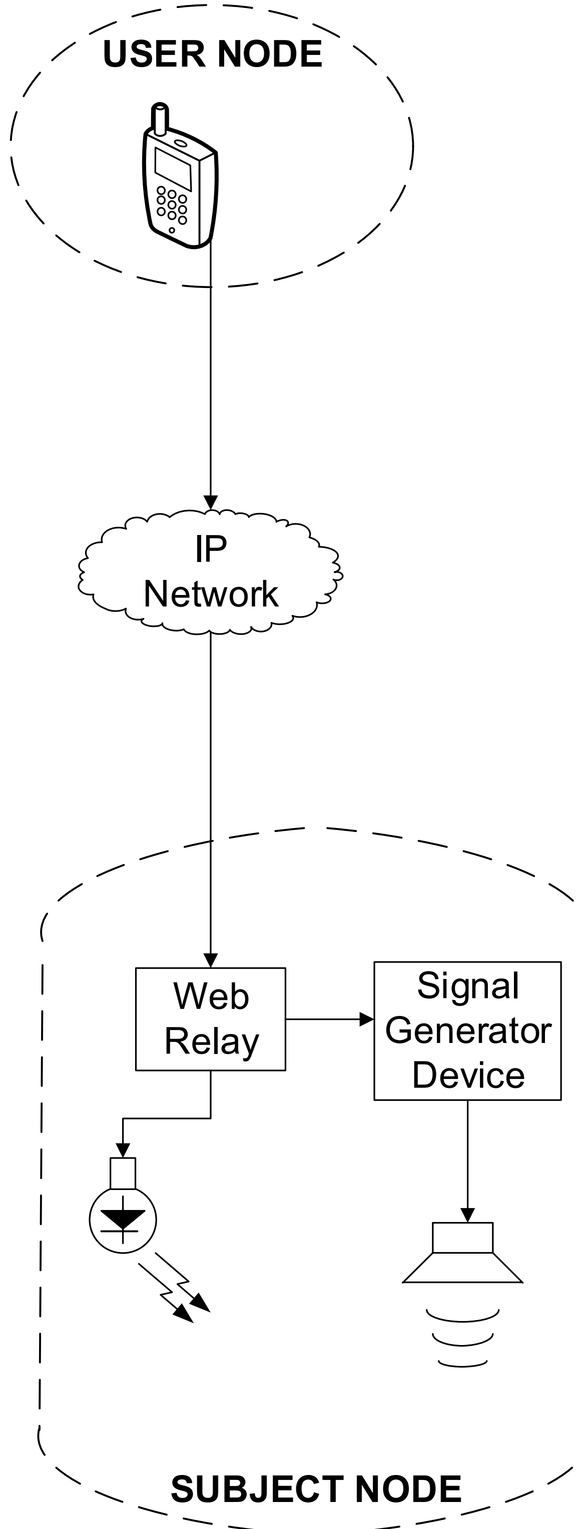

USER NODE
IP
Network
Web
Relay
Signal
Generator
Device
SUBJECT NODE

FIG. 5F

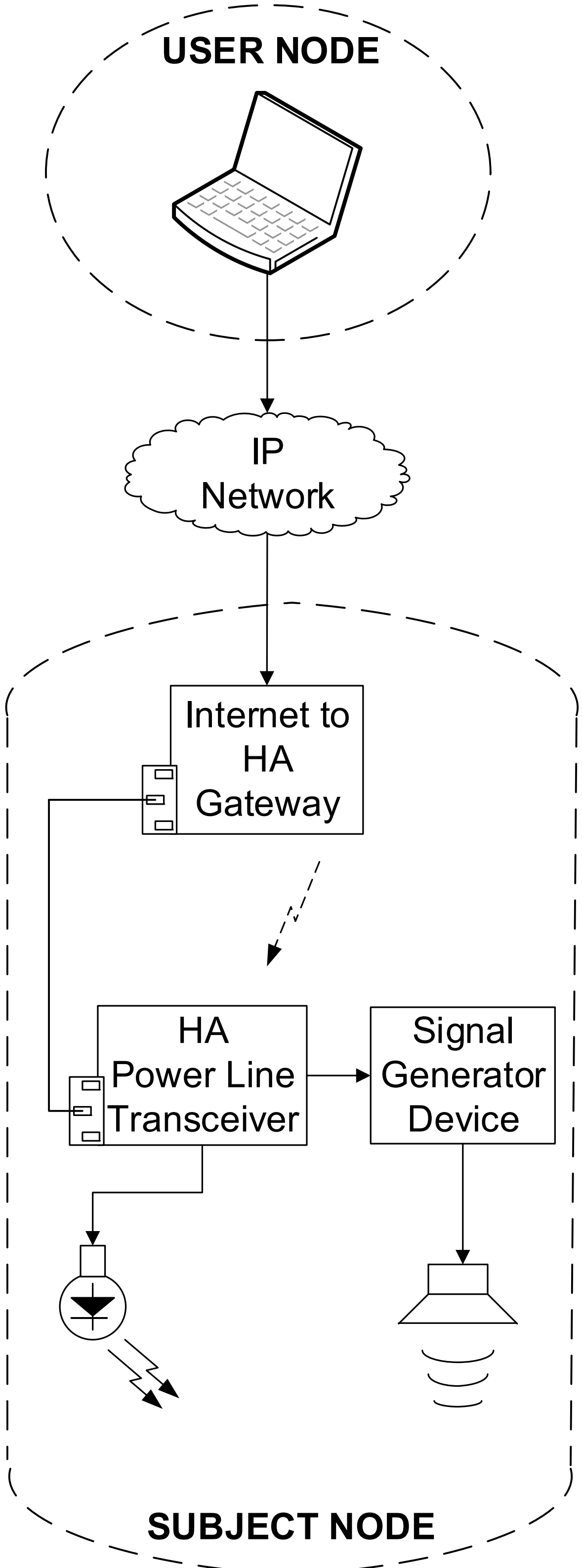

USER NODE
IP
Network
Internet to
HA
Gateway
HA
Power Line
Transceiver
Signal
Generator
Device
SUBJECT NODE

FIG. 5G

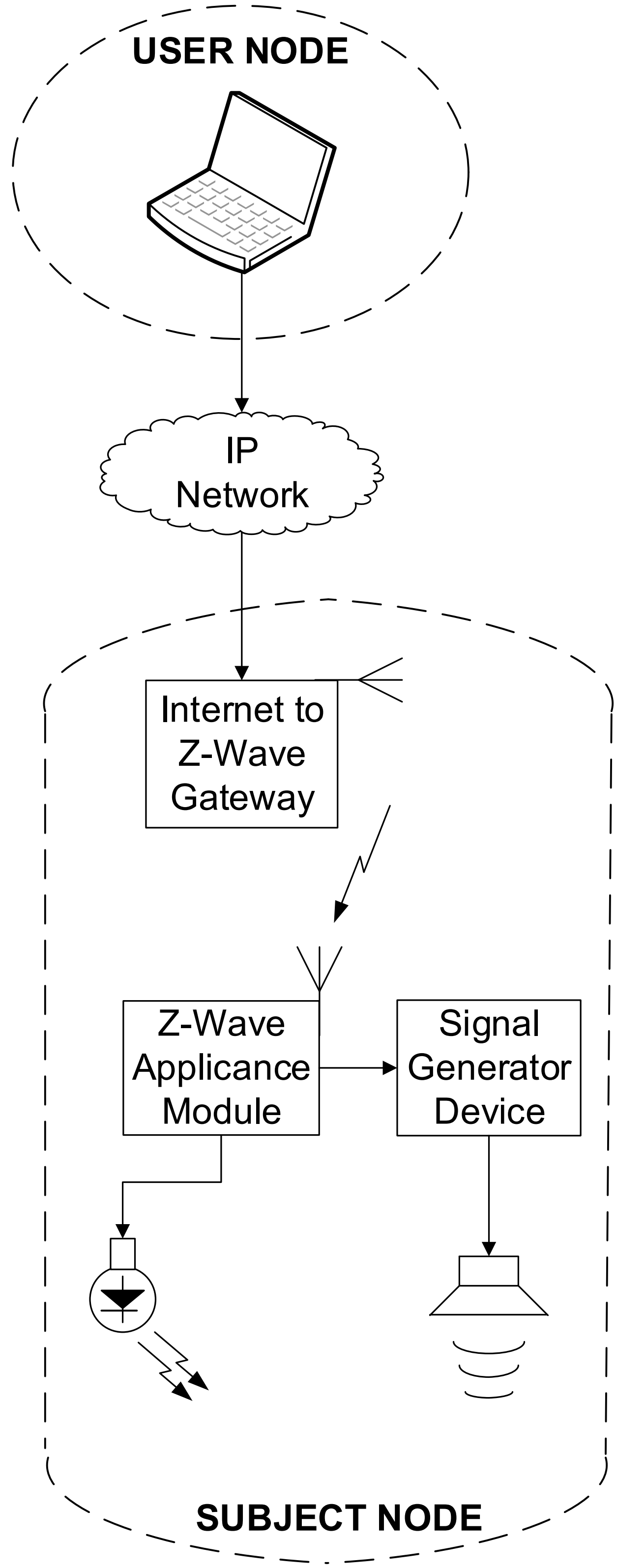

USER NODE
IP
Network
Internet to
Z-Wave
Gateway
Z-Wave
Applicance
Module
Signal
Generator
Device
SUBJECT NODE

FIG. 5H

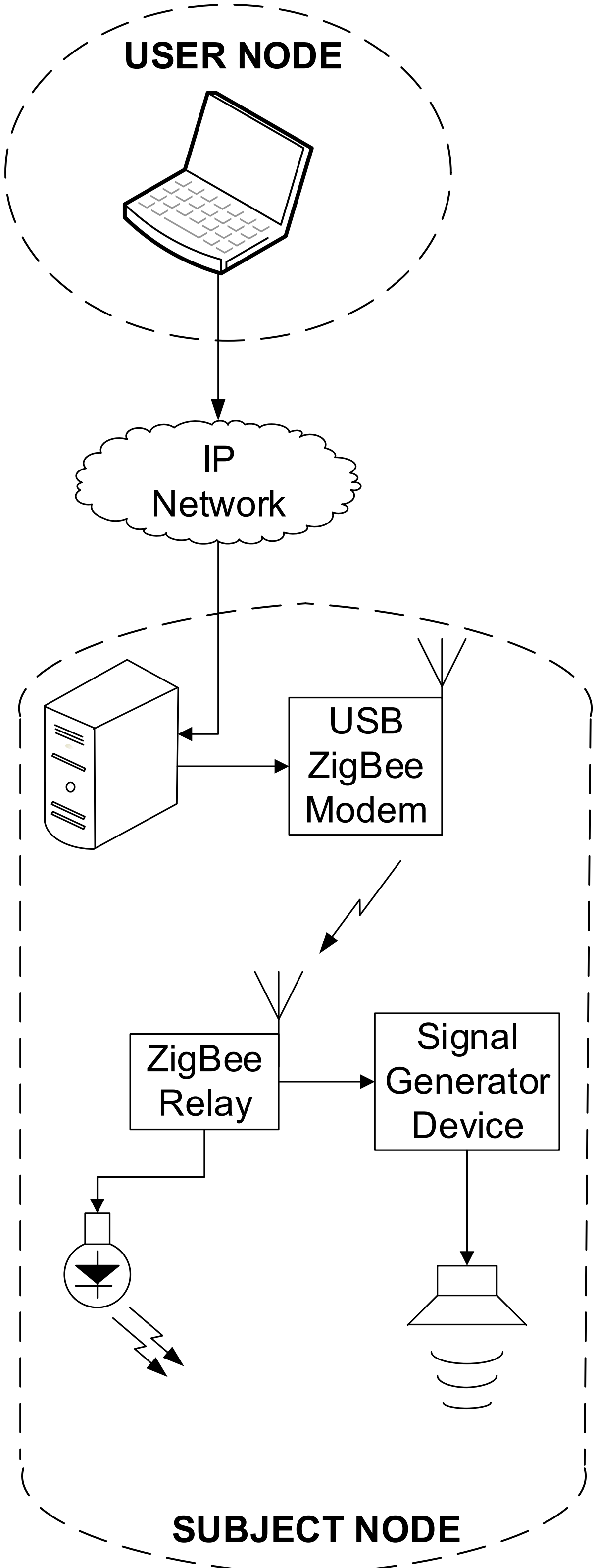
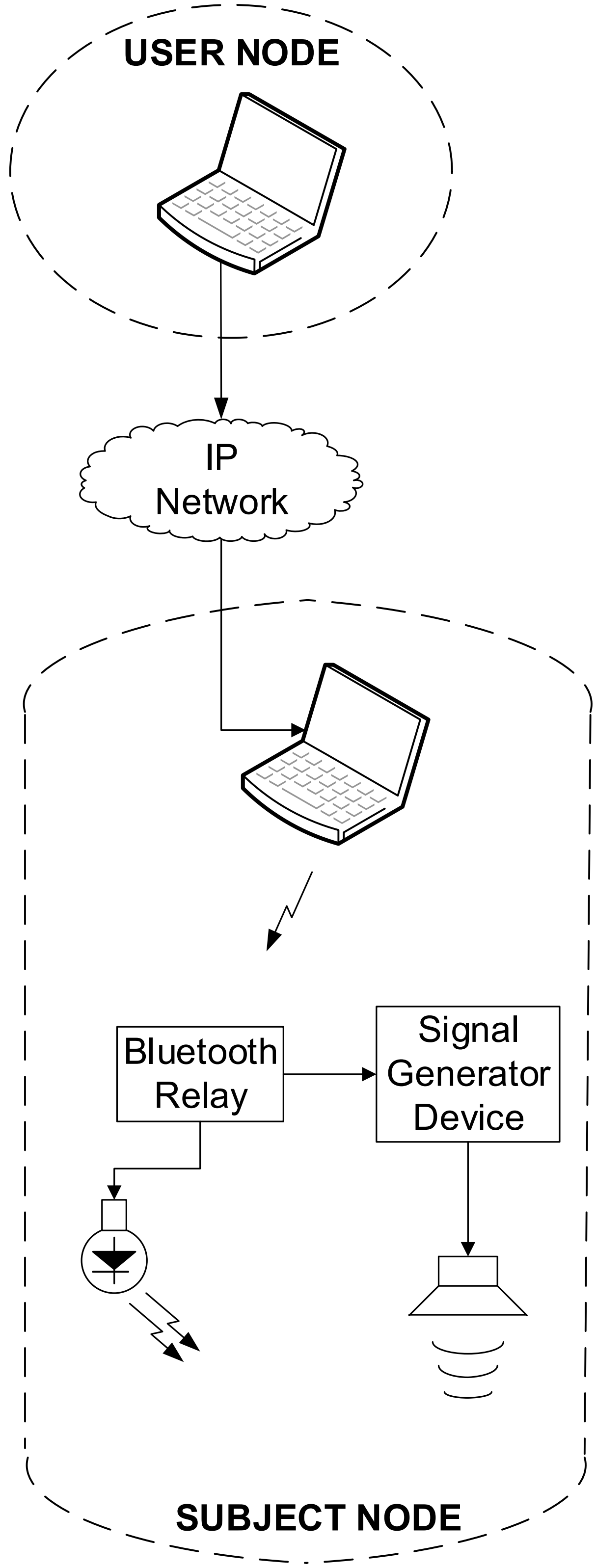
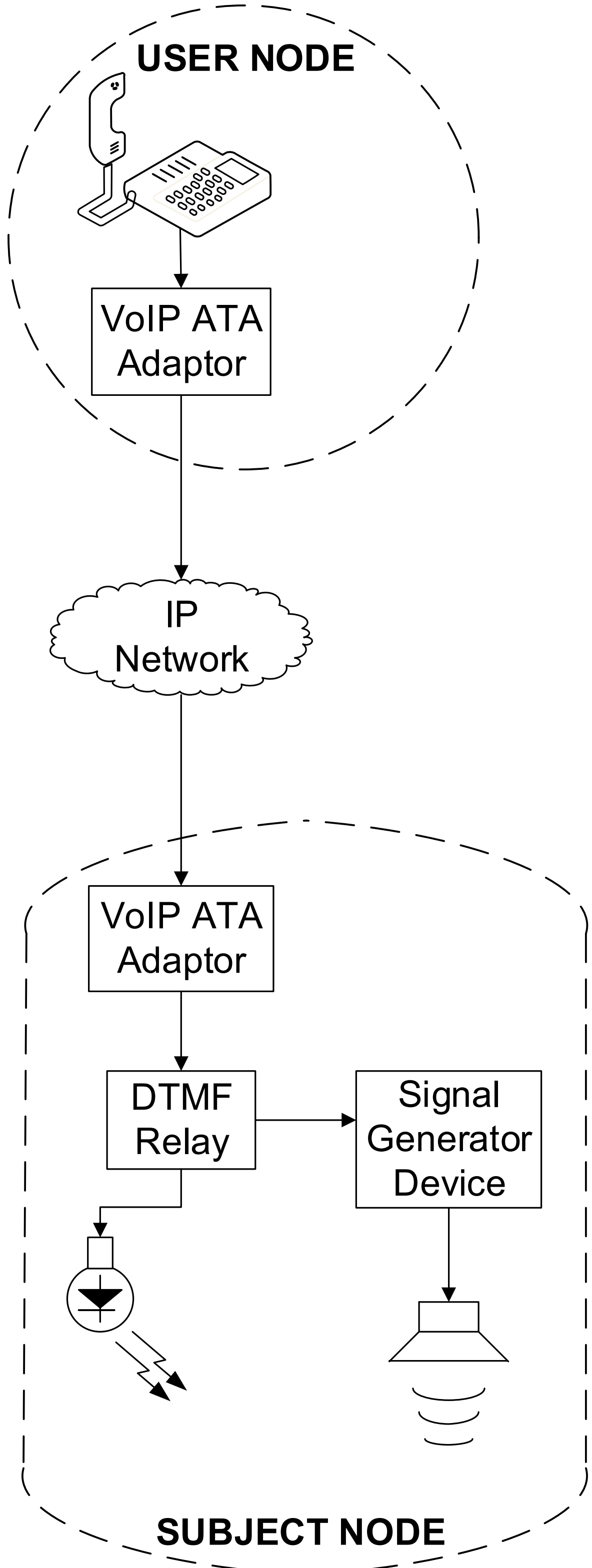

USER NODE
IP Network
USB ZigBee Modem
ZigBee Relay
Signal Generator Device
SUBJECT NODE

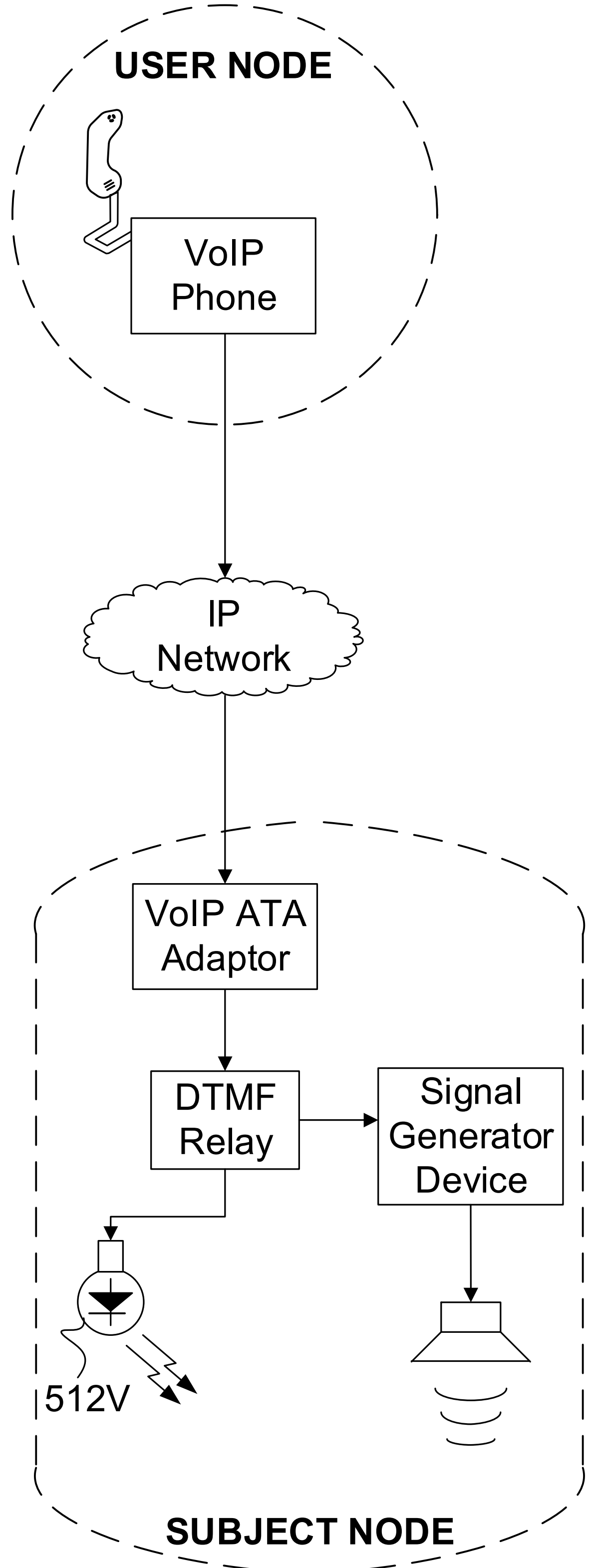
FIG. 5I


USER NODE
IP Network
Bluetooth Relay
Signal Generator Device
SUBJECT NODE

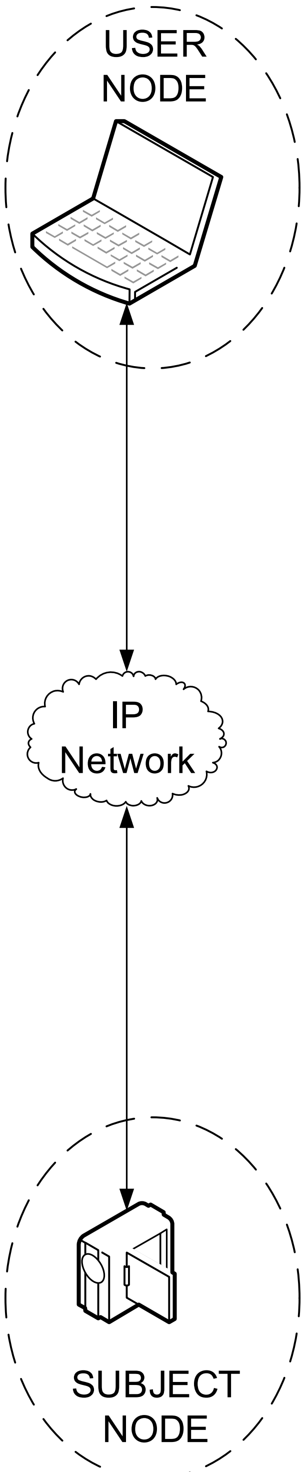
# FIG. 5J


USER NODE
VoIP ATA Adaptor
IP Network
VoIP ATA Adaptor
DTMF Relay
Signal Generator Device
SUBJECT NODE

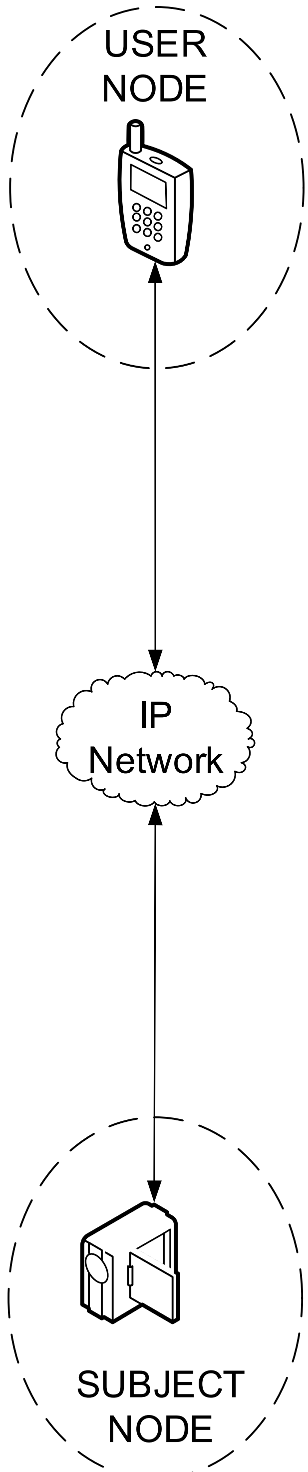
# FIG. 5K


USER NODE
VoIP Phone
IP Network
VoIP ATA Adaptor
DTMF Relay
Signal Generator Device
512V
SUBJECT NODE

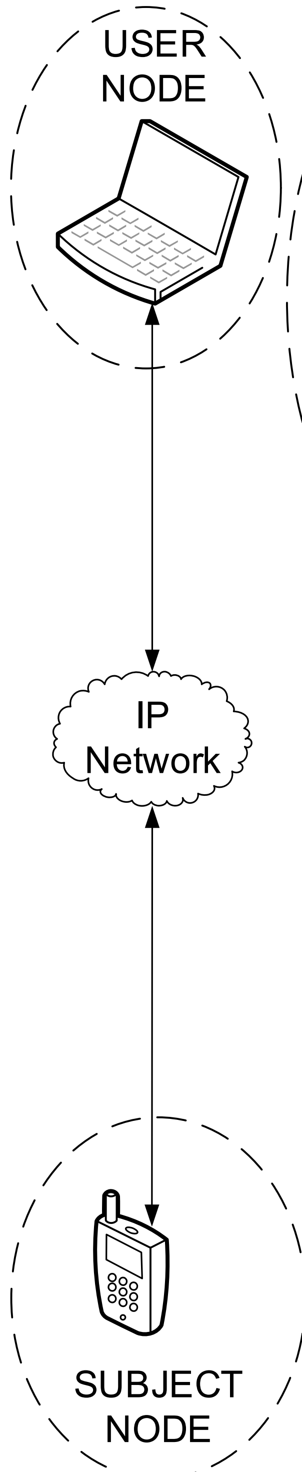
# FIG. 6A



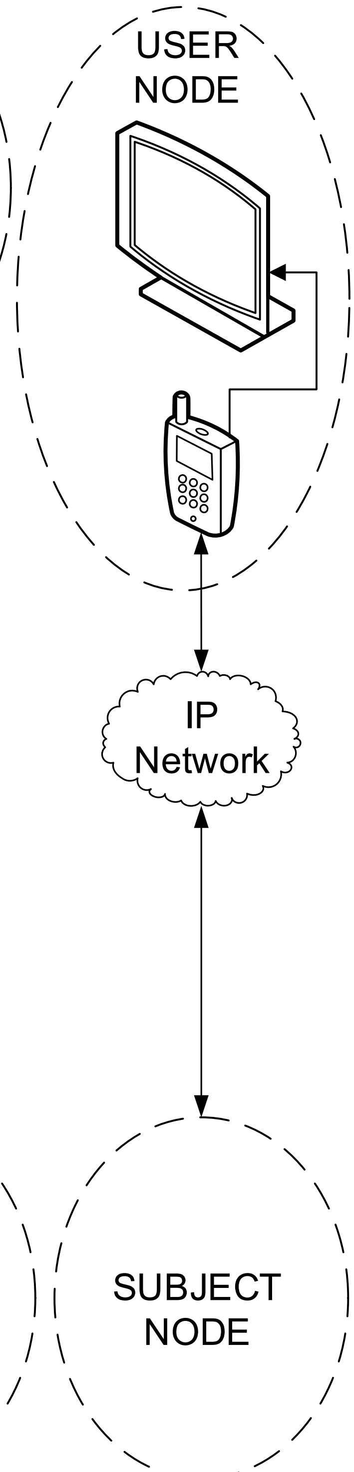

# FIG. 6B




# FIG. 6C




# FIG. 6D



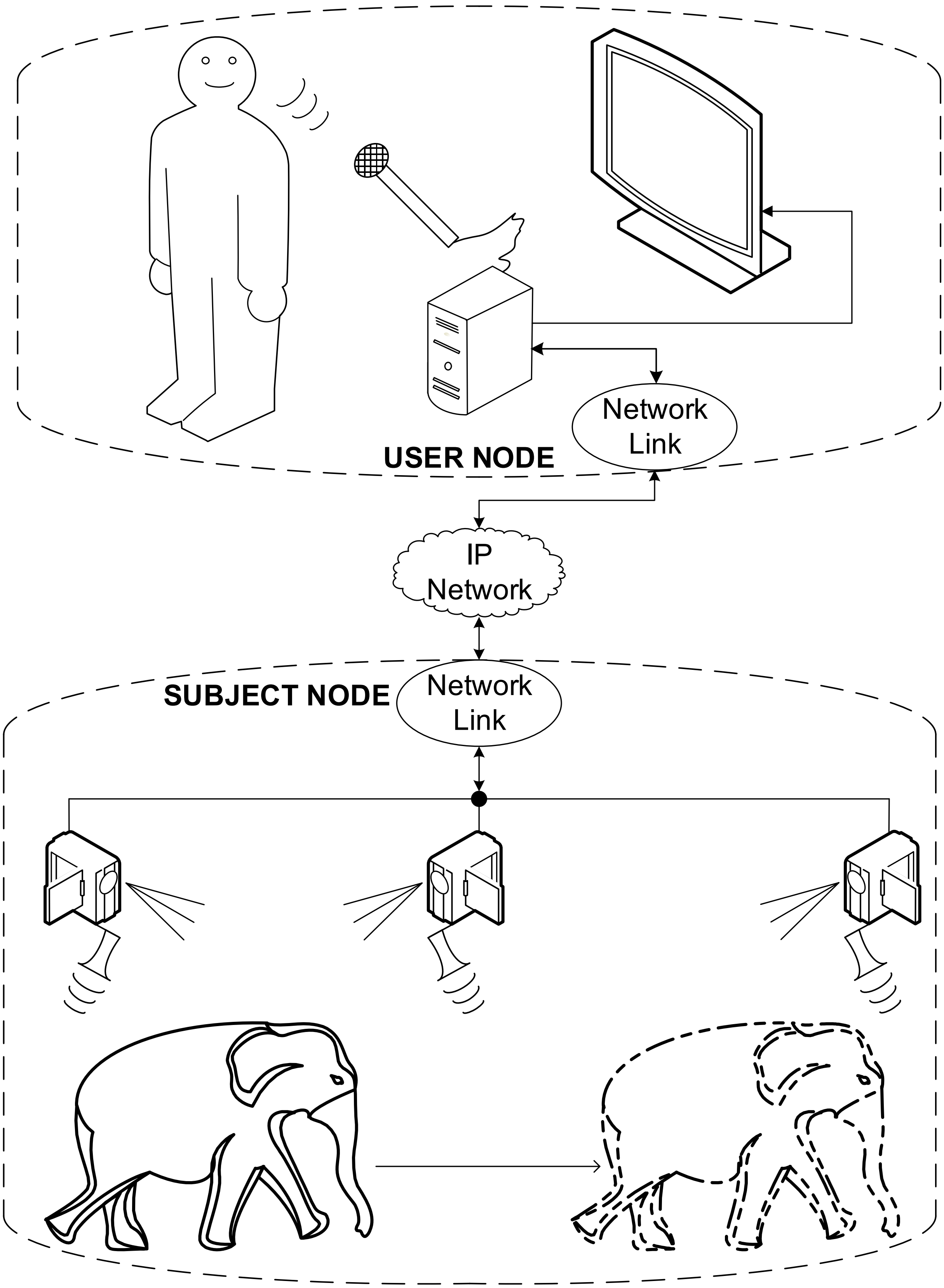

Network Link
USER NODE
IP Network
SUBJECT NODE
Network Link

FIG. 7

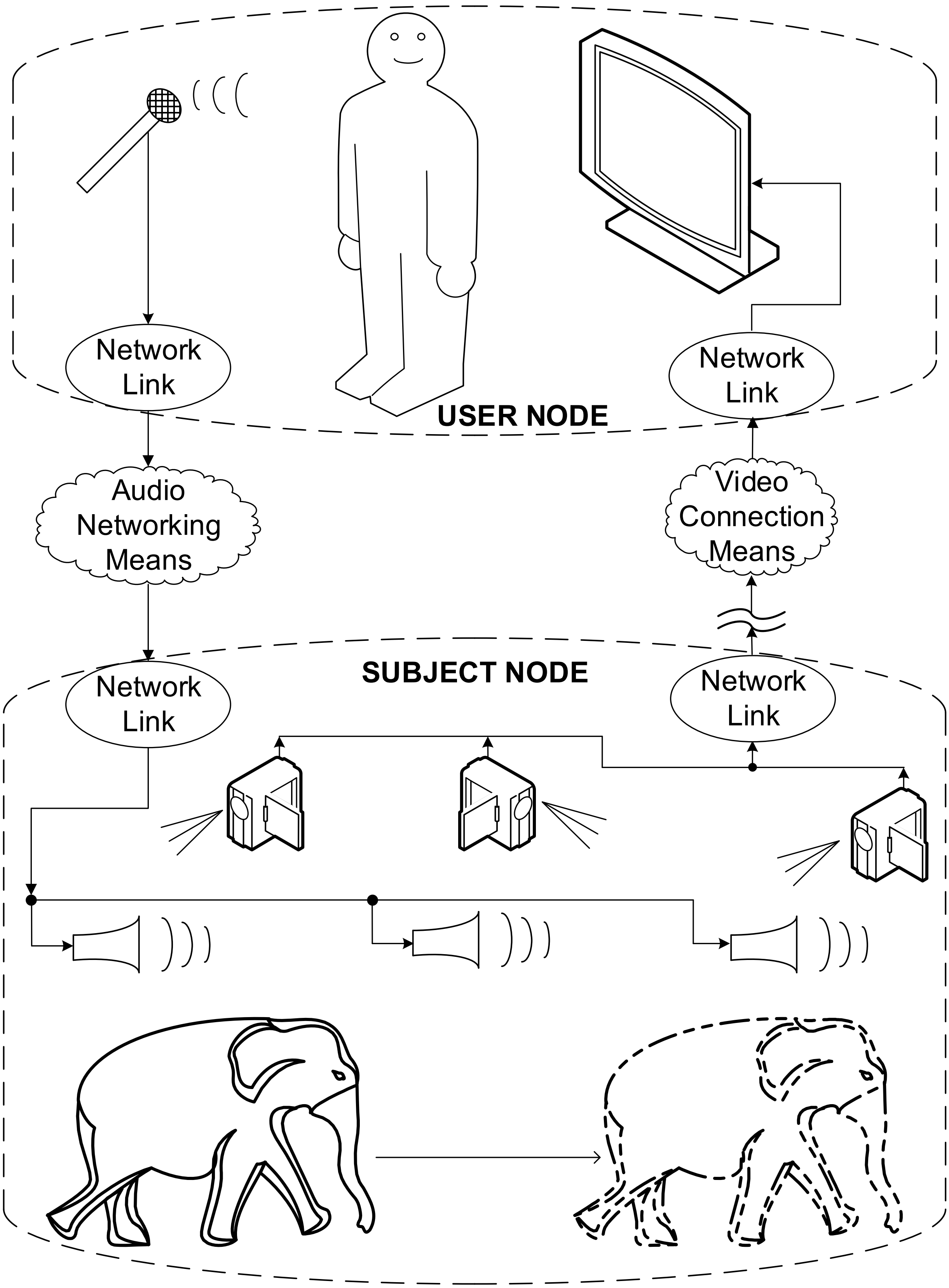
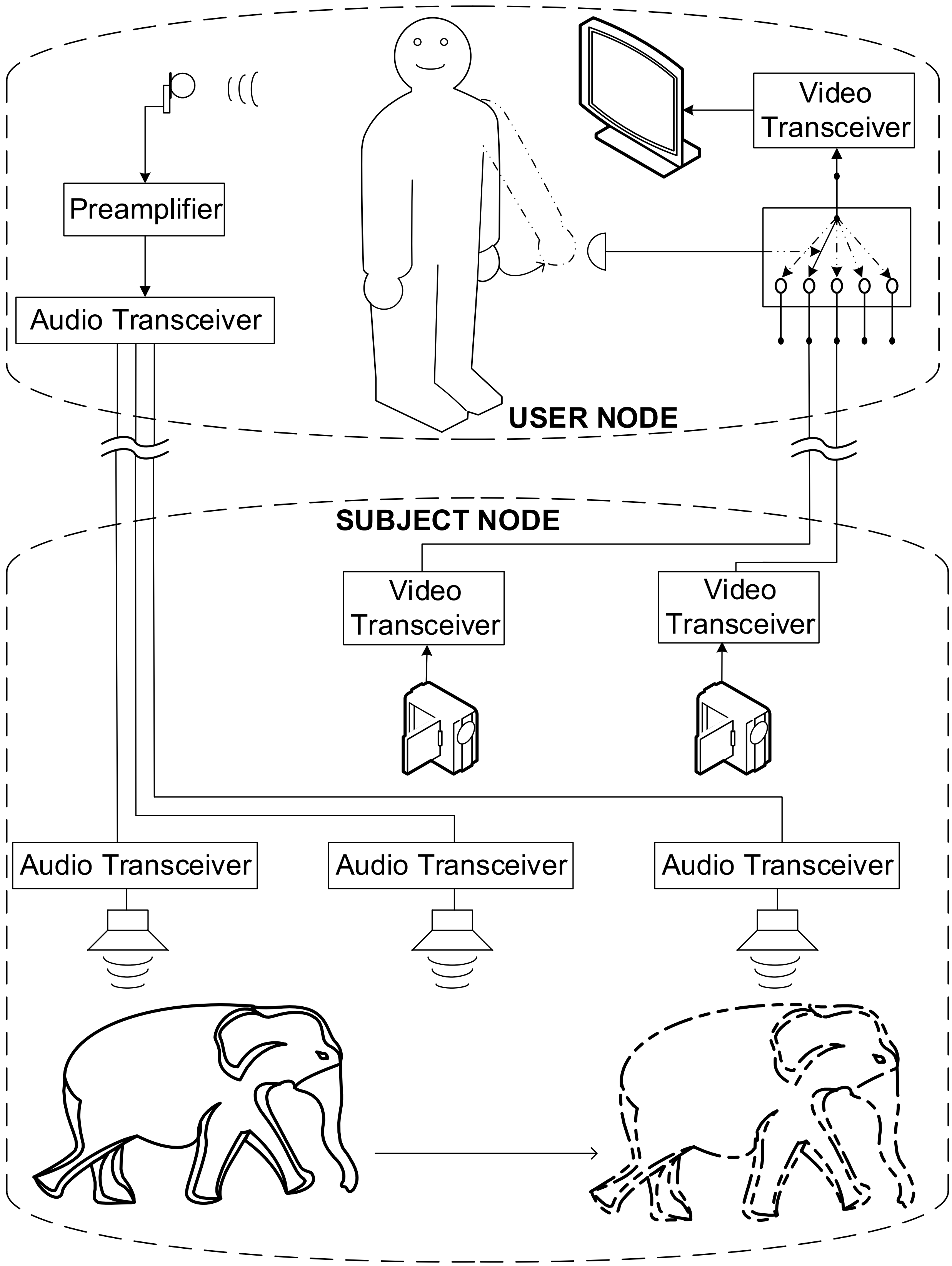

Network
Link
USER NODE
Network
Link
Audio
Networking
Means
Video
Connection
Means
SUBJECT NODE
Network
Link
Network
Link

FIG. 7A



Video
Transceiver
Preamplifier
Audio Transceiver
USER NODE
SUBJECT NODE
Video
Transceiver
Video
Transceiver
Audio Transceiver
Audio Transceiver
Audio Transceiver


**FIG. 7B**

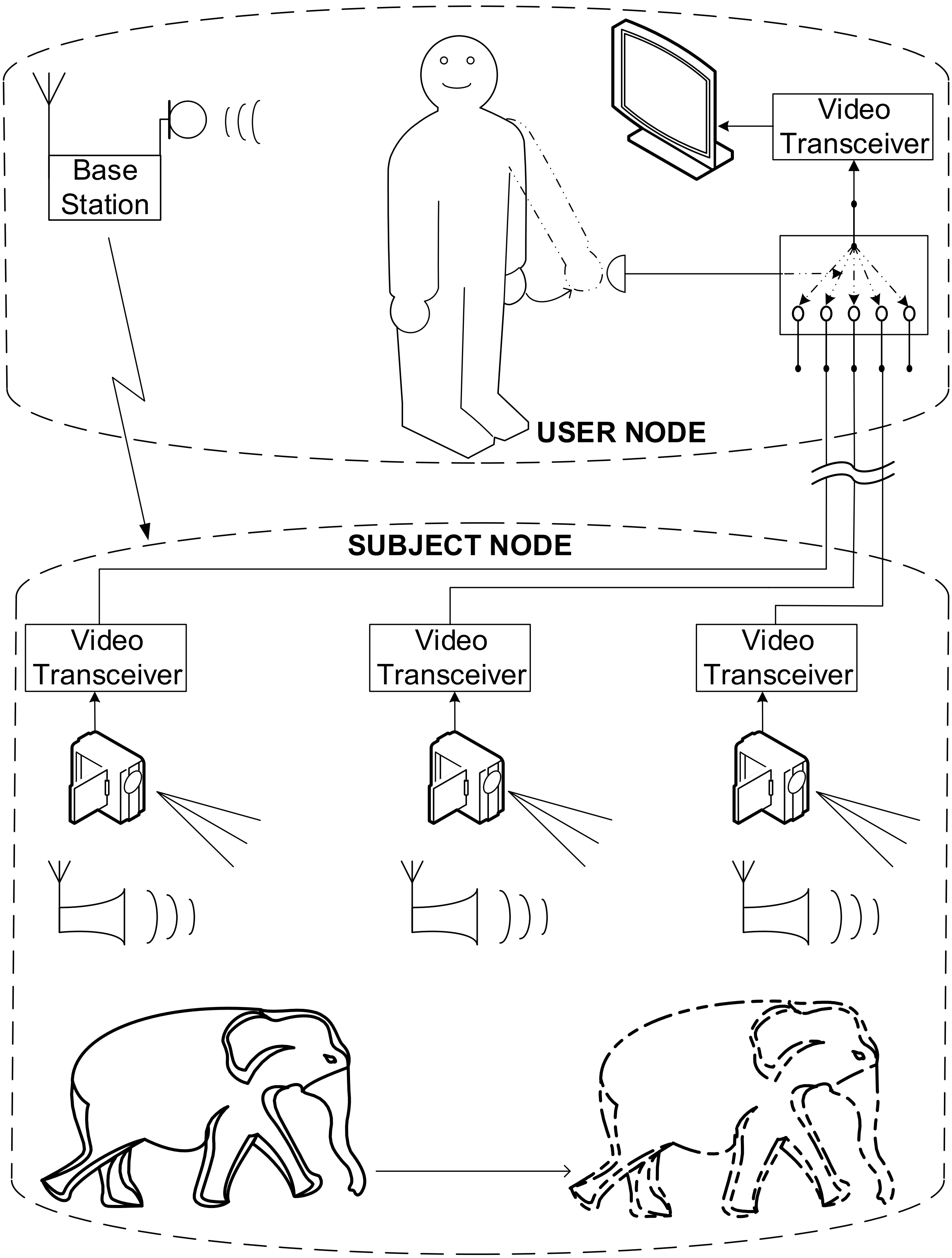

Base
Station
Video
Transceiver
USER NODE
SUBJECT NODE
Video
Transceiver
Video
Transceiver
Video
Transceiver

**FIG. 7C**

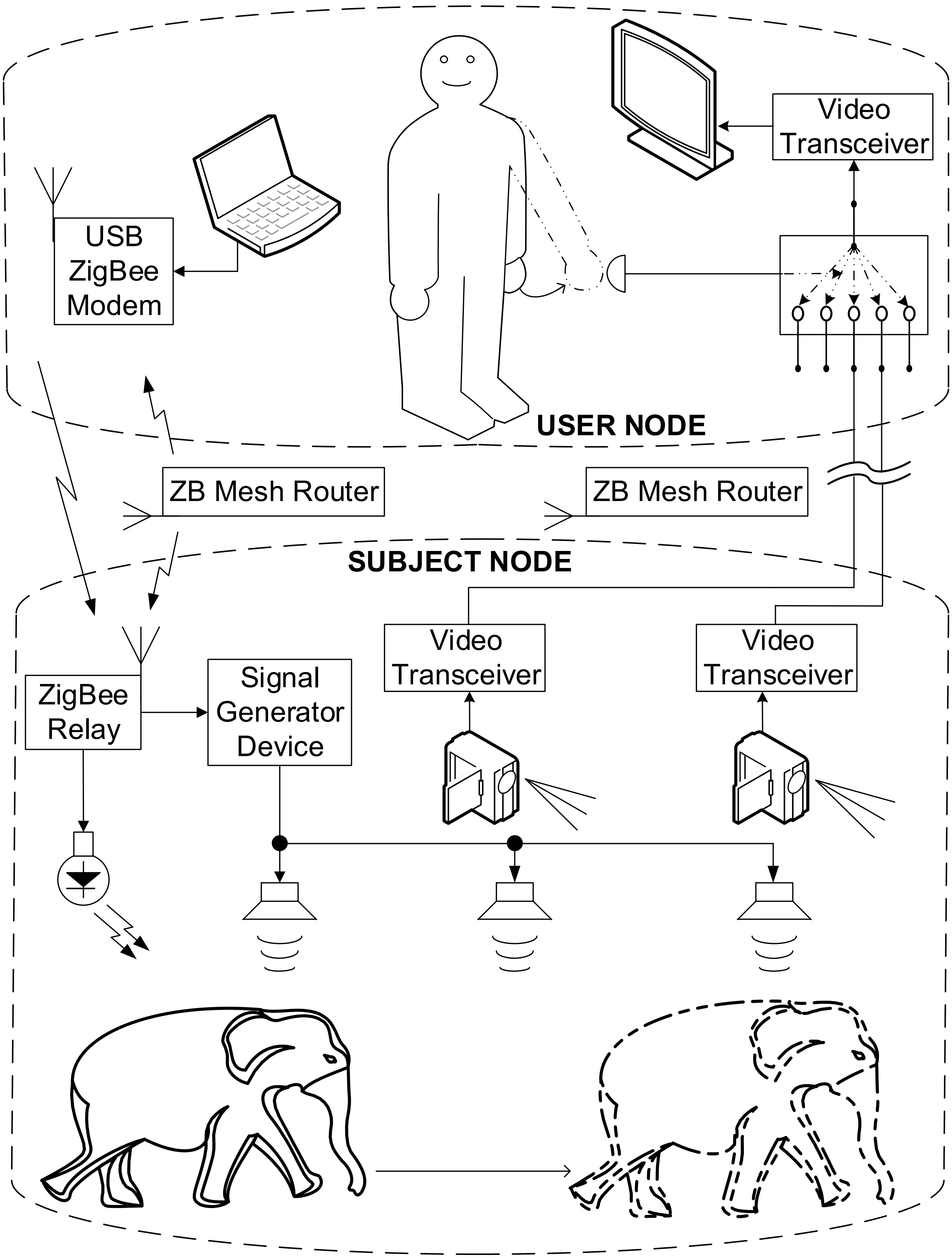

Video
Transceiver
USB
ZigBee
Modem
USER NODE
ZB Mesh Router
ZB Mesh Router
SUBJECT NODE
Video
Transceiver
Video
Transceiver
ZigBee
Relay
Signal
Generator
Device

FIG. 7D

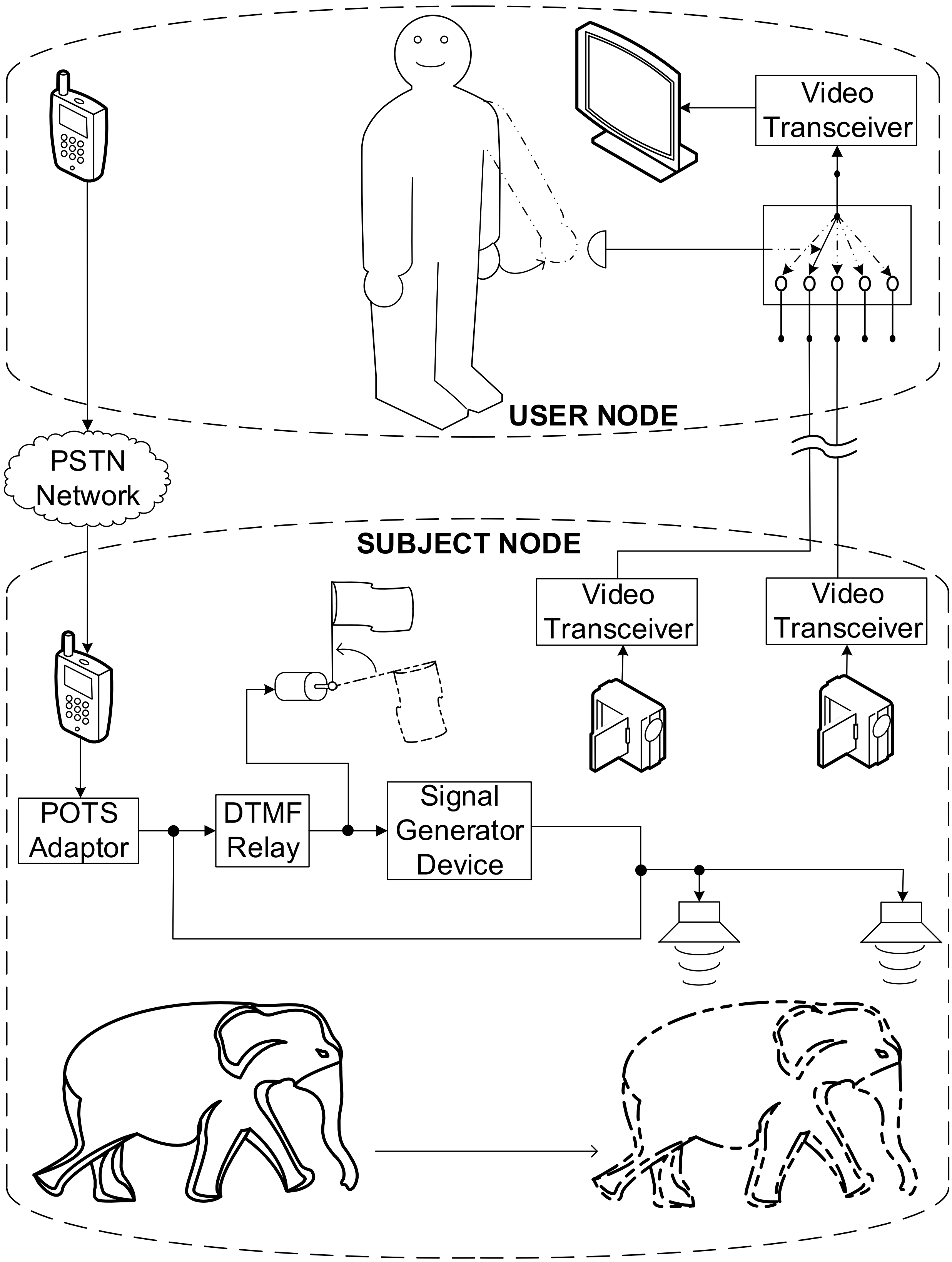

Video
Transceiver
USER NODE
PSTN
Network
SUBJECT NODE
Video
Transceiver
Video
Transceiver
POTS
Adaptor
DTMF
Relay
Signal
Generator
Device

FIG. 7E

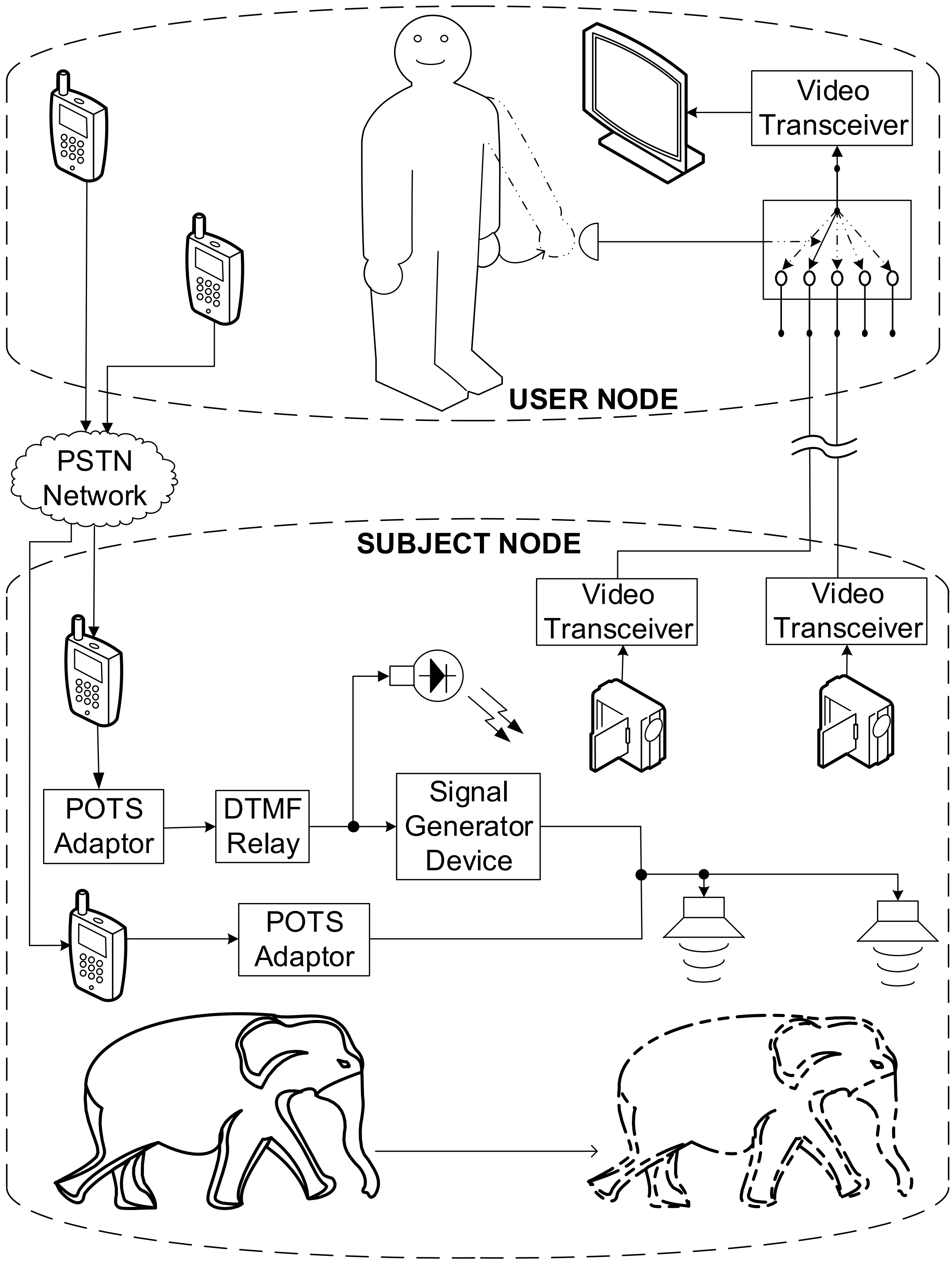

Video
Transceiver
USER NODE
PSTN
Network
SUBJECT NODE
Video
Transceiver
Video
Transceiver
Signal
Generator
Device
POTS
Adaptor
DTMF
Relay
POTS
Adaptor

**FIG. 7F**

FIG. 8A

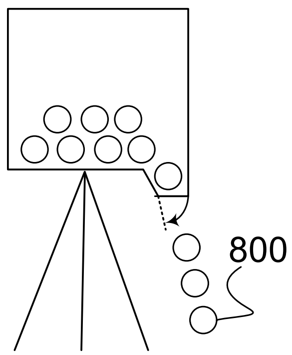



FIG. 8B

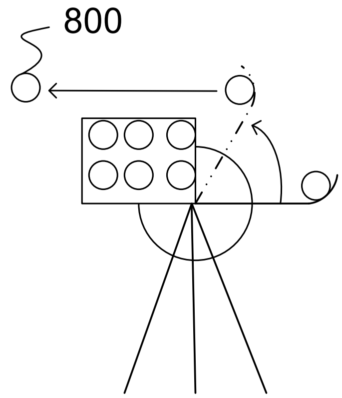



FIG. 8C

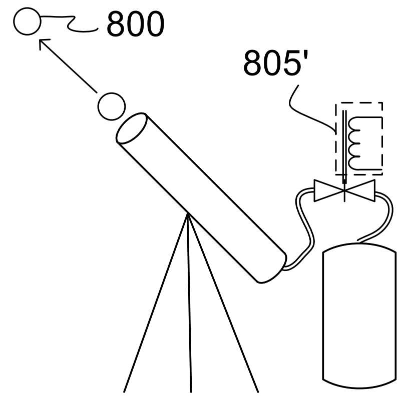
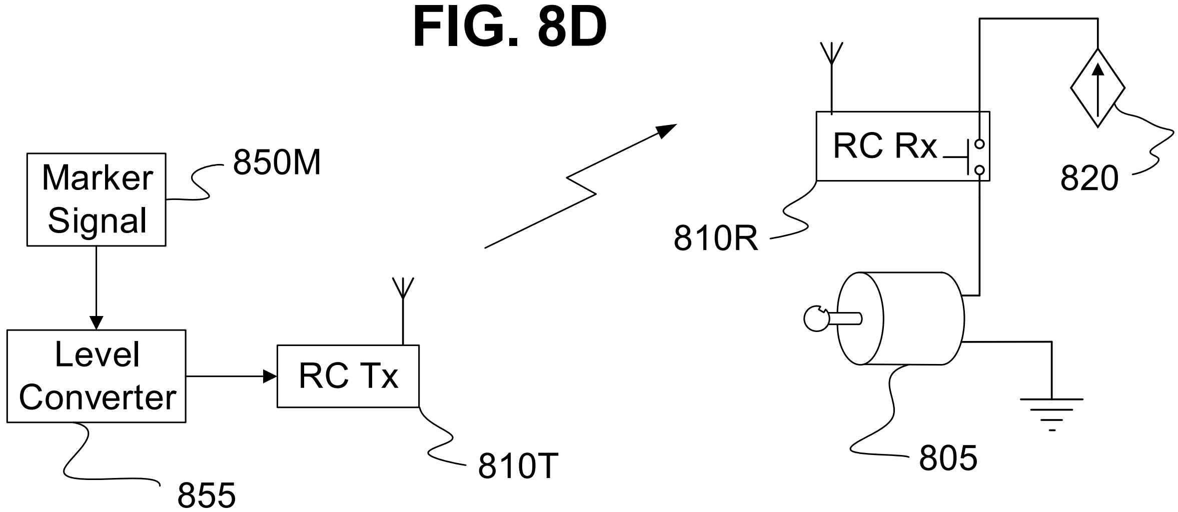



FIG. 8D



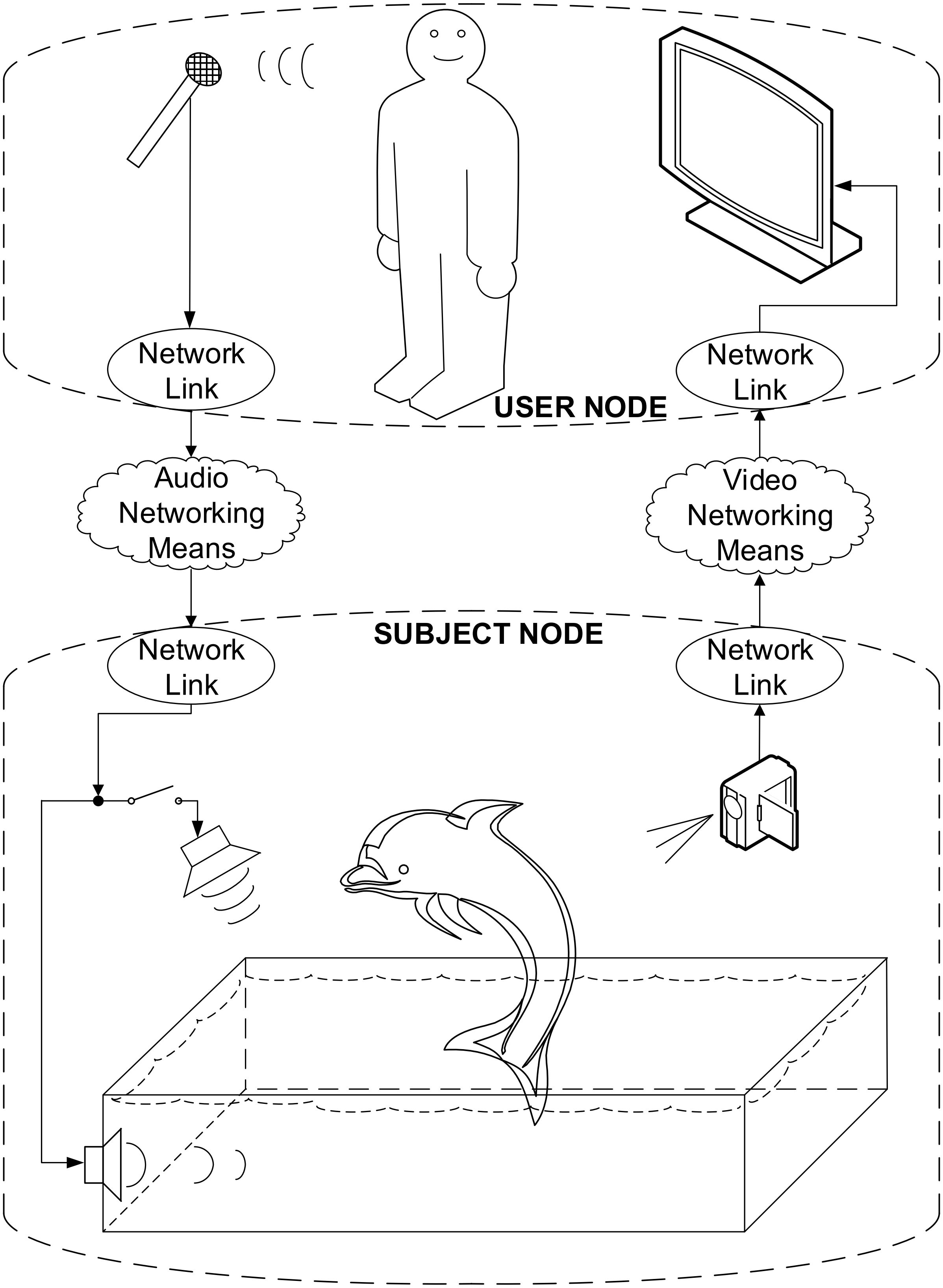

Network
Link
USER NODE
Network
Link
Audio
Networking
Means
Video
Networking
Means
SUBJECT NODE
Network
Link
Network
Link

FIG. 9

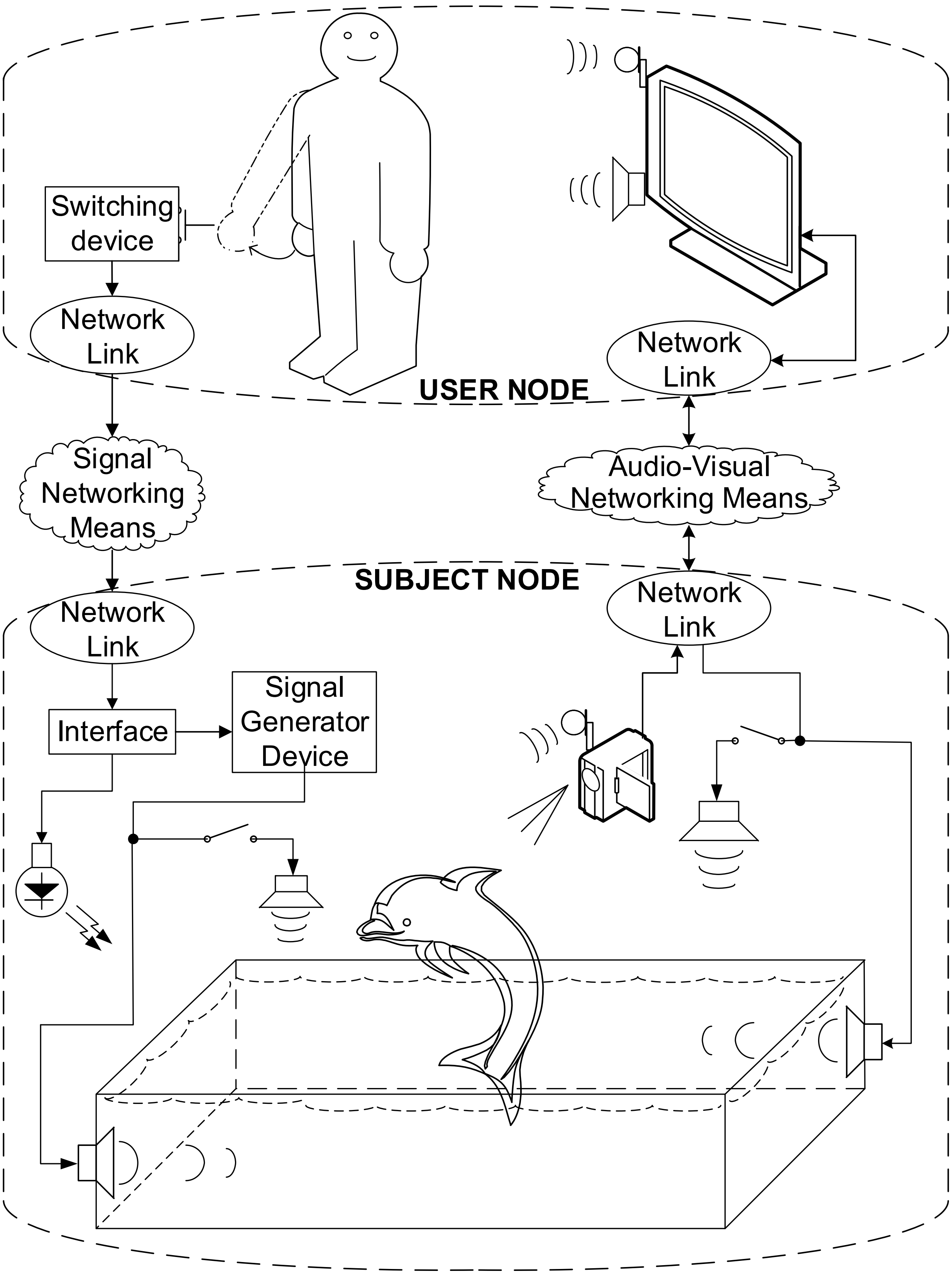

Switching device
Network Link
USER NODE
Network Link
Signal Networking Means
Audio-Visual Networking Means
SUBJECT NODE
Network Link
Network Link
Interface
Signal Generator Device

**FIG. 9A**

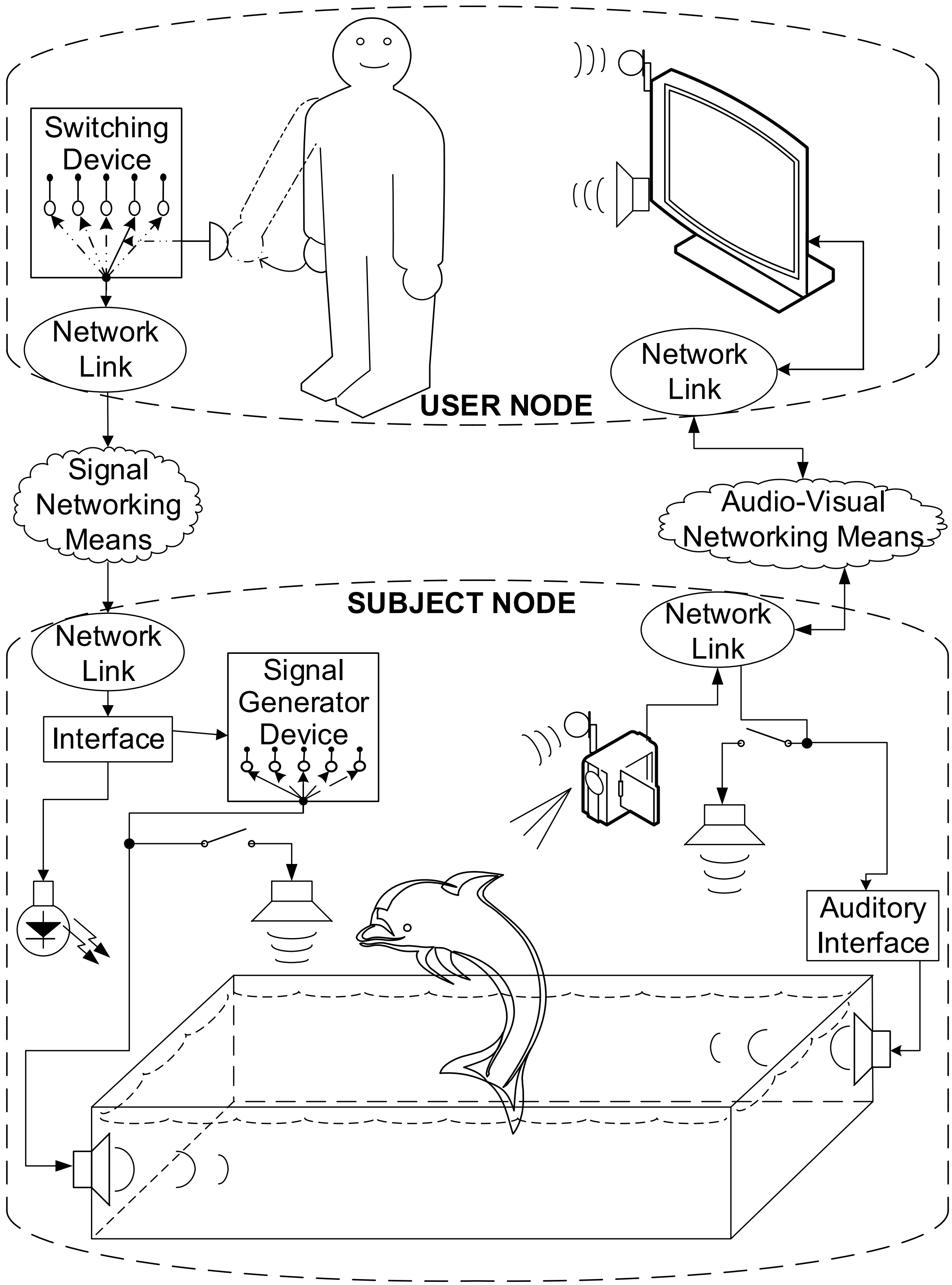
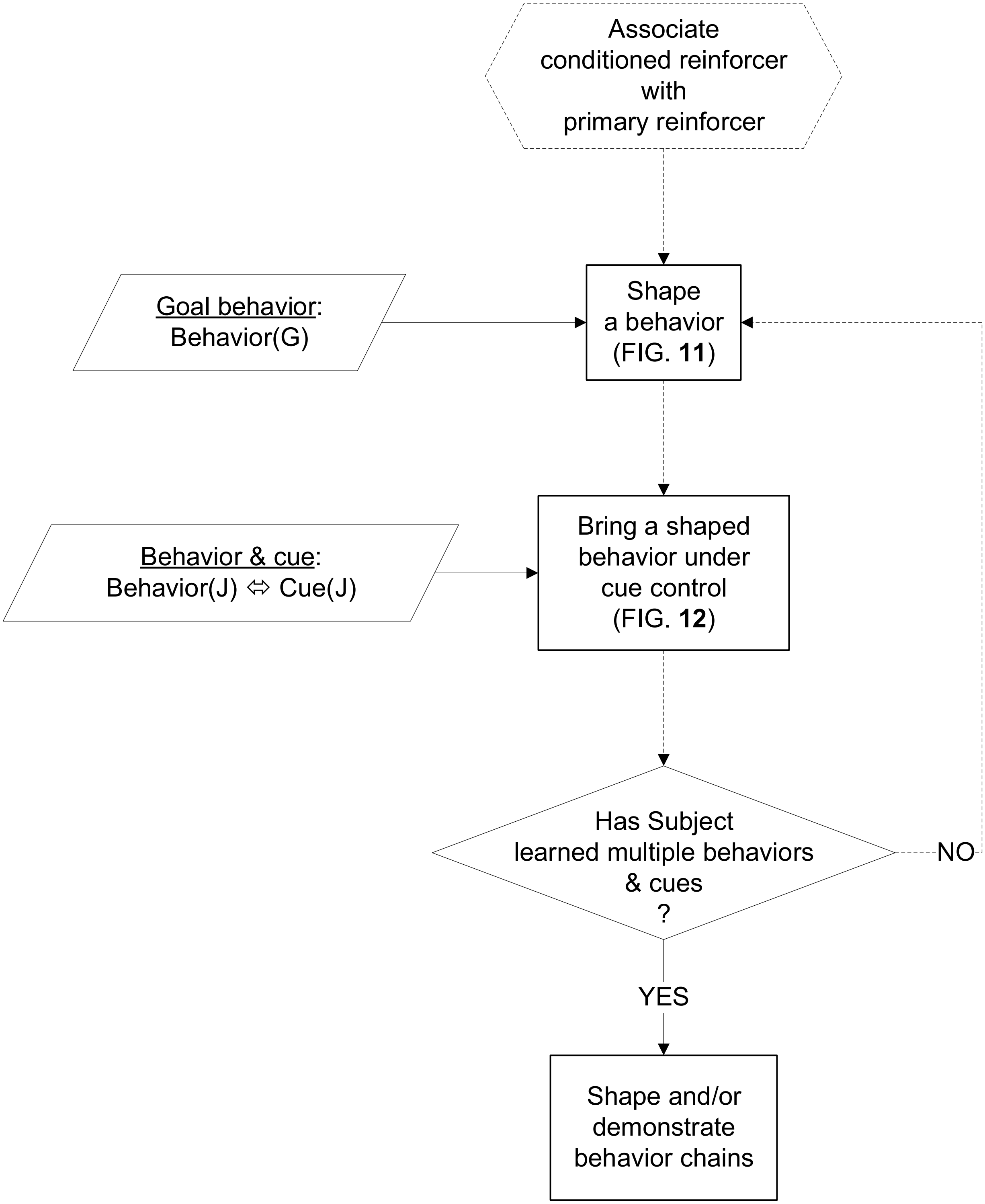

Switching Device
Network Link
USER NODE
Network Link
Signal Networking Means
Audio-Visual Networking Means
SUBJECT NODE
Network Link
Network Link
Signal Generator Device
Interface
Auditory Interface

FIG. 9B




# FIG. 10
# Modes of Operation

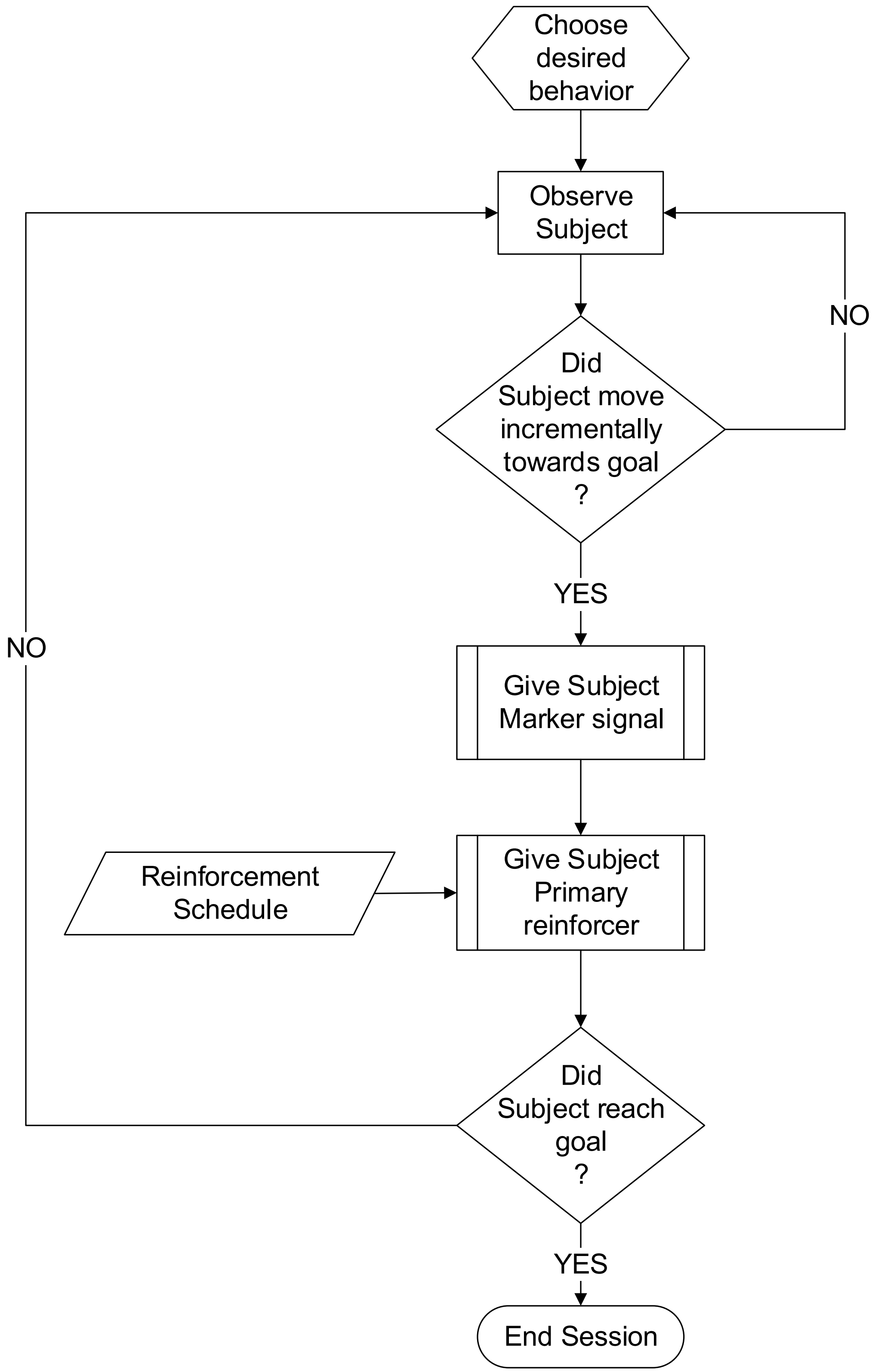
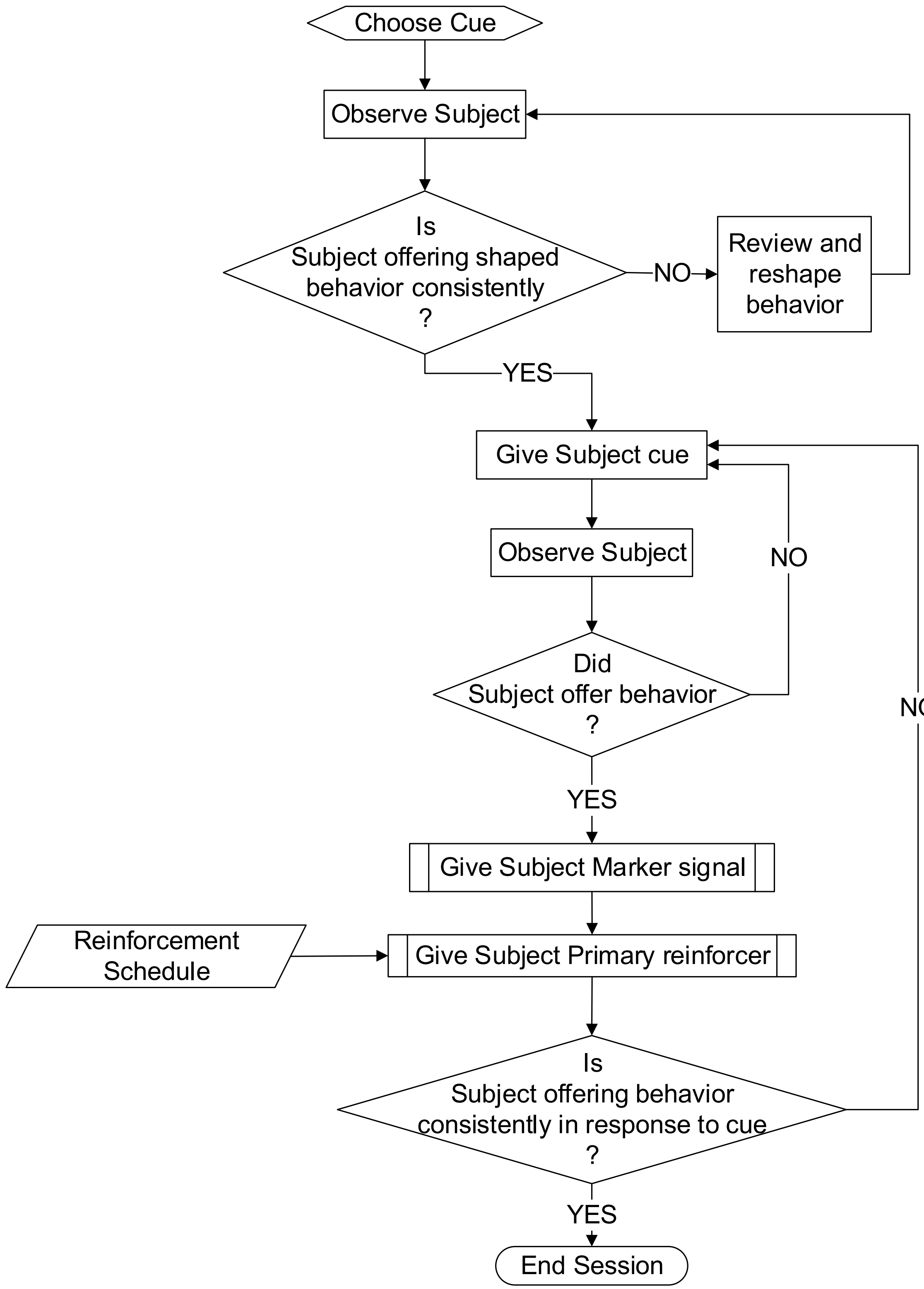



**FIG. 11**
**Shaping a Behavior**




# FIG. 12
# Bring Shaped Behavior under Cue Control

## INTRODUCTION

FIG. **1** shows a high-level view of an example distributed operant conditioning system, comprising a user node in communication with several example subject nodes

FIG. **1**A shows the user node in communication with the example single subject node using networking means.

FIG. **2** shows the user audience at a single user node with a display means shown as a plurality of display monitors or screens suitably sized and/or oriented for the user audience.

As used in this description, “user audience” means one or more people assembled at the user node as a group, classroom or other audience. The user audience can include a moderator for the group, such as a teacher for a class in an educational setting or presenter in an entertainment setting. In the figures to follow, where the user audience is illustrated as a single figure it is understood that an associated group, if applicable, is implicitly understood even if not explicitly shown.

Referring to FIGS. **3**A, **3**B, **3**C, & **3**D, a fundamental paradigm and principles for use of the embodiments will be described.

FIG. **3**A shows as a baseline a model used in classical conditioning: An Effector provides (in other words effects, or effectuates) a stimulus to a subject and the subject then gives a response. In other words, the Stimulus (or cause) causes the Response (or effect), which was initiated by the Effector.

FIG. **3**B shows the case where the Effector is, by way of example, a Trainer (or teacher) giving a command to a subject animal so that the subject then gives a behavior in response (for example, sitting in response to the command “SIT”, or silencing in response to “HUSH”). The subject has responded to the command, which was initiated by the Trainer (or teacher).

FIG. **3**C depicts an operant conditioning scenario wherein the subject voluntarily, or operantly, offers a behavior to a user audience. The user audience, as shown in the embodiments herein, responds to the observation of a desired or selected behavior by providing a conditioned reinforcer. The subject has operated on the environment to cause it to be reinforced. In the example case of a subject animal, the animal is training the trainer to give it treats, or in the example case of a subject child, the child is training the teacher to give her treats, or allow play with a toy, etc.

FIG. **3**D illustrates the fact that the reinforcer is given to the subject by the user audience, thereby closing the loop and illustrating the interactive nature inherent in the underlying principles of operant conditioning and their use in the embodiments: with reference to the baseline model of FIG. **3**A the subject is acting as an effector to the user audience while the user audience is acting as an effector to the subject. In other words, both the user audience and the subject are each simultaneously acting as a subject to the other.

This interactivity is highly educational and entertaining in that, similar to improvisational forms of comedy, the results are inherently surprising and unexpected.

## EXAMPLES - Audio and Visual Networking

Referring to FIG. **4**, shown is a high-level view of an example embodiment of user node and an example subject node. The Networking means of previous high-level diagram of FIG. **1**A is illustrated as having two example components, audio networking means and video networking means.

Referring to FIG. **4**A, a finer level of detail is shown. Illustrated is an example subject at the example subject node; in this figure the example subject is illustrated as a bear.

A user node output Network link operatively connects with or to the audio networking means, a user node input Network link operatively connects with or to the video networking means, A subject node output Network link operatively connects with or to the video networking means, and a subject node input Network link operatively connects with or to the audio networking means.

In the more particularized example embodiments to follow, any of the network links may be internal components of an explicitly illustrated device (i.e., an internal interface circuit in a telephone device, an internal network card with drivers in a computing device, internal sound or display card with drivers in a computing device, etc.).

At the user node the user audience observes the subject on the display means through video camera means located at the subject node. The display means can be a plurality of display monitors or screens suitably sized and/or oriented for the user audience, as previously described with reference to FIG. **2**. The display means can be one or more display devices integral or peripheral to a computer.

If at the subject node the subject is an animal in an enclosure with obstructions, or in a particularly large enclosure or habitat such as in an animal park or zoo with a natural habitat, then the video camera means at the subject node can be a networked suitable plurality of cameras such that the subject animal is not obscured, as will be shown in later embodiments.

Referring again to FIG. **4**A, the signal from the video camera means is transmitted through video networking means. The user audience at the user node communicates to the subject by emitting suitably audible sound signals which are picked up by a microphone device.

These sound signals are transmitted through audio networking means to a suitably amplified speaker means in a proximity to the subject at the subject node such that it perceives the emitted sounds. The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed, as will be shown in later embodiments.

The emitted sounds can be verbalizations such as “Good boy/girl!” or “Yes!” These are conditioned reinforcers, and when precisely timed serve as marker signals to the subject. More precisely in serving as a distinctive marker signal to the subject, the user audience can directly make a unique sound (e.g., a clucking sound, or the sound of a hand clap). Most precisely the user audience can use a device such as a metallic party clicker (a handheld device with a bendable noise producing flap), a whistle, horn or the like, operated in proximity to the microphone device.

The emitted sounds can also be signals serving as cues, for example verbalizations such as “HUSH” or “TOUCH”. The user audience can therefore generate both marker signals and cues, independently as needed, suitable for the example subject at hand and the session at hand.

Although in the present example the conditioned reinforcer serving as a marker signal is auditory, in accordance with the underlying principles of the embodiments, this conditioned reinforcer can be a stimulus from any sensory mode (e.g., light, sound, smell, tactile, etc.). For species with electroreception for example, such as some fish, sharks and rays, the stimulus may be an electric field. As another example, for many species of fish a flash of light may be more appropriate than a noise. An IR (Infra-red) light source such as an IR LED (Light Emitting Diode), may be appropriate for some snakes. For species of animals that are tetrachromats, such as some birds, bees or dragonflies, for example, an UV (Ultra-violet) light source such as an UV LED may be appropriate.

For the present example, in the description of an audible marker signal serving as the conditioned reinforcer signal the microphone device and audio networking means of FIG. **4**A can be embodied by a telephone operating over the PSTN (Public Switched Telephone Network) such as a telephone and PSTN network as shown in FIG **4**B. The subject node input network link can be embodied by a telephone and/or speaker phone device with speaker means either operatively connected to or a component of the device.

FIG. **4**C shows, equivalent in function, a VoIP (Voice over Internet Protocol) phone operating over an IP network (i.e., the internet network). The subject node input network link can be embodied by a VoIP telephone similar to that at the user node.

FIG. **4**D illustrates as a functionally equivalent example the use of a computing device where one of the user input devices is a microphone (either integrated or peripheral to the computer). This functionality is enabled when the computing device programming comprises an operating system including drivers for a microphone device, a sound card, web browser, and software for VoIP service (also known as “softphone” software). The subject node input network link again can be embodied by either a telephone similar to the VoIP telephone of the previous example or a VoIP softphone similar to that at the user node.

The marker signal, instead of a clicker or whistle, for example, can also be any of the distinctive tones produced by a DTMF telephone digit key. The user audience, once connected over the network to the subject node, can generate one (or more) of these tones recognizable to the subject as a conditioned reinforcer.

As with the emitted signals previously discussed, some of the tones can also serve as cues, and so the user audience can therefore generate both marker signals and cues, independently as needed, suitable for the example subject at hand and the session at hand.

These and substantially equivalent example embodiments such as the use of a cellular phone instead of a landline and an analog phone with the use of a VoIP analog telephone adaptor (ATA) will be shown and described further in the context of other additional embodiments and their variants presented later.

Referring to FIG. **4**E, the camera means and video networking means of FIG. **4**A can be embodied by an IP (Internet Protocol) camera (also referred to as a network camera) or functional equivalent connected to the internet network with the user audience employing a suitably equipped web-enabled computing device (shown here with an integrated display) with an operating system including display drivers and web browser. An external display monitor or plurality of display monitors suitably oriented for the user audience would embody the same functionality as the integrated display illustrated. The subject node output network link, illustrated to functionally show the flow of image data information, could be integrated in hardware and/or software with the prior network link illustrated to functionally show the flow of audio signal information as well. This would be the case, for example, in the context of the integrated audio-visual content of a webcast, as will be shown in the context of later additional embodiments.

As discussed earlier, if the subject is an animal in a large enclosure or habitat, the video camera means can be a networked suitable plurality of cameras such that the animal is not obscured. In the present case of an IP or network camera, this can be enabled by the use of commercially available multiple IP camera surveillance systems typically used in security applications. These network cameras as commercially available often have embedded Pan, Tilt and Zoom ("PTZ") functionality to aid in observing the subject animal as it moves.

Alternatively, instead of the IP network camera**,** a suitably equipped 3G, 4G, 5G or higher cellular phone, PDA (Personal Digital Assistant), smart phone or the like with an integrated video camera, web browser and web conferencing application, either installed or hosted or both, can be used as shown in FIG. **4**F to broadcast, webcast or otherwise stream video (and audio) from the subject node. Similarly, later figures will show examples of the use of such suitably equipped cellular phone or mobile personal appliance devices to both broadcast and display images of the subject for the user audience.

As will also be seen in various embodiments shown and described further later, the audio networking means and visual networking means of FIG. **4**A can utilize the same or separate networks (e.g., telephone and/or internet networks) or be physically and/or logically integrated in hardware, software and/or firmware as implemented by multimedia computers equipped with webcams, videophones (also referred to as video telephones), or smart camera phones or the like. Commercially available video conferencing systems can also fill this functionality. Several such integrated embodiments, for example, are also represented in Figs **6**A – **6**D. These integrated embodiments will be described further in the descriptions of later figures.

## EXAMPLES - Signal and Audio-Visual Networking

Referring to FIG. **5**, shown is a high-level view of an example embodiment of a user node and an example subject node. The Networking means of previous high-level diagram of FIG. **1**A is illustrated as having two example components, signal networking means and audio-visual networking means.

Referring to FIG. **5**A, a finer level of detail is shown. Illustrated is an example subject at the example subject node; in this figure the example subject is illustrated as a tiger, an exotic feline.

A user node output Network link operatively connects with or to the signal networking means, a user node network link operatively connects with or to the audio-visual networking means, a subject node network link operatively connects with or to the audio-visual networking means, and an input subject node network link operatively connects with or to the signal networking means. The user node network link in this example embodiment combines the functionality of a user node input link and user node output link, and similarly the subject node network link combines the functionality of a subject node input link and a subject node output link.

In the more particularized example embodiments to follow, any of the network links illustrated to show functionality may be integrated in hardware and/or software or be internal components of another explicitly illustrated device (i.e., an internal interface circuit in a telephone device, an internal network card with drivers in a computing device, internal sound or display card with drivers in a computing device, etc.). Where not explicitly shown, the input and/or output network links are implicit in the configuration: i.e., a network link configured to interconnect with the PSTN network could be embodied by an “RJ-11” (telephone) jack (but not illustrated), whereas a network link configured to interconnect with the internet (IP) network could be embodied by an “RJ-45” (8P8C or Ethernet) jack (but not illustrated).

At the user node the user audience observes the subject on the display means through video camera means located at the subject node. The image data is transmitted through the audio-visual networking means. The display means can be a plurality of display monitors or screens suitably sized and/or oriented for the user audience, as previously described with reference to FIG. **2**, and can be one or more display devices integral or peripheral to a computer.

Referring again to FIG. **5**A, the user audience communicates to the animal by emitting suitably audible sounds directed towards a microphone device. These sounds are transmitted through the audio-visual networking means to a suitably amplified speaker means in proximity to the subject such that the subject perceives the emitted sounds. The speaker means can be a suitably located plurality of speaker devices if needed, as will be shown in later embodiments. The emitted sounds can serve as either marker signals or cues, independently as needed, suitable for the example subject at hand and the session at hand.

A person (not shown) located at the subject node can optionally communicate verbalized information or instructions to the user audience by speaking into a microphone device. These verbalizations are transmitted through the audio-visual networking means to a suitably amplified speaker means at the user node so that the user audience hears the emitted verbalizations.

The user audience can activate a switching device which then transmits a switched signal responsive to this switching device through signal networking means to the subject node. Through an interface**,** a suitable relay device as shown later, this switched signal energizes a signal generator device to produce a predefined sound serving as a marker signal such as an audio tone, whistle, horn, chirp or the like. Although described here as generating a single tone, whistle, horn, chirp, or the like, the signal generator device can be a switched plurality of tone (or waveform) generating circuits or similarly a selectably tunable waveform or tone generator. The generated signals can also serve as cues, suitable for the example subject at hand and the session at hand, for use with the example operations described later. The audible signals are emitted by suitably amplified speaker means in proximity to the subject such that the subject perceives the emitted sounds.

As discussed previously, the conditioned reinforcer signal (or a cue signal) to the subject can be a stimulus from any sensory mode (e.g., light, sound, smell, tactile, electro-reception, etc.).

In addition to an acoustic transducer (as exemplified by the speaker means), another example of effectuating a marker signal (or a cue signal) is illustrated as a visual signal source which is energized by the interface. As discussed earlier, a flash of light may be an appropriate conditioned reinforcer signal when the subject is a fish, an IR light source such as an IR LED may be more appropriate for some snakes as subjects, and an UV light source such as an UV LED may be more appropriate when the subject is a tetrachromatic animal such as with some birds, bees or dragonflies.

Another example of a visual marker signal (or cue signal) would be the actuatable raising of a flag or sign or the like, as illustrated by the alternate example of an assembly depicting an actuator motor raising a flag in such a way as to be visible to the subject. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Additional example embodiments are now described in further detail for the generation of marker signals (or cue signals) by the user audience using a switching device at the user node, with the relevant networking means, interfacing, and signal generating means whereby the signal is communicated to the subject at the subject node.

Referring to FIG. **5**B, a DTMF (Dual Tone Multi Frequency or “Touch-Tone”, also known as tone-dialing) telephone is used by the user audience as a switching device at the user node. The telephone communicates over a PSTN (Public Switched Telephone Network) to the subject node. The call is received at the subject node by a DTMF Relay. The relay is energized when the user audience enters preprogrammed digits on the telephone. A signal generator device, activated by the DTMF relay, generates an audio marker signal (or cue signal). This signal generator device can be any distinctive noise producing device such as a buzzer, chime, horn, whistle, etc. Although described here as generating a single tone, whistle, chirp, or the like, the signal generator device can be a switched plurality of tone (or waveform) generating circuits or similarly a selectably tunable waveform or tone generator. A suitably amplified speaker means is located in proximity to the subject such that the emitted sound is readily perceived by it as a known marker signal (or cue signal). In addition to an acoustic transducer, the example effectuation of a visual signal is illustrated as example visual signal source which is energized by the DTMF Relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5C**, instead of the DTMF telephone in FIG. **5**B, a DTMF capable cellular phone is shown to be used by the user audience at the user node as a switching device. The telephone communicates over the PSTN (Public Switched Telephone Network) to the subject node as previously described such that the emitted sound is readily perceived by the subject as a known marker signal (or cue signal). In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by the DTMF Relay. As with acoustic signals, the generated visual signals can serve not only as marker/reinforcer signals, but also serve as cues to the subject.

Referring to FIG. **5**D, a computing device is used as a switching device. The computing device (shown here with an integrated display) can be a computing device with an operating system, input device drivers, web browser, and programs including application software compatible with the Web Relay. This software is commercially available either installed or commercially hosted or both. This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated input devices or peripheral to the computing device). The computing device, when so used, acts as a switching device to communicate over the IP (Internet Protocol) Network to the subject node. At the subject node a Web Relay containing an embedded web server is energized in response to the pre-programmed inputs provided by the user audience. A signal generator device, powered by the relay, generates an audio signal. This signal generator device can be any distinctive noise producing device such as a buzzer, chime, horn, whistle, etc. A suitably amplified speaker means is located in proximity to the subject such that the emitted sound is readily perceived by the subject. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by the Web Relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5**E, a suitably equipped (e.g., internet enabled) cellular phone device, PDA or the like is used by the user audience at the user node as a switching device. This internet enabled computing device can be equipped with application software compatible with the Web Relay. This software is commercially available either installed or commercially hosted or both. This programming enables the computing device to function as a switching device wherein the user audience uses a keypad, pen stylus, touch screen or other user input to communicate over the IP Network to the subject node. At the subject node the Web Relay containing an embedded web server is energized in response to the pre-programmed inputs provided by the user audience as previously described such that the emitted sound is readily perceived by the subject. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by Web Relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

If the subject node does not have internet access throughout, such as might be the case where at the subject node the subject is an animal in a particularly large enclosure or habitat such as in an animal park or zoo with a natural habitat, then the following additional embodiments can be used. (As noted earlier, the video camera means at the subject node can be a networked suitable plurality of cameras such that the subject animal is not obscured, as will be shown in later embodiments).

Referring to FIG. **5**F, the internet enabled computing device (shown here with an integrated display) can be a computing device with an operating system, input device drivers, web browser, and programs including application software compatible with HA (“Home Automation”) Gateway. This software is commercially available either installed or commercially hosted or both. This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated or peripheral). The computing device, when so used, acts as a switching device to communicate over the IP Network to the subject node. At the subject node, responsive to the switched signal from the user node using the Home Automation application software, the Internet to HA Gateway energizes the HA Power Line Transceiver. If the home automation software program, gateway, and transceiver used are X-10 based, for example, then the transceiver is activated by the X-10 commands sent through the power line wiring (extension cords can be used at the subject node). If the home automation application software, gateway, and transceiver used are INSTEON based, for example, then the transceiver is activated by the INSTEON commands sent through the power line wiring and the additional wireless signal inherent in the protocol. When the HA Power Line Transceiver is energized, the signal generator device, powered by the relay of the transceiver, generates an audio signal as previously described such that a suitably amplified speaker means is located in proximity to the subject such that the emitted sound is readily perceived by the subject as a known marker signal (or cue signal). The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed, as will be shown in later embodiments. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as example visual signal source which is energized by the HA Power Line Transceiver. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5**G, use of an example wireless protocol at the subject node will be described. The internet enabled computing device (shown here with an integrated display) can be a computing device with an operating system, input device drivers, web browser, and programs including application software compatible with an Internet to Z-Wave Gateway. This software is commercially available either installed or commercially hosted or both.  This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated or peripheral). The computing device, when so used, acts as a switching device to communicate over the IP Network to the subject node. At the subject node, responsive to the switched signal from the user node using the Z-Wave software program, the Internet to Z-Wave Gateway energizes the Z-Wave Appliance Module. When energized, the signal generator device, powered by the relay of the Z-Wave Appliance Module, generates an audio signal as previously described such that a suitably amplified speaker means is located in proximity to the subject such that the emitted sound is readily perceived by the subject as a known marker signal (or cue signal). The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed, as will be shown in later embodiments. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by the Z-Wave Appliance Module. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5**H, another example of the use of a wireless protocol at the subject node will be described. If the subject node does not have internet access throughout, such as might be the case where at the subject node the subject is an animal in a particularly large enclosure or habitat such as in an animal park or zoo with a natural habitat, but there is internet access in nearby administrative buildings, the following example embodiment can be used.

The wireless example illustrated herein is the ZigBee suite of protocols (based on the IEEE 802.15.4 standard) but any radio specification for wireless personal area networks (WPAN's) would enable the example embodiment with the same functionality in substantially the same way to achieve the same result (e.g., XBee). The internet enabled computing device at the user node shown in the figure (shown here with an integrated display) can have an operating system, input device drivers, web browser, and programs including application software compatible with a ZigBee Modem. This software is available either installed or commercially hosted or both. This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated or peripheral). The computing device, when so used, acts as a switching device to communicate over the IP Network to the subject node. At the subject node, for example in an administrative building with internet access, an internet enabled general purpose computer with USB (Universal Serial Bus) ports and drivers is operatively connected to the internet, with a web browser and programs including application software compatible with the ZigBee USB Modem. Responsive to the switched signal from the user node using the application software, the computer at the subject node sends a command to the USB ZigBee Modem, which wirelessly energizes the ZigBee Relay, closing its contacts. The signal generator device, powered by the ZigBee relay, generates an audio signal as previously described such that suitably amplified speaker means is located in proximity to the subject and the emitted sound is readily perceived by it as a known signal. The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed, as will be shown in later embodiments. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as example visual signal source which is energized by the ZigBee Relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5**I, another example of the use of a wireless protocol at the subject node will be described where the subject node may not have internet access throughout but there is internet access in nearby administrative buildings. The internet enabled computing device at the user node (shown here with an integrated display) can be a computing device with an operating system, input device drivers, web browser, and programs including application software compatible with a Bluetooth Relay. This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated or peripheral). The computing device, when so used, acts as a switching device to communicate over the IP Network to the subject node. At the subject node, for example in an administrative building with internet access, an internet enabled general purpose computer with Bluetooth capability is operatively connected to the internet, with a web browser and programs including application software compatible with Bluetooth Relay. Responsive to the switched signal from the user node using the Bluetooth relay compatible application software, the computer wirelessly energizes the Bluetooth Relay. When energized, the signal generator device, powered by the Bluetooth relay, generates an audio signal as previously described such that suitably amplified speaker means is located in proximity to the subject and the emitted sound is readily perceived by the subject. The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed, as will be shown in later embodiments. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by a Bluetooth Relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

FIG. **5**J shows an example embodiment for use with the internet. A DTMF telephone is used by the user audience at the user node as a switching device. The telephone is connected to an IP (Internet Protocol) network by a VoIP (Voice over Internet Protocol) adaptor, also known as a VoIP ATA (Analog Telephone Adaptor). At the subject node another VoIP ATA connected to the internet network provides a telephone connection for a DTMF relay which as described previously is energized in response to the preprogrammed digits entered by the user audience. A signal generator device, powered by the relay, generates an audio signal. The signal generator device can be any distinctive noise producing device such as a buzzer, chime, horn, etc. Although described here as generating a single tone, whistle, chirp or the like, the signal generator device can be a switched plurality of tone (or waveform) generating circuits or similarly a selectably tunable waveform or tone generator. A suitably amplified speaker means is located in proximity to the subject such that the emitted sounds are readily perceived by the subject as known marker signals (or cue signals). In addition to an acoustic transducer, the example effectuation of a visual marker signal is again illustrated as an example visual signal source which is energized by the DTMF relay. As with acoustic signals, the generated visual signals can serve not only as marker signals, but also serve as cues to the subject.

Referring to FIG. **5**K, a dedicated VoIP telephone is used by the user audience at the user node as a switching device instead of the DTMF telephone and VoIP ATA adaptor of FIG. **5**J. The telephone is connected directly to the IP (Internet Protocol) network. The user audience communicates over the internet network to the subject node as previously described such that the emitted sounds are readily perceived by the subject as known marker signals (or cue signals). In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by the DTMF relay. As with acoustic signals, the generated visual signals can also serve not only as marker signals, but also serve as cues to the subject.

Additional embodiments are shown in FIGS. **6**A, **6**B, **6**C & **6**D. These embodiments enable the audio-visual networking means previously described in FIGS. **5** & **5**A.

Referring to FIG. **6**A, at the user node a suitably equipped (e.g., internet enabled multimedia) computer with display is used by the user audience. This suitably equipped computer has an integrated microphone device and speakers, and incorporates components which were also shown in FIG. **5**A. The internet enabled computing device (shown here with an integrated display) can be a computing device with an operating system, input device drivers, web browser, and programs including web conferencing application software, either installed or commercially hosted or both. This computer communicates over an IP (Internet Protocol) Network (i.e., the internet) to the subject node. At the subject node, a CCTV (Closed-Circuit Television) camera that uses Internet Protocol to transmit image data is used. This camera is also known as an IP or network camera, typically used in security and home monitoring applications. The cameras are available with two-way audio capability and therefore such converged devices can embody both of the functionalities previously described and shown in FIGS. **4** & **4**A as audio networking means and video networking means, as well as the audio-visual networking means previously described and shown in FIGS. **5** & **5**A.

Referring to FIG. **6**B, instead of the computer at the user node, a similarly suitably equipped 3G, 4G, 5G or higher cellular phone, PDA, smart phone or the like with a web browser and web conferencing application, either installed or hosted or both, can be used as shown by. This web-enabled cellular device communicates over the IP (Internet Protocol) Network to the subject node. At the subject node, the IP camera is used as previously described with respect to FIG. **6**A.

Referring to FIG. **6**C, instead of the IP network camera at the subject node, a suitably equipped 3G, 4G, 5G or higher cellular phone, PDA, smart phone or the like with an integrated video camera and audio capability, web browser and web conferencing application, either installed or hosted or both, can be used as shown to broadcast, webcast or otherwise stream video (and audio) from the subject node.

Referring to FIG. **6**D, at the user node a suitably equipped web-enabled cellular phone device as previously described with respect to FIG. **6**B communicates over the IP (Internet Protocol) Network to the subject node. The received audio-visual content is output to a display means. The connection can be made via a port such as HDMI (“High Definition Multimedia Interface”), DVI (“Digital Video Interface”), Firewire, USB, streamed wirelessly or the like. The display means can be a plurality of suitably sized and/or oriented display monitors or screens for the user audience.

## EXAMPLES - Large Habitats

If the subject is an animal and at the subject node the subject animal is in an enclosure with obstructions, or a particularly large enclosure or habitat such as in an animal park or zoo with a large natural habitat, the video camera means can be a networked plurality of cameras suitable in number such that the subject animal is not obscured as it moves throughout its habitat. This functionality is enabled by commercially available IP network multiple camera surveillance systems. Often these cameras have PTZ (Pan, Tilt & Zoom) features embedded within the camera units. Even with this embedded PTZ capability, it would often be advantageous, and possibly necessary, to implement the video camera means as a plurality of cameras.

The additional embodiments shown herein will enable this functionality and features previously discussed for the example case of particularly vast animal enclosures, such as with animal parks and zoos emulating natural habitats, especially for animals such as zebra, giraffes, elephants and other such migratory animals. If nearby or on site administrative buildings have internet access, then the addition of one or more Wireless Access Points (WAPs) (possibly converged devices which also function as Routers and/or Ethernet switches or broadband modems) (and possibly directional antennas if needed) would allow for wireless internet access and therefore any of the previously shown embodiments using IP networking could be used, thus allowing animals in large enclosures or habitats such as in an animal park or zoo to be operantly conditioned in the same interactive manner as previously described, with the same educational and entertaining results. Any of the embodiments exemplified by FIGS. **4** & **4**A (showing Audio Networking Means & Video Networking Means) or FIGS. **5** & **5**A (showing Signal Networking Means & Audio-Visual Networking Means) wherein the networking means used between user and subject nodes used an IP network could thus be enabled. Commercially available web relays with embedded web servers as previously described are also available for wireless use (e.g., “Wi-Fi” relays). Therefore, the generation of marker signals (or cue signals) with the switched signal means described with reference to FIGS. **5**, **5**A, **5**D, **5**E, **5**F, **5**G, **5**H, **5**I, **5**J, & **5**K are enabled by such use of WAP’s (in other words, the term “Web relay’ as used herein includes “Wi-Fi” relays).

Referring to FIG. **7**, an example embodiment for the present case of using wireless internet (and/or wired, if available at the subject node) is shown. The user audience at the user node observes the subject animal on a display means. In this figure the example subject is illustrated as an elephant, an example of a subject which might have a wide-ranging habitat. The display means can be a plurality of suitably sized and/or oriented display monitors or screens for the user audience. The user node Network link operatively connects a computing device with or to the IP network (containing such inherent elements in the IP infrastructure as broadband modems, routers, WAP's, antennas, and other such elements). The user node network link can be embodied by a network card in the computing device for example, combining the functionality of a user node input link and user node output link, similar to the user node network link of FIG. **5**A and other similar embodiments.

The computing device at the user node can be a computing device with an operating system, input device drivers (including those for integrated or external audio devices), web browser, and programs including application software compatible with IP network cameras, available either installed or commercially hosted or both. As is found in available security surveillance systems, wireless IP (or network) cameras are available with 2-way audio, and are shown particularized in the example figure as camera/speaker combinations. The signals from the network cameras are transmitted through the IP network to the computing device at the user node. The plurality of cameras can vary, depending on the size of the habitat, obstructions, and effectiveness of embedded PTZ (Pan, Tilt & Zoom) capabilities, if any. The shown number of individual instances of cameras in any of the following figures varies and is arbitrary for illustrative purposes. The user audience in the present example communicates to the subject animal by emitting suitably audible sound signals which are picked up by a microphone device, either one of the user input devices integrated with or peripheral to the computing device. The display means, similarly, can be integrated with the computing device but is shown here illustrated as an external display. The sound signals made by the user audience are transmitted through the IP network to a plurality of the suitably amplified camera/speaker combinations in proximity to the subject animal such that it perceives the emitted sounds. The emitted sounds can be either a marker signal or a cue signal. In the case of a marker signal, as previously described in the context of other embodiments, these sounds can be verbalizations such as “Good boy/girl” or “Yes!”

However, more precisely in serving as a distinctive marker signal to the subject animal, the user audience can directly make a unique sound (e.g., a clucking sound). Most precisely the user audience can use a device such as a metallic party clicker (a handheld device with a bendable noise producing flap), a whistle, horn or the like, operated in proximity to the microphone device. In the case of a cue, the user audience chooses or directs the choice of a particular cue (such as the verbalization “sit” or “jump”, for example) to be associated with a previously shaped behavior.

If internet access is not available, or the implementation of wireless internet coverage of a vast animal enclosure or zoo habitat otherwise is not practical, the following additional example embodiments can be used to realize the previously described methods.

Referring to FIG. **7A**, a high-level view of the present example is shown. The user audience at the user node can be located at or near such an animal park or zoo, but at an intermediate safe distance from the subject animal habitat, and observes the subject animal on display means. The display means can be a plurality of suitably sized and/or oriented display monitors or screens for the user audience.

A user node network link operatively connects with or to the audio networking means, a user node network link operatively connects with or to the video connection means, a subject node network link operatively connects with or to the video connection means, and a subject node network link operatively connects with or to the audio networking means. In the more particularized example embodiments to follow, any of the network links may be internal components of an explicitly illustrated device (i.e., an internal interface circuit in a telephone device, an internal network card with drivers in a computing device, internal sound or display card with drivers in a computing device, etc.).

The signals from the multiple camera video means at the subject node are transmitted through the video connection means. The user audience selects the video signal which presently contains the subject animal in its field of view, this switching means to be shown and described in the next figure. The plurality of cameras in the camera video means can vary, depending on the size of the habitat, obstructions, and effectiveness of embedded PTZ (Pan, Tilt & Zoom) capabilities, if any. The shown number of individual instances of cameras illustrated in any of the following figures varies and is arbitrary, used only for illustrative purposes.

The user audience communicates to the subject animal by emitting suitably audible sound signals which are picked up by a microphone device. These sound signals are transmitted through the audio networking means to a plurality of suitably amplified speaker devices in proximity to the subject animal such that it perceives the emitted sounds. The shown number of individual instances of speaker devices in any of the following figures varies and is arbitrary for illustrative purposes. As in previous embodiments, the emitted sounds can be marker signals or cue signals, either verbalizations or other distinctively produced sounds.

Referring to FIG. **7**B, example embodiments of the audio networking and video connection means will now be described.

As previously discussed with reference to prior embodiment examples, where not explicitly illustrated, input and/or output network links are implicit in the configuration: i.e., a network link configured to interconnect with the PSTN network could be embodied by an RJ-11 jack (but not illustrated), a network link configured to interconnect with the internet (IP) network could be embodied by an RJ-45 jack (but not illustrated), a network link configured to interconnect with A/V cables could be embodied by Co-Ax connectors, RCA or component jacks, S-Video or HDMI connectors, etc., but not explicitly illustrated in a figure. Similarly, a network link configured to operate wirelessly could be embodied by an antenna but not explicitly illustrated, and so on.

At the user node the user audience observes the subject animal at the subject node as it moves in its enclosure or habitat by switchably selecting which of the individual instances of video camera means presently contains the subject animal in its field of view. This is enabled by selecting an individual video channel, input to a switching device (commonly referred to as a multi-port AV Distribution or Switching Hub), and outputting that channel to the display means. The cameras comprising the video camera means can be analog CCTV (Closed Circuit Television) cameras with video cables bridging the distance between the user node and the selected camera locations in the subject animal's enclosure or habitat. The video cables used for these intermediate distances can be UTP (Unshielded Twisted Pair) cables such as Cat5 (or higher) if, as shown in the figure, video transceivers (also known as impedance transformers or "baluns"), are used at each end for impedance matching purposes. In this fashion, Composite, S-Video, Component Video, or other video formats (including digital formats such as VGA, RGB, or the like) can be transmitted over the distances involved. In other equivalent example implementations, composite video can be transmitted over coaxial cable, S-Video transmitted over S-Video, Component video transmitted over component cables, etc. In these cases the video transceivers shown in the figure would not be used.

Still referring to FIG. **7**B, an example embodiment of the audio networking means for communicating with the subject animal is shown. This particular embodiment uses cabling means for audio connections and so is a hard wired network. The user audience at the user node communicates to the subject animal by emitting suitably audible sound signals which are picked up by a microphone device operably connected to a preamplifier, producing line level audio signal. This signal is transmitted over audio cables bridging the distance between the user node and a plurality of suitably amplified speaker devices located in the subject animal's enclosure or habitat at the subject node. The audio cables used for these intermediate distances can be UTP (Unshielded Twisted Pair) cables such as Cat5 (or higher) if, as shown in the figure, audio transceivers (also known as impedance transformers or "baluns"), are used at each end for impedance matching purposes. In this fashion, midrange audio formats can be transmitted over the distances involved. In other equivalent example implementations, audio can be transmitted over speaker wire, high end audio cable, or the like. In these cases the audio transceivers shown in the figure would not be used. In the embodiment presently shown in the figure, the use of UTP (Unshielded Twisted Pair) cables such as Cat5 (or higher) has the advantage of sharing conductor pairs in the same cable, such that video cable means and audio cable means can be embodied in the same multi-conductor cable, and both the audio transceivers and the video transceivers can be embodied in audio-video transceivers (combination A/V "baluns" which combine the functionality of both audio and video impedance transformers in a combination device). A plurality of suitably amplified speaker devices are suitably distributed and located in proximity to the subject animal such that it readily perceives the emitted sound. As in previous embodiments, these sounds can be marker signals or cue signals, either verbalizations or other distinctively produced sounds.

Referring to FIG. **7**C, an additional example embodiment is shown for the audio networking means between user and subject nodes. In this example, the user audience communicates with the subject animal using wireless means. At the user node the user audience communicates to the subject animal by emitting suitably audible sound signals which are picked up by a microphone device operably connected to or incorporated within a two-way radio or wireless intercom base station. These sound signals are transmitted over the wireless radio or intercom frequencies to one or more wireless PA speaker devices. These wireless PA speaker devices, or equivalently, intercom system “Callboxes”, available for outdoor use at property gates and the like, are suitably distributed and located in proximity to the subject animal such that it readily perceives the emitted sound. As in previous embodiments, these sounds can be marker signals or cue signals, either verbalizations or other distinctively produced sounds.

Referring to FIG. **7**D an additional example embodiment is shown for the audio networking means between user and subject nodes using wireless means. The wireless example illustrated herein is the ZigBee suite of protocols (based on the IEEE 802.15.4 standard) but any radio specification for wireless personal area networks (WPAN’s) would enable the example embodiment with the same functionality in substantially the same way to achieve the same result (e.g., XBee). At the user node the user audience uses the computing device as a switching device. The computing device (shown here with an integrated display) can be a computing device with an operating system, input device drivers, and programs including application software compatible with a ZigBee Relay. This software is available either installed or commercially hosted or both. This programming enables the computing device to function as a switching device wherein the user audience uses a mouse, keyboard or other user input device (either integrated or peripheral). The computing device, when so used, acts responsively to user input to communicate a command to the USB ZigBee Modem. The modem then communicates wirelessly to the ZigBee Relay at the subject node to energize it. If the subject animal’s habitat is such that the ZigBee Relay is out of the wireless range of the ZigBee modem, a ZigBee Mesh Router can be positioned between the modem and relay and used to bridge the gap in coverage. A ZigBee Mesh network can so be built, using as many such ZigBee Mesh Routers as needed, placed around the periphery of the subject animal’s habitat and/or within it if necessary. When the ZigBee relay energizes and closes its contacts, the Signal Generator Device is powered and generates an audio signal as previously described with reference to prior embodiments. A suitably amplified speaker means is located in proximity to the subject such that the emitted sound is readily perceived by it as a known marker (or cue) signal. The speaker means can be a suitably located plurality of suitably amplified speaker devices if needed. In addition to an acoustic transducer, the example effectuation of a visual signal is again illustrated as an example visual signal source which is energized by the ZigBee Relay. For the type of subject in the current particular embodiment, the alternate example depicted in FIG. **5A** may also be appropriate to effectuate a visual signal, i.e., actuating a sign or flag or the like in such a way that it is visible to the subject. As with acoustic signals, the generated visual signals can serve as marker signals or cues to the subject.

A plurality of ZigBee Relay/Signal generator device combinations can be used, and addressed as a group or selectively in the mesh using the ZigBee compatible programming with computing device, therefore enabling different marker signals for different animals within the same habitat. This same selectivity which enables the delivery of a variety of signals also enables the use of some of them to serve as predefined cues to a subject animal. Therefore, the example embodiment serves to provide a variety of cues as well as a variety of marker signals.

Referring to FIG. **7**E, an additional embodiment is shown using audio means for communicating with the subject animal if at the subject node the animal enclosure or habitat at the animal park or zoo has cellular phone coverage.  A plurality of suitably amplified speaker devices is suitably located in the subject animal's habitat. At the user node, as previously described with reference to prior embodiments, a DTMF (Dual Tone Multi Frequency or "Touch-Tone", also known as tone-dialing) capable cellular phone communicates over the PSTN (Public Switched Telephone Network) and is used by the user audience as a switching device. The call is placed to a second cellular phone at the subject node in or near the subject animal's enclosure or habitat. This cellular phone is connected to a POTS (Plain Old Telephone System) Adaptor (also referred to as a Cell Phone to POTS Adaptor, Cell Phone Adaptor, or Socket Adaptor). This connection can be made by cable or wirelessly by a Bluetooth connection. The output of the POTS adaptor is input to a DTMF Relay (the connection most commonly being made via standard RJ-11 phone jacks and cord). The relay is energized when the user audience enters preprogrammed digits on the telephone. A signal generator device, activated by the DTMF relay, generates a signal, for example an audio marker signal. This signal generator device can be any distinctive noise producing device such as a buzzer, chime, horn, etc. Although described here as generating a single tone, whistle, chirp or the like, the signal generator device can be a switched plurality of tone (or waveform) generating circuits or similarly a selectably tunable waveform or tone generator. The suitably amplified speaker devices are located in the subject animal's habitat such that the audio signal is amplified so that emitted sound is readily perceived by the animal, for example as a known marker signal (or a cue signal – however, see below for another implementation allowing for the generation of cue signals in the present example).

In addition to an acoustic transducer, the example effectuation of a visual marker signal (or, additionally, cue signals) such as the example visual source (previously described as the actuation of a flag or sign) is shown, energized by the DTMF Relay.

In addition to the above marker signal, audible cues in the form of verbalizations also can be generated for the subject animal. Still referring to FIG. **7**E, the audio output of the POTS Adaptor can also be fed to the suitably amplified speaker devices (or different amplified speaker devices, if desired), thereby allowing any vocalizations into the cellular phone at the user node to be amplified such that the resulting emitted sound can be used by the user audience as a cue. Further, the example effectuation of a visual cue signal such as the example visual source illustrated in prior embodiments could be used, energized by the DTMF Relay.

Referring to FIG. **7**F, another example embodiment of audio means to generate an audible verbalized cue signal is shown. A second cellular phone in or near the subject animal's enclosure or habitat at the subject node can also be used to produce a cue to the subject animal. This cellular phone is connected to a second POTS Adaptor in a similar manner to that described above, and its output audio signal is amplified by suitably amplified speaker devices such that the resulting emitted sound can be used by the user audience as a cue. Further illustrated is the example effectuation of a visual cue signal such as the example visual source as used in prior embodiments, energized by the DTMF Relay.

If the user audience does not wish to use a single cellular phone to generate both marker signals and cues to the subject animal, preferring to use one as a switching device to generate marker signals and the other to transmit verbal cues, a second cellular phone at the user node can be used by the user audience. This could also be used to increase classroom participation in an educational setting or audience participation in an entertainment setting. In this particular embodiment of audio means, the user audience then would use one of the cellular phones at the user node to dial one cellular phone at the subject node, for example, and generate a marker signal by pressing digits to send pre-preprogrammed tones. The user audience would then use the other cellular phone at the user node to dial the second cellular phone at the subject node, for example, and vocalize cues to the subject animal. Further illustrated is the example effectuation of a visual cue signal such as the example visual source as used in prior embodiments, energized by the DTMF Relay.

## EXAMPLES - Primary Reinforcer Delivery

As previously discussed, a marker signal marks a desired behavior or event precisely in time by virtue of being a conditioned positive reinforcer, in that the subject animal associates it with a primary reinforcer - in other words, it has learned a primary reinforcer is coming when it hears (or senses) the conditioned reinforcer. Embodiments described here will focus on delivery of a food treat as the primary reinforcer at the subject node.

A handler or keeper at the subject node can enable delivery of a food treat as a primary reinforcer in response to the marker signal given to a subject animal in a variety of ways, depending on whether or not the animal is safely handle-able and the qualifications of the handler. The animal can be hand fed, given food on a stick, from either within its enclosure or through a relatively small opening, receive food delivered through a trap door, long tube or similar geometry which isolates the keeper from the animal, have food thrown into its enclosure or habitat, or other similar method. For animals in relatively vast enclosures or habitats, a means of delivering the food remotely following the marker signal may be particularly advantageous. This delivery can be done manually in response to the marker signal or in an automatic fashion. Depending on the habitat size, terrain, perimeter fencing, type of animal, and food, it might be advantageous to employ not only a plurality of remote means, but also a suitable variety of these means in various combinations.

Referring to Figs **8**A, **8**B, & **8**C, embodiments of varied means for remotely delivering food treats as a primary reinforcer following a marker signal will be described. Shown in the figures are devices dispensing food pellets. FIG. **8**A shows a game feeder used to dispense food, FIG. **8**B a pitching machine used to throw food, and FIG. **8**C an air cannon device used to shoot food.

Referring to FIG. **8**A, game feeders such as that shown are typically available in hanging or freestyle configurations and so can be located in the habitat and/or on the perimeter. Such game feeders are often designed to operate and dispense food on timers, but are also often available with an add-on wireless remote control accessory. The wireless signal sent when the user presses a button energizes a relay in the feeder, temporarily actuating the motor or other actuator that dispenses the food.

Referring to FIG. **8**B, pitching machines such as that shown are typically spring loaded arm pitching machines normally used for throwing baseballs, softballs, wiffle balls, and/or tennis balls. They can be used for throwing fruit to the animal, including but not limited to spherical fruits like oranges and grapefruits. Pitching machines can also be activated by a remote control.

Referring to FIG. **8**C, air cannon devices such as that shown are also known as “spud guns” or “potato cannons”, perhaps as an indication of their possible origin in use to shoot potatoes to bears in forests. Air cannon devices are typically used to shoot promotional items such as T-shirts or hot dogs at sporting events and the like and have been used on an annual basis in pumpkin throwing contests in the United States. They are typically powered by CO2 or compressed air. Valves in pneumatic versions admitting pressure to the barrel or firing cylinder are available as electronic solenoid valves (or can be replaced with such solenoid valves), illustrated here as a solenoid valve plumbed to a tank in the figure.

Upon hearing the marker signal, a handler or keeper at the subject node can manually actuate an accessory remote control accessory unit with the devices described above to actuate them and deliver food in response to hearing the marker signal. Instead of or in addition to manually operating accessory remote control units, an automatic food delivery means in response to the marker signal will now be described.

Referring to FIG. **8**D, a wireless remote control transmitter/receiver pair can enable this functionality. A wireless remote control receiver, here shown as “RC Rx”, contains internal relay contacts can replace or operate in parallel with an embedded accessory remote control unit in the food delivery device. This wireless remote control receiver is installed in or near the food delivery device and receives a signal from a compatible wireless remote control transmitter, here shown as “RC Tx” . When this signal is received by the receiver RC Rx, the receiver closes its internal relay contacts, allowing current to flow from a device power source and through a motor or actuator (or solenoid valve in the case of the air cannon in FIG. **8**C), thereby energizing the actuator and dispensing or projecting the food. The transmitter RC Tx can be used as a remote control manually operated by a switch on the unit (not shown) in response to hearing the marker signal, or in an automatic mode by transmitting in response to the electrical marker signal. The voltage level of the electrical marker signal can be converted by a level converter to a level compatible with and sufficient to switch transmitter RC Tx (this could be effected, for example, by a relay whose coil is energized by the electrical marker signal and whose output contacts connect a suitable voltage supply to transmitter RC Tx).

In the example embodiments shown for a large enclosure or habitat, for example, the electrical marker signal would be the output of the DTMF Relay (of FIG. **7**E & **7**F) or ZigBee Relay (of FIG. **7**D). Equivalently, if wireless internet access is available, as previously discussed the previous example embodiments utilizing the IP network could be used in the same manner in which case the electrical marker signal could be the output of the Web Relay of prior embodiments. Other equivalent implementations are available for generating equivalents to the electrical marker signal such as using outputs of the signal generator devices (of FIGS. **5**A - **5**K) or direct acoustic detection of the audible marker signals.

In this manner, food (as a primary reinforcer) is dispensed automatically at the subject node after the animal has been given a marker signal (a conditioned reinforcer). Other functionally equivalent devices serving as automated food delivery means can be centrifugal spinning devices, various other catapult devices such as trebuchet sling devices, etc.

## EXAMPLES - Aquatic Animals

Additional example embodiments for use where the subject is an aquatic animal are shown in Figs **9**, **9**A & **9**B. The subject animal is shown as an aquatic animal in a pool of water. Underwater tones are often used with aquatic animals, in particular marine mammals such as dolphins, whales, porpoises and the like.

Referring to FIG. **9**, all of the microphone, speaker, camera and display means, network links, audio networking means and video networking means equivalent to those shown in FIG. **4**A are shown, but with speaker means also shown as an underwater speaker. The speaker device as originally shown (above water) is now shown optionally switched on or off via a switch.

Referring to FIG. **9**A, all of the switching, interfacing, signal generating, microphone, speaker, camera and display means, network links, signal networking means and audio-visual networking means equivalent to those shown in FIG. **5**A are shown but with speaker means also shown as underwater speakers. The speaker devices as originally shown (above water) are now shown optionally switched on or off via switches.

As in prior embodiments, in addition to an acoustic transducer, the additional example of effectuating a visual signal is illustrated as an example visual signal source which is energized by an interface. For the type of subject in the current particular embodiment, the alternate visual example depicted in FIG. **5A** may also be appropriate to effectuate a visual signal, i.e., actuating a sign or flag or the like in such a way that it is visible to the subject. As with acoustic signals, the generated visual signals can serve not only as marker signals but also as cues to the subject.

Referring then to both Figs **9** & **9**A, it follows that all of the example embodiments previously described with reference to, detailing and flowing from FIGS. **4**A and **5**A can be used in the same manner as previously described. Thus, using the embodiments herein, aquatic animals can be operantly conditioned in the same interactive manner as previously described, with the same educational and entertaining results.

Additional uses of the embodiments shown for aquatic subject animals that are already trained with predetermined audible cues will now be described. For example, in the case where the aquatic subject animal is already trained to recognize predefined certain underwater tones as cues, the operant conditioning can be implemented using the embodiments described.

Referring to FIG. **9**B, the switching device of FIG. **9**A (and FIG. **5**A) is now illustrated with more detail in the figure. At the subject node, the signal generator device of FIG. **9**A (and FIG. **5**A) is now illustrated with more detail in the figure. At the user node, the user audience operates the switching device to selectably switch the desired tone (or composite of tones). At the subject node, the signal generator device can be a switched plurality of tone (or waveform) generating circuits or similarly a selectably tunable waveform or tone generator. The switching devices and signal generators can be used to generate predetermined tones in selectable fashion, so that the emitted sounds are used as predefined cues to the aquatic subject animal (in addition to or instead of as marker/conditioned reinforcer signals). In the example embodiments previously described in FIGS **5**B & **5**C, and FIGS. **5**J & **5**K, telephones are used as switching devices with DTMF relays used as the interfaces. In Figs **5**D & **5**E, web relays are used as the interfaces. Both DTMF relays and web relays contain multiple output channels (if the number of output channels is not sufficient they can be paralleled or grouped). These relay outputs open and close selectively in response to varied pre-programmed touch-tone digits or computer inputs. Therefore both the DTMF relays and web relays shown in the prior embodiments can selectably energize different waveform or tone generating circuits of the signal generator devices shown in the previous example embodiments. Similarly, the ZigBee Relay shown in the previous example embodiments has multiple selectable channels, as well as other prior example embodiments (e.g., Home Automation, Bluetooth embodiments). These relay outputs can therefore selectably energize different waveform or tone generating circuits of the signal generator device. Thus, varied pre-programmed tones can be produced such that the emitted sounds are known predefined cues to the aquatic subject animal (in addition to or instead of as marker/conditioned reinforcer signals). A particular one of the emitted tones (a whistle tone for example) can be used as a marker signal recognized by the aquatic subject animal. Alternatively, the emitted sounds at the subject node can be used as a marker signal by the user audience if a device such as a whistle, for example, is used to produce sound in proximity to the microphone at the user node. Further, the user audience can verbalize a sound as a verbalized cue (“SPLASH” for example).

As in prior embodiments, in addition to an acoustic transducer at the subject node, the additional example of effectuating a signal is illustrated as an example visual signal source which is energized by an interface. For the type of subject in the current particular embodiment, the alternate visual example depicted in FIG. **5A** may also be appropriate to effectuate a visual signal, i.e., actuating a sign or flag or the like in such a way that it is visible to the subject. As with acoustic signals, the generated visual signals can serve not only as marker signals but also as cues to the subject.

If the marine park or aquarium at the subject node has its own internal auditory cueing system, an onsite marine animal handler can still enable the user audience at the user node to provide cues to the animal, providing the same interactive, educational and entertaining benefits previously described, such as with the operant conditioning and/or demonstration of a behavior chain. The user audience gives the animal a cue (for example, "SPLASH"). The corresponding known auditory cue for that behavior can be delivered to the animal through an Auditory Interface at the subject node which can take several forms:

A "MIL" ("Man-In-the-Loop") Interface: The onsite marine animal handler at the subject node, upon hearing the verbalized cue (with the switch closed), responsively enters the corresponding codes or commands on the park or aquarium's auditory cueing system and the underwater cue known to the animal (for "SPLASH", for example) is effected. In this scenario, the (above water) speaker responsive to the audio-visual networking means shown in the figure can be effectuated by a headset worn by the onsite marine animal handler, with the microphone shown at the subject node also worn and used to transmit instructions or explanations to the user audience if necessary. Marker signals can be given by the user audience using the switching device at the user node as described in the previous embodiments.

Alternatively, the Auditory Interface can be an electronic interfacing circuit which accepts either sounds or other inputs from the user audience and outputs either the predefined auditory cues known to the aquatic animal or the input codes in a compatible format for the marine park or aquarium internal cueing system.

## MODES OF OPERATION

Referring to FIG. **10**, shown are examples of modes of operation of the various embodiments:

- Shape a behavior
- Bring a shaped behavior under cue control

Each of these can represent an operant conditioning session between a user audience and a different example subject at a different example subject node, and so the steps shown do not need be followed in the sequence shown, although if the embodiments are used by the same user audience for the same subject at the same subject node the sequence shown could be a logical progression for that subject. Different steps in and of themselves may have differing degrees of educational purpose and/or entertainment value.

Associate conditioned reinforcer with primary reinforcer – This prerequisite step depicts associating a conditioned reinforcer with a primary reinforcer (or unconditioned reinforcer, something always wanted by the subject, such as food or the opportunity to play). If the subject is a child, for example, then the primary reinforcer might be a piece of candy. If the subject is a dolphin, for example, the primary reinforcer might be fish. A conditioned reinforcer can be any signal which can be sensed by the subject indicating to the subject that the primary reinforcer is coming: a whistle preceding a fish, a clicking sound preceding some candy, etc. For example, for a classroom of children the recess bell is a conditioned reinforcer through its association with a primary reinforcer (the opportunity to play). Different example subjects, whether at the same or different subject nodes, can have different conditioned reinforcers established and predefined.

Shape a behavior – This step depicts using the example embodiments to operantly shape a behavior. A predefined behavior shown as Behavior(G) is chosen or selected by the user audience and used as a goal (see FIG. **11**).

Bring a shaped behavior under cue control - This step depicts operantly shaping a behavior to be under cue control for a subject in which at least one behavior has already been shaped, the particular behavior shown as Behavior(J) in the figure. The user audience selects a predefined cue shown as Cue(J) corresponding to the selected shaped Behavior(J) (for example, “SIT” for a sitting behavior) (see FIG. **12**).

Referring to FIG. **11**, an example of the operation of the embodiments will now be described in using operant conditioning whereby the user audience at the user node shapes a predefined behavior in the subject at the subject node. The user audience chooses a predefined behavior that will serve as a goal for the subject, such as jumping onto a platform, lying down, touching a certain object, etc. The user audience observes the subject. If the subject moves incrementally towards the goal (for example moving towards a predefined object), then the user audience gives the subject a marker signal. In the case where the example subject is an animal, upon hearing the amplified marker signal at the subject node, a handler located there (not shown) can provide the subject animal with a primary reinforcer such as a food treat. As was shown in prior embodiments, this can also be done through both remote and/or automated means (see FIGS. **8**A – **8**D).

“Reinforcement Schedule”: As discussed in the Introductory Glossary under “Variable Reinforcement”, the frequency and amount of the primary reinforcer described can be varied, such that on occasion the subject is given, for example, a large amount and/or special kind of food treat, a highly desired “jackpot”. This unpredictability adds to the excitement and enthusiasm of the subject and so the results are inherently surprising and unexpected.

If the subject has not yet achieved the selected goal behavior, then the subject is again observed as it operantly offers behaviors to make the marker signal occur. If the subject again moves incrementally towards the goal, the marker signal is again given with the subsequent delivery of the primary reinforcer. In this manner, the subject is reinforced for successive, increasingly accurate approximations of the chosen desired behavior. This observation and signaling process continues until the determination is made that the behavior is fully shaped and the subject has reached the goal, and the session ends.

Referring to FIG. **12**, an example of the operation of the embodiments will now be described in using operant conditioning to shape a behavior in the subject to be under cue control.

The user audience chooses or selects a predefined verbal cue (such as “SIT” or “JUMP”, for example) to be associated with a previously shaped behavior. The user audience observes the subject. If the subject is not offering the shaped behavior consistently then the behavior should be reviewed or reshaped. If the subject is offering the desired behavior consistently so as to earn reinforcements, then the subject is given the chosen. The subject is observed and if the subject does not offer the desired behavior then the cue is given again. If the subject does offer the behavior, the user audience gives the subject the marker signal. The primary reinforcer is given responsive to the marker signal. In the case where the example subject is an animal, upon hearing the amplified marker signal at the subject node, a handler located there (not shown) can provide the subject animal with a primary reinforcer such as a food treat or as was shown in prior embodiments, this can also be done through both remote and/or automated means (see FIGS. **8**A – **8**D).

“Reinforcement Schedule”: As discussed in the Introductory Glossary under “Variable Reinforcement”, the frequency and amount of the primary reinforcer described can be varied, such that on occasion the subject is given, for example, a large amount and/or special kind of food treat, a highly desired “jackpot”. This unpredictability adds to the excitement and enthusiasm of the subject and so the results are inherently surprising and unexpected.

This process of reinforcing the subject responsive to performance of the behavior only after the cue is given continues until the determination is made that the subject is offering the desired behavior consistently in response to the cue, at which case the session is ended. The subject has effectively learned that that particular cue is a green light to operantly earn reinforcement for a particular predefined behavior and the behavior is now under cue control. From the subject’s point of view since the cue is a green light to earn positive reinforcement, it is a desirable thing and so each cue in and of itself becomes a conditioned reinforcer.